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IJMS

INTERNATIONAL JOURNAL *of* MEDICAL STUDENTS

International Journal of Medical Students
The International Journal of Medical Students (IJMS) is a peer-reviewed open-access journal (ISSN 2076-6327) created to share the scientific production and experiences of medical students and recently graduated physicians worldwide.

International Journal of Medical Students
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EDITORIAL STAFF

IJMS

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The *International Journal of Medical Students* (IJMS) is an open-access, peer-reviewed scientific journal (ISSN 2076-6327) that publishes original research in all fields of medicine. The Journal was created in 2009 to share the scientific production and experiences of medical students (*i.e.*, MBBS students, MD students, DO students, MD/MSc students, MD/PhD students, etc.) and recently graduated physicians (<3 years into practice) from all over the world. Our objective is to be the primary diffusion platform for early-career scientists, using standards that follow the process of scientific publication.

The *IJMS* receives submissions where there is at least one author enrolled as a medical student in any medical school in the world or a recently graduated physician worldwide. For research articles, early-career scientists must be accompanied by a senior researcher that must be also responsible for the research, guaranteeing the quality of the work. We publish Original Articles, Short Communications, Reviews, Case Reports, Interviews, Experiences, and Letters, which follow an innovative and unique two-step, double-masked peer-review process, in brief:

> *The first step of revisions is carried out by two Student Editors (medical students with publications indexed in the US National Library of Medicine (NLM) with the supervision of an Associate Editor. The aim of this step is to improve the quality of articles and identify those that can proceed to external peer-reviews. The second step of revisions is carried out by external peer-reviewers who are researchers with publications indexed in the NLM related to the topic of the submission.*

The time between submission and final publication in most cases has been two to four months depending on the diligence of Peer-Reviewers and Authors.

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The *IJMS* acceptance rate in 2022 was 27.5% of the almost 502 submissions. Published articles in 2022 came from 34 different countries. The average days to a first decision is 4 days, 117 for acceptance, and 10 days to decline a submission. The time between submission and final publication in most cases has been three to four months depending on the diligence of Peer-Reviewers and Authors.

The journal's website got over 269 thousand visits only in 2022. The *IJMS*'s reach includes a growing social media presence (more than 20,000 followers on X, Facebook, Instagram, YouTube, and LinkedIn). Only in the last year, the Journal has been visited from nearly every place in the world (+190 countries). You can find more of the *IJMS* statistics here.

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The *IJMS* review process guarantees and supports the quality and validity of the work published at the *IJMS*. Reviewers are given three weeks to complete their tasks.

Reviewers and editors are obliged to retain the contents as privileged and confidential until publication. The Editor in Chief and the Editorial Board will have final authority over an article's suitability for publication.

The *IJMS* also strive towards the training of a new generation of Editors and Peer-reviewers promoting different training strategies among our Editorial Team that includes the Web of Science Academy courses and the Committee on Publication Ethics (COPE) courses available to its members (*IJMS* is a member of COPE).

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Year 2023 • Months Oct-Dec • Volume 11 • Issue 4

Int J Med Stud. 2023 Oct-Dec; 11(4)

Table of Contents

International Journal of Medical Students

Year 2023 • Months Jul-Sep • Volume 11 • Issue 4

Int J Med Stud. 2023 Oct-Dec; 11(4)

IJMS INTERNATIONAL JOURNAL of MEDICAL STUDENTS

Editorial

The Silent Casualties: War's Impact on Medical Students and Medical Education

Berjo D. Takoutsing,[1] Mihnea-Alexandru Găman,[2] Juan C. Puyana,[3] Francisco J. Bonilla-Escobar.[4]

Medical education has always been a vital aspect of both health and educational systems, largely because of its significant role in enhancing health outcomes and its capacity to transform existing governance structures.[1, 2] Students pursuing medical education form the cornerstone of these systems globally.[3] Their involvement in medical education extends well beyond the improvement of patient care on an individual level. It has far-reaching impacts, influencing various societal aspects ranging from local to international spheres,[2,4] including policy implementation, leadership roles, and advocacy efforts.[5-6] Particularly during critical times, such as pandemics, medical students have played pivotal roles in promoting public health measures, combating misinformation, and enhancing vaccine acceptance.[7-9] Moreover, medical education and the medical field in general are fundamental to research and innovation,[10,11] driving advancements in medical science and technology.[12]

The field of medicine has made significant contributions to the global economy. This contribution is evident in the advancements in medical technology, groundbreaking research, and the development of a highly skilled workforce, including medical students. These advancements have opened up numerous economic opportunities, leading to job creation and, consequently, fostering economic growth.[13] Beyond economic development, medical students play a pivotal role in promoting social development by addressing health disparities and improving access to equitable healthcare.[14] In addition, initiatives for international medical education—such as those offered by the International Federation of Medical Students—are essential for fostering cross-cultural communication and understanding. Future medical professionals can broaden their viewpoint and acquire varied cultural ideas through these possibilities. This not only makes it easier to promote peace inside and between countries, but it also makes a big difference in helping to create a society that is just and equal.[15]

However, medical students face a wide range of challenges during their training. These challenges encompass financial, academic, physical, and emotional aspects.[16] War and conflicts further exacerbate these challenges, having a profound and often detrimental impact on medical education and the lives of future physicians.[17]

Disruption and Challenges in Achieving Career Dreams

The impact of war and conflict on medical education and the aspirations of future healthcare professionals is a matter of grave concern. Conflicts severely disrupt the peace, economy, and sustainability of nations, causing loss of life and adversely affecting medical students and the entire medical education system.[18,19] Historical instances, starting from World War I in 1914, have shown that conflicts, contribute to traumatic injuries, psychological distress, and infection epidemics.[17, 20-22] Such unfortunate events have led to the closure of medical schools, destruction of educational resources, and displacement of students and faculty.[20, 23-25] resulting in disrupted medical learning processes and the potential graduation of underprepared health professionals.[26]

Medical students training in conflict-ridden areas encounter a complicated and morally challenging environment that extends well beyond the parameters of traditional medical education. These students are frequently placed in situations where they must weigh the need to give the best treatment possible against the backdrop of chaos and shortage while making crucial decisions with limited resources. Prioritizing treatment for a large number of patients, managing possible multiple allegiances to the military and the civilian world, and resolving the moral dilemma of maybe having to provide care under duress are all examples of typical ethical issues. These students also have to consider how their choices may affect longer-term public health outcomes and the dynamics of the larger community in addition to the specific patients. Their ethical framework and decision-making processes are unquestionably shaped by these experiences, which also impart a profound awareness of the complex interactions that exist between medical ethics, conflict, and humanitarian ideals.

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In the 21st century, online learning platforms have become a crucial source of knowledge acquisition.[27] However, during war and conflicts, access to technology is often prioritized for military use, limiting medical students' access to these vital digital resources.[28] Wars have tragically led to the death and disability of many medical students,[20, 23-25] negatively impacting their ability to concentrate, learn, and retain information as they constantly fear attacks affecting their peers and families. This leads to decreased academic performance and adds to the mental health burden faced by medical students.[29] In times of war, priorities within the medical education system shift,[29] with students more concerned about their survival and that of their loved ones, and less on knowledge acquisition.[20,23-25] Moreover, economic instability caused by conflicts makes it difficult for students to fund their tuition and living expenses,[20] and those relying on families, loans, and government grants are equally affected. Consequently, talented medical students may be forced to migrate, internally or externally, from conflict zones, contributing to the brain drain, particularly in low- and middle-income nations.[30]

Regions affected by war and conflict require healthcare providers and infrastructure adapted to emergency medicine, trauma and acute care surgery, and mental health care.[31,32] However, these war-torn regions often lack the resources and infrastructure to provide specialized training due to destruction, loss of equipment and supplies, and disrupted supply chains, typically relying on assistance from humanitarian organizations like the International Committee of the Red Cross (https://www.icrc.org/en) and Doctors Without Borders (https://www.msf.org/). The resulting limited skilled healthcare workforce and infrastructure significantly exacerbate existing health disparities.[33]

Psycho-Social Impact of Conflicts on the Social and Professional Lives of Future Medical Doctors

Psychosocial impact on medical students in conflict zones is profound, often leading to a spectrum of mental health disorders, including post-traumatic stress disorder, depression, and anxiety.[34,35] For instance, Al Saadi et al., estimated high prevalence rates of these conditions among Syrian medical students.[35] The firsthand experience of the horrors of war can influence the future practice of medical students, fostering increased empathy and resilience, but also leading to burnout, compassion fatigue, and emotional distress.[36-39] Training in conflict zones may shift medical students' focus towards specializations in social justice, community health, and policy advocacy,[20,40] and provide invaluable experience in treating war-related injuries.[20] Alternatively, it may direct them into emergency medicine, mental health, or trauma surgery, where their personal knowledge of psychological trauma and war-related ailments is extremely helpful but might eventually restrict access to specialist care. It is important to remember, too, that frequent exposure to trauma in these settings can also lead to social isolation, emotional weariness, and poor communication abilities.[41]

Safeguarding the Future of Healthcare

In times of war and conflict, safeguarding the wellbeing of medical students is of paramount importance. They are a crucial component of the healthcare workforce, instrumental in recovery and rebuilding efforts post-conflict, thus playing a key role in restoring healthcare systems.[42] Amidst conflicts, advanced medical students often take on critical roles, providing care to both civilians and military personnel affected by the warfare.[43] In accordance with the principles of the Geneva Convention and related protocols, it is imperative to ensure the safety of medical students and the broader medical education system during conflicts. This responsibility lies with a collaboration of government bodies, private entities, humanitarian organizations, educational institutions, and the medical community at large.[44]

Support for medical students impacted by war can be facilitated through financial aid and provision of shelter,[26] enabling access to education that might otherwise be unattainable and helping maintain the continuity of their professional journey. This contribution is essential in addressing the shortage of healthcare professionals prevalent in conflict-affected areas. Moreover, efforts should focus on rebuilding educational infrastructure and enhancing the availability of online learning resources in regions emerging from conflicts.[45,46] Incorporating conflict medicine and peace resolution studies into medical curriculums is also a vital consideration for programs globally.[20]

Recognizing that medical students, like all individuals, are susceptible to emotional and mental health challenges, it is crucial to provide them with mental health support services and trauma-informed care, particularly given the potential long-term impacts on their professional practice.[47] Medical students have shown initiative in promoting peace by forming associations, engaging in international collaborations, and participating in activities aimed at peace and conflict resolution. These actions are geared towards ensuring the safety of medical education systems, their families, and the global community. Therefore, it is incumbent upon relevant stakeholders to intensify their efforts to create an environment where medical students can pursue their education in a secure and effective manner.

Conclusion

Political conflicts deeply impact medical students, who are vital to the future of healthcare, technology, and research.[17] Recent escalations of conflicts, underscore the need to support medical education systems globally affected by sociopolitical conflicts.[48] Nevertheless, despite these difficulties, medical students' experiences in war zones embody fortitude, kindness, and an unrelenting dedication to healing in the face of hardship.

The experiences of students in war zones show us that even under the most difficult circumstances, there are no limits to the search for information and recovery. As we ensure the resilience of healthcare systems and pave the path for a more fair, peaceful, and equitable society, it is our common obligation to support and defend the dreams of these future healers. As we honor these medical students' unwavering energy, let us not forget that their goals are inextricably linked to the welfare of all people.

By doing this, we may use a collaborative, multi-sectoral strategy to address the complex issues encountered by medical students in conflict areas. By working together, we can nurture their

dreams and, in the process, heal the wounds of conflict and division that afflict our world.

The Awards for the Editors of the Year

In this 2023 Volume 11, we are proud to spotlight Dr. *Yvan Zolo* as the **IJMS Associate Editor of the Year 2023**, alongside Dr. *Lourdes Adriana Medina Gaona* and Dr. *Ahmed Nahian*, who have been recognized as **IJMS Student Editors of the Year 2023**. Their dedication to the Journal's various initiatives and their readiness to contribute at every opportunity are truly praiseworthy.

Introducing the IJMS December Issue

Apart from our mission to become the voice of medical students worldwide, our journal also assists social and humanitarian values. We are thus simultaneously co-publishing the editorial entitled ***Time to Treat the Climate and Nature Crisis as One Indivisible Global Health Emergency*** with reputed scientific publications in the field of medicine such as The BMJ, JAMA or The Lancet, to call on The United Nations, political leaders and healthcare professionals worldwide to recognize that climate change and loss of biodiversity are another unsolved crisis of the present days which will undoubtedly impact on the health and wellbeing of millions of individuals if immediate action to seek adequate solutions is not taken.[49]

On another note, IJMS's December issue is filled with four original research articles, two narrative reviews, three case reports, one editorial and three experiences.

Despite notable efforts, the COVID-19 pandemic has not come to an end with willingness of the general population to get immunized due to low awareness, fear of side effects or other barriers.[50,51] Effiong et al. analyze the awareness, coverage, and barriers to COVID-19 vaccination among undergraduate students in Nigeria stressing out that despite the fact that awareness levels are high amongst students, vaccination rates remain low potentially due to misinformation regarding the safety of vaccines against SARS-CoV-2 and inaccessibility of vaccination centers in Nigeria.[52]

In order to keep up with the latest advances in medicine, medical education must make appeal to newer strategies of teaching and evaluation and evolve from traditional methods to student-centered and patient-centered education, involving students in research and clinical clerkships, encouraging dissemination of knowledge and participation in congresses and conferences, grant writing or organization of scientific events.[5-12] Spaced repetition has been hypothesized to improve medical students' performances in exams.[53] Cooper et al. investigate the impact of spaced repetition on medical students' performance at the medical board exam, revealing that despite the fact that medical students who did not use the Anki platform had higher GPAs those who did use the platform failed Step 1 Exam in a lesser percentage and scored higher on the USMLE Step 1 and COMPLEX exams.[54]

Nikkhahmanesh et al. assessed malpractice awareness amongst medical students enrolled in The University of Arizona College of Medicine – Phoenix, United States of America, pointing out an alarming rate of non-awareness regarding medical malpractice in their study cohort. Thus, future physicians need to be schooled and well-informed regarding medical malpractice before they start their careers in the hospital.[55]

Jones et al. studied several factors that influenced prognosis of patients who received veno-arterial (VA) extracorporeal membrane oxygenation (ECMO). Their findings highlight that older subject had elevated odds of survival to hospital discharge, whereas mortality was linked to a history of dialysis or cardiac arrest. Surprisingly, sex, body mass index (BMI) or some of the most common chronic illnesses (atrial fibrillation, diabetes, hypertension, COPD) did not notably impact prognosis in individuals who required VA-ECMO.[56]

Palliation remains a pillar of end-of-life care in the course of cancer management.[57] In their narrative review, Tseng et al. provide an overview of different models of palliative care delivery and palliative care services in several East and Southeast Asian Countries, focusing on the significance of cancer on the continent, as well as the role of palliative care in ensuring the psychological, spiritual, and physical well-being of patients living with malignancies in order to improve their quality of life.[58]

Career specialty selection after medical school is influenced by one's past experience with the desired discipline, including clinical elective choices and clerkships.[59] Chen at al. review the literature regarding the status of radiology clerkships for medical students in The United States of America and discuss perceptions of medical students towards clerkships, well-received practices and weaknesses of the available training programs and methods in the field of imaging.[60]

Tuberculosis (TB) remains a health threat worldwide with low levels of TB awareness amongst the general population in many parts of the globe.[61,62] Moreover, the emergence of multidrug resistant TB (MDR-TB) poses significant challenges to attending physicians. Marwah et al. present a series of MDR-TB cases who developed pulmonary embolism, with a particular emphasis on the management of this complication with anticoagulants.[63]

Ladner et al. stress out the importance of ethics in clinical medicine and call to action for standardization and prioritization of ethics training during medical school and beyond. The authors present the case of a male subject diagnosed with acute gas gangrene osteomyelitis and schizoaffective psychosis whose autonomy was prioritized when selecting the treatment option despite his lack of decisional capacity.[64]

Cernatescu et al., dive into the fascinating realm of editorial excellence and explore which steps are crucial in maintaining the quality of scientific publications. In an illuminating interview with the distinguished Dr. Russell Van Gelder, MD, Ph.D., the Editor-in-Chief of Ophthalmology, the Journal of the American Academy of

Ophthalmology, they unravel the essential steps that uphold the impeccable quality of scientific publications.[65]

Three experiences close IJMS's December issue. Franke presents an autobiographical case report in which the medical student tells the story of how she was diagnosed with beta-thalassemia minor,[66] Wright present his experience in building a water system in one of the rural communities of the Dominican Republic,[67] and Daniel et al. stresses out how better internship experiences can help the ongoing brain drain of Nigeria's healthcare force.[68]

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Editorial

Time to Treat the Climate and Nature Crisis as One Indivisible Global Health Emergency

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Introduction

Over 200 health journals call on the United Nations, political leaders, and health professionals to recognise that climate change and biodiversity loss are one indivisible crisis and must be tackled together to preserve health and avoid catastrophe. This overall environmental crisis is now so severe as to be a global health emergency.

The world is currently responding to the climate crisis and the nature crisis as if they were separate challenges. This is a dangerous mistake. The 28th Conference of the Parties (COP) on climate change is about to be held in Dubai while the 16th COP on biodiversity is due to be held in Turkey in 2024. The research communities that provide the evidence for the two COPs are unfortunately largely separate, but they were brought together for a workshop in 2020 when they concluded that: "Only by considering climate and biodiversity as parts of the same complex problem…can solutions be developed that avoid maladaptation and maximize the beneficial outcomes".[1]

As the health world has recognised with the development of the concept of planetary health, the natural world is made up of one overall interdependent system. Damage to one subsystem can create feedbacks that damage another—for example, drought, wildfires, floods and the other effects of rising global temperatures destroy plant life, and lead to soil erosion and so inhibit carbon storage, which means more global warming.[2] Climate change is set to overtake deforestation and other land-use change as the primary driver of nature loss.[3]

Nature has a remarkable power to restore. For example, deforested land can revert to forest through natural regeneration, and marine phytoplankton, which act as natural carbon stores, turn over one billion tonnes of photosynthesising biomass every eight days. Indigenous land and sea management has a particularly important role to play in regeneration and continuing care.[4]

Restoring one subsystem can help another—for example, replenishing soil could help remove greenhouse gases from the atmosphere on a vast scale.[5] But actions that may benefit one subsystem can harm another—for example, planting forests with one type of tree can remove carbon dioxide from the air but can damage the biodiversity that is fundamental to healthy ecosystems.[6]

The impacts on health

Human health is damaged directly by both the climate crisis, as the journals have described in previous editorials,[7,8] and by the nature crisis.[9]This indivisible planetary crisis will have major effects on health as a result of the disruption of social and economic systems—shortages of land, shelter, food, and water, exacerbating poverty, which in turn will lead to mass migration and conflict. Rising temperatures, extreme weather events, air pollution, and the spread of infectious diseases are some of the major health threats exacerbated by climate change.[10] "Without nature, we have nothing," was UN Secretary-General António Guterres's blunt summary at the biodiversity COP in Montreal last year.[11] Even if we could keep global warming below an increase of 1.5◦C over pre-industrial levels, we could still cause catastrophic harm to health by destroying nature.

Access to clean water is fundamental to human health, and yet pollution has damaged water quality, causing a rise in water-borne diseases.[12] Contamination of water on land can also have far- reaching effects on distant ecosystems when that water runs off into the ocean.[13] Good nutrition is underpinned by diversity in the variety of foods, but there has been a striking loss of genetic diversity in the food system. Globally, about a fifth of people rely on wild species for food and their livelihoods.[14]

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2 Editor-in-Chief, International Nursing Review.
3 Editor-in-Chief, Medical Journal of Australia.
4 Editor-in-Chief, Danish Medical Journal.
5 Editor-in-Chief, JAMA.
6 Editor-in-Chief, British Dental Journal.
7 Editor-in-Chief, The Lancet.
8 University of Exeter.
9 Editor-in-Chief, African Journal of Primary Health Care & Family Medicine.
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Declines in wildlife are a major challenge for these populations, particularly in low- and middle-income countries. Fish provide more than half of dietary protein in many African, South Asian and small island nations, but ocean acidification has reduced the quality and quantity of seafood.[15]

Changes in land use have forced tens of thousands of species into closer contact, increasing the exchange of pathogens and the emergence of new diseases and pandemics.[16] People losing contact with the natural environment and the decline loss in biodiversity have both been linked to increases in noncommunicable, autoimmune, and inflammatory diseases and metabolic, allergic and neuropsychiatric disorders.[9,17] For Indigenous people, caring for and connection with nature is especially important for their health.[18] Nature has also been an important source of medicines, and thus reduced diversity also constrains the discovery of new medicines.

Communities are healthier if they have access to high-quality green spaces that help filter air pollution, reduce air and ground temperatures, and provide opportunities for physical activity. (19) Connection with nature reduces stress, loneliness and depression, while promoting social interaction.[20] These benefits are threatened by the continuing rise in urbanisation.[14]

Finally, the health impacts of climate change and biodiversity loss will be experienced unequally between and within countries, with the most vulnerable communities often bearing the highest burden.[9] Linked to this, inequality is also arguably fuelling these environmental crises. Environmental challenges and social/health inequities are challenges that share drivers and there are potential co-benefits of addressing them.[9]

A global health emergency

In December 2022 the biodiversity COP agreed on the effective conservation and management of at least 30% percent of the world's land, coastal areas, and oceans by 2030.[21] Industrialised countries agreed to mobilise $30 billion per year to support developing nations to do so.[21] These agreements echo promises made at climate COPs.

Yet many commitments made at COPs have not been met. This has allowed ecosystems to be pushed further to the brink, greatly increasing the risk of arriving at 'tipping points', abrupt breakdowns in the functioning of nature.[2,22] If these events were to occur, the impacts on health would be globally catastrophic.

This risk, combined with the severe impacts on health already occurring, means that the World Health Organization should declare the indivisible climate and nature crisis as a global health emergency. The three pre-conditions for WHO to declare a situation to be a Public Health Emergency of International Concern[23] are that it: **1)** is serious, sudden, unusual or unexpected; **2)** carries implications for public health beyond the affected State's national border; and **3)** may require immediate international action. Climate change would appear to fulfil all of those conditions. While the accelerating climate change and loss of biodiversity are not sudden or unexpected, they are certainly serious and unusual. Hence we call for WHO to make this declaration before or at the Seventy-seventh World Health Assembly in May 2024.

Tackling this emergency requires the COP processes to be harmonised. As a first step, the respective conventions must push for better integration of national climate plans with biodiversity equivalents.[3] As the 2020 workshop that brought climate and nature scientists together concluded, "Critical leverage points include exploring alternative visions of good quality of life, rethinking consumption and waste, shifting values related to the human-nature relationship, reducing inequalities, and promoting education and learning".[1] All of these would benefit health.

Health professionals must be powerful advocates for both restoring biodiversity and tackling climate change for the good of health. Political leaders must recognise both the severe threats to health from the planetary crisis as well as the benefits that can flow to health from tackling the crisis.[24] But first, we must recognise this crisis for what it is: a global health emergency.

This Comment is being published simultaneously in multiple journals. For the full list of journals see: https://www.bmj.com/content/full-list-authors-and-signatories-climate-nature-emergency-editorial-october-2023.

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Original Article

Awareness, Coverage, and Barriers to COVID-19 Vaccination among Undergraduate Students in Nigeria

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Abstract

Background: With the resumption of physical learning activities across Nigeria's higher education institutions, tertiary-level students, a priority group in the deployment of the COVID-19 vaccines according to the WHO SAGE, face circumstances that necessitate widespread vaccination coverage among them. This study aimed to assess Nigerian undergraduate students' knowledge, coverage, and barriers to COVID-19 vaccination. **Method:** A cross-sectional survey of Nigerian undergraduates was conducted in October 2021, using an online questionnaire and a combined simple random and snowballing sampling technique. The questionnaire included sections on respondents' demographic characteristics, COVID-19 vaccine awareness, coverage, barriers, and recommendations. A total of 326 respondents electronically completed and returned the informed consent form along with the questionnaire. The data obtained were analyzed using the statistical package for the social sciences (SPSS) version 25. **Results:** The overall awareness of COVID-19 vaccines among the sampled students was high; with 62.3%, 20.9%, and 16.9% having good, average, and poor levels of knowledge respectively. However, a majority of the respondents (81.3%) had not received the vaccines. The most prominent barrier to vaccination was misinformation about vaccine safety (23.6%). Opening vaccination centers on campuses (18.6%), demonstrating vaccine effectiveness and safety (18.7%), and organizing awareness campaigns (17.2%) were the most frequently recommended actions. **Conclusion:** Most respondents were aware of the availability and potential benefits of COVID-19 vaccines; however, coverage remained extremely low. Our findings emphasize the importance of addressing vaccination barriers by public health stakeholders to achieve optimal COVID-19 vaccine coverage.

Introduction

The Chinese government reported to the World Health Organization (WHO) on December 31, 2019, an outbreak of viral pneumonia of unknown cause in Wuhan, Hubei Province, China.[1] The disease was dubbed COVID-19 after it was discovered to be caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2; formerly known as 2019-nCoV).[2] As more COVID-19 cases were reported outside of China, the WHO declared the outbreak a Public Health Emergency of International Concern (PHEIC) on January 30, 2020.[3] The WHO declared the coronavirus outbreak a global pandemic on March 11, 2020, emphasizing the importance of enforcing mitigation measures by stakeholders in various countries.[4]

Accordingly, Nigeria responded quickly after the first few cases in the country were recorded. The Nigerian government restricted flights from 13 countries where COVID-19 was confirmed endemic, established a Presidential Task Force to enforce safety measures, began contact tracing, prohibited large social gatherings, placed several states on lockdown, approved stimulus packages for households and businesses, and ordered school closures.[5] As a result, all academic institutions in the country were closed to reduce community transmission, with no provision for a viable alternative. While some tertiary institutions in Nigeria implemented online learning models to ensure education continuity, most institutions were completely shut down throughout the lockdown due to insufficient e-learning infrastructure to implement virtual learning. Tertiary institutions resumed physical activities in January 2021 to mitigate the devastating effects of school closure on Nigerian students.[6,7]

However, due to overcrowding and inadequate health infrastructure in the majority of Nigerian tertiary institutions, the resumption of physical activities raised concerns about the increased risk of COVID-19 spread in the institutions, potentially

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worsening the national COVID-19 burden.[7] As a result, a safe, nationally implemented vaccination program would most likely be the long-term solution to COVID-19. As evident in previous vaccination campaigns, vaccines have the potential to break the chain of transmission and stabilize the incidence of an infectious disease.[8] Evidence suggests that densely populated settings like school campuses are at high risk of COVID-19 spread.[9] As such, tertiary university students who interact in such settings are considered a priority group for the national vaccination program, according to the WHO SAGE value framework for the allocation and prioritization of the COVID-19 vaccination.[3]

In comparison to other parts of the world, Nigeria has had very low coverage of COVID-19 vaccination.[10] Since the start of Nigeria's vaccination program on March 5, 2021, about 133 million vaccine doses have been administered. Only 45.5% of citizens had received at least one dose of the vaccine and only 39.4% were fully vaccinated as of November 5, 2023.[11] By implication, Nigeria missed the national COVID-19 vaccination coverage goal of 70% by mid-2022 recommended by the WHO.[12] Vaccine uptake and coverage are constantly hampered by factors such as fear, hesitancy, conspiracy theories, disgust, and distrust in the government.[10] However, vaccination programs can only be successful if the vaccines are widely accepted by the citizens. It is worthy of note that there is a significant difference in the levels of knowledge, perception, willingness, and acceptance of the COVID-19 vaccines among citizens worldwide. This has been attributed to multiple factors including differences in socioeconomic, educational, health, age, gender, religious and personal belief statuses across the countries.[13] As a result, to improve vaccination coverage and uptake rates in Nigeria, a context-specific approach at various societal levels is required.

It is important to understand the factors influencing vaccination intention and behavior of the people in Nigeria, particularly among undergraduate students, who are an important part of the large youthful populace.[3,14] Some studies have assessed the level and factors influencing vaccine acceptance or hesitancy among tertiary students in specific Nigerian institutions and disciplines, identifying similar predictors of acceptance as the general population.[14,15] However, it remains unclear how the willingness to vaccinate or its predictors translate to actual vaccination uptake among the students since the roll-out. More so, to design an efficient vaccination program, more data is required on the coverage rate of the COVID-19 vaccine as well as the student-reported barriers to vaccination uptake across diverse institutional settings and disciplines. Therefore, this study assessed the COVID-19 vaccination awareness, coverage, and barriers among students in Nigerian tertiary institutions in different regions across the country. It also investigated the students' agreement with previously reported recommendations on ways of increasing vaccination uptake. This will serve as a means of informing policies to enhance the country's COVID-19 vaccination program and reduce virus spread.

Methods

Study Design

This cross-sectional study employed an open self-administered online survey conducted via Google Forms from October 20th to December 19th, 2021. A combined simple random and snowballing sampling technique was used to recruit the respondents for the study. Undergraduate students in tertiary institutions in Nigeria were invited by sharing the survey's hyperlink via electronic mail and social networking platforms (Telegram, Facebook, Twitter, and WhatsApp), where the students interact. In turn, respondents were also requested to share the survey invitations on their social media pages and groups. To increase response rates, recurring reminders were sent via similar channels. The Google Form used was set up to only accept one response per respondent using their unique email address. To improve questionnaire completion, key survey questions were also designated as 'required.' The guidelines for Strengthening the Reporting of Ob'ervationa' Studies in Epidemiology (STROBE) were followed in conducting and reporting the findings of this study.[16]

Study Setting and Populations

Undergraduate students at Nigerian tertiary institutions were the target audience for this study. The survey was administered electronically and participants were contacted online. Eligible participants were Nigerian undergraduates above 18 years of age; with active studentship status; who were enrolled in an active academic session and had partially or completely resumed physical learning methods at their institutions; and who had a functional email account and internet access. Undergraduate students who did not meet the above eligibility criteria could not participate in the study.

Survey Questions and Outcomes Measure

The questionnaire for the study was developed using the WHO Strategic Advisory Group of Experts (SAGE) on Immunization's validated scale for assessing vaccination coverage[17] and hesitancy,[18] literature review, and relevant discussions with experts. Independent survey experts reviewed and validated the final survey tool. A pilot study of 48 undergraduate students was conducted to determine the tool's face validity. The pilot study's sample was excluded from the main study.

The research survey tool was divided into three sections. Following the consent form, the first section collected respondents' demographic data: age, place of residence, location of institution, level of study and mode of instruction at school at the time of the survey. The second section assessed respondents' knowledge of COVID-19 and COVID-19 vaccines, as well as their vaccination status at the time of the survey. The vaccination status assessment involved the number of doses of the available vaccines received, the vaccination schedule, and facility used. These first two sections were made up of closed-ended questions with the response options designed as categorical variables. The

final section investigated the perceived or experienced barriers to COVID-19 vaccination by respondents, as well as recommendations for improving vaccination coverage among Nigerian undergraduate students. The response options in this section, also framed into categorical variables, were derived from a list of commonly reported barriers and recommendations in the literature,[19-21] while the respondents were allowed to include unmentioned ones.

Sample Size

The minimum sample size for this study was calculated using the formula described by Kadam and Bhalerao[22]: $n = Z^2 \times S^2 / m^2$
Where n is the sample size; Z is z-value for a 95% confidence level (1.960); S is the population standard deviation (0.5); and m is the margin of error of 5%. The minimum sample size was determined to be 385.

Data Preparation and Analysis

The survey responses were downloaded into a Google spreadsheet and then imported into IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA.) for data analysis. The categorical variables were presented as frequencies, percentages, and histograms, as appropriate.

The level of knowledge (awareness) about COVID-19 and its vaccines among the respondents was assessed by scoring and summing the respondents' responses to the questions asked with this objective. Four questions (*Table 1*) were asked and each appropriate answer was given a score of 1. Those who scored 1 out of 4 or less were categorized as having "poor" knowledge, 2 out of 4 as "average" knowledge, and 3 out of 4 and 4 out of 4 (i.e. above average) as "good" knowledge (See Result). Two questions were used to assess vaccination coverage – 'Have you received any of the COVID-19 vaccines?' and 'number of doses taken so far' with options for respondents to choose from. The proportion of the respondents that had received at least a dose of the vaccines at time of the survey was calculated. Chi-square test was used to determine the association between knowledge level and vaccination coverage among the respondents. A p-value of <0.05 was considered statistically significant. Descriptive statistics were conducted on the reported barriers and recommendations for improved vaccine uptake among the respondents.

Results

Socio-Demographic Data of the Respondents

A total of 326 responses were obtained and analyzed. Most of the respondents were between the ages of 18 and 29 (97.2%) with more male respondents (54.3%) compared to females (45.7%). The represented institutions were mostly from the south-western part of the country (43.9%) followed by the south-south (22.1%) and south-east (17.8%). 89.3% of the respondents resided in the urban parts of the country while the remaining 10.7% lived in rural areas. The educational level of the respondents ranged from 100 level to 600 level with 500 level students accounting for 33.7% of the total respondents, closely followed by 200 level students (29.8%). At the time of the survey, the majority (59.3%) of respondents had fully resumed physical learning methods, 38.7% were in programs running both physical and virtual lectures simultaneously, while 2.1% were having solely virtual lectures (*Table 2*).

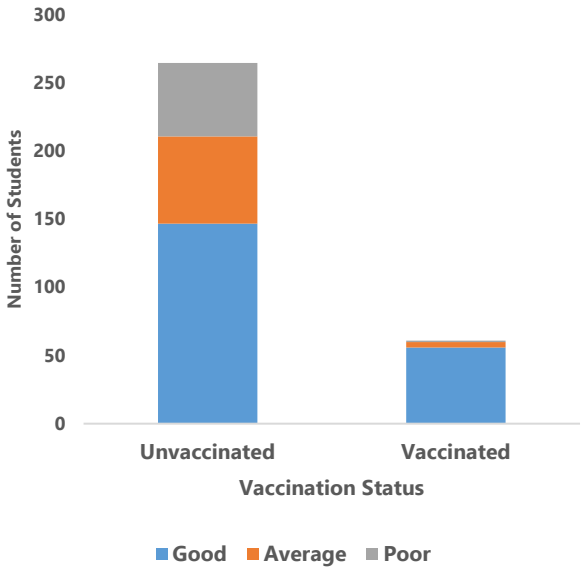
Respondents' Knowledge of COVID-19 and the COVID-19 Vaccine

Four questions (*Table 1*) were asked of the respondents to assess their knowledge of COVID-19 and the COVID-19 vaccine. Knowledge of COVID-19 and COVID-19 vaccines, according to literature, entailed understanding the likelihood of COVID-19 spreading on and off campuses, the availability of COVID-19

Table 1. Questions Assessing Knowledge about COVID-19 and COVID-19 Vaccines.

Questions	Appropriate response
Do you think COVID-19 pandemic is still ongoing in Nigeria	Yes
Do you think there is a possibility of the spread of COVID-19 on campus	Yes
Are you aware of the availability of COVID-19 vaccines in Nigeria	Yes
The COVID-19 vaccine can protect you from COVID-19. Do you agree?	Yes

Figure 1. Association Between Vaccination Coverage and Awareness (Knowledge Grading) about COVID-19 and COVID-19 Vaccines Among Respondents.



Legend: Chart reflecting the associations between vaccination coverage (uptake of the COVID-19 vaccines) and awareness (knowledge grading) of COVID-19 and COVID-19 vaccine among respondents. Having a good level of knowledge is associated with a higher chance of getting vaccinated. However, other factors may influence actual vaccination coverage in the population. $X2 = 28.189$, $p < 0.001$, $n = 326$.

vaccines in Nigeria, and the ability of the vaccines to protect against COVID-19. These indicators correspond to data provided by health authorities both locally and globally. 62.3% of the respondents had good knowledge while 20.9% and 16.9% had average and poor knowledge, respectively.

Table 2. Socio-demographic Characteristics of the Respondents.

Variable	Frequency (n = 326)	Percentage (%)
Age (years)		
18-29	317	97.2
30-39	8	2.5
40-49	1	0.3
Sex		
Female	149	45.7
Male	177	54.3
Religion		
Christianity	225	69.0
Islam	100	30.7
Other	1	0.3
Place of residence		
Rural	35	10.7
Urban	291	89.3
Location of institution		
North Central	21	6.4
North East	15	4.6
North West	15	4.6
South East	58	17.8
South South	72	22.1
South West	145	43.9
Level of study		
100L	13	4.0
200L	97	29.8
300L	33	10.1
400L	59	18.1
500L	110	33.7
600L	14	4.3
Current mode of instruction		
Physical Classes	193	59.2
Virtual Classes	7	2.1
Both	126	38.7

Assessment of the COVID-19 vaccination coverage among the respondents

COVID-19 vaccination coverage level of the respondents was determined by the number of respondents that have received at least one dose of the vaccine at the time of the survey. Only 61 respondents (18.7%) had received at least one dose of the vaccine. Of these, 46 (75.4%) were fully vaccinated while the remaining 15 (24.6%) respondents had an incomplete vaccination status. 42.6% of those that had received the vaccine got their shots within the premises of their institutions while 45.8% claimed to have gotten the vaccine outside of their institution premises (*Table 3*). Correlation between the knowledge of COVID-19 and COVID-19 vaccine and vaccine coverage was carried out to determine if the level of awareness of the respondents had any significant influence on the level of vaccine uptake. Interestingly, we found that 91.8% (56/61) of the vaccinated respondents had 'good' knowledge of COVID-19/COVID-19 vaccines while 6.6% and 1.6% had 'average' and 'poor' knowledge respectively. Among the unvaccinated students, while 55.4% (147/265) of them had 'good' level of knowledge, 24.1% of them had 'average' knowledge, and 20.4% had 'poor' knowledge of COVID-19/COVID-19 vaccines at the time of the survey. A Chi-square test result indicated a significant association ($\chi 2=28.189$ P-value<0.001) between the knowledge of COVID-19/COVID-19 vaccines and vaccine coverage (*Figure 1*).

Responses on barriers to COVID-19 vaccination

Rumors about the safety of the vaccine (23.6%), difficulty in accessing vaccination centers (16.1%) and lack of trust in the government or country of vaccine import (15.2%) were the most prominent barriers to vaccination considered by the respondents (*Figure 2a*).

Recommendations for improving vaccine uptake

Showing proof of vaccine safety (18.7%), opening of vaccination centers on campus (18.6%), and creating awareness on vaccine benefits (17.2%) were the actions mostly recommended by the students to improve their level of vaccine uptake (*Figure 2b*).

Table 3. Coverage of COVID-19 Vaccine Among the Respondents.

Questions	Frequency (n=326)	Percentage (%)
Have you received any of the COVID-19 vaccines?		
Yes	61	18.7
No	265	81.3
Number of doses taken so far?		
Complete (one dose)	16	4.9
Complete (two doses)	30	9.2
Partial (one dose)	15	4.6
None	265	81.3
If you picked YES to having been vaccinated, please indicate your last vaccination schedule; (Pick "Nil" if unvaccinated):		
March, 2021	3	0.9
May, 2021	2	0.6
June, 2021	7	2.1
July, 2021	5	1.5
August, 2021	10	3.1
September,2021	15	4.6
October ,2021	8	2.5
November 2021	9	2.8
Nil	267	81.9
If you picked YES to having been vaccinated, please indicate where you received the vaccine; (Pick "Nil" if unvaccinated)		
Health facility on campus	26	42.6
Health facility off campus	28	45.9
Nil	267	81.9

Figure 2a. Barriers To Vaccination and Recommendations to Improve the Uptake of the COVID-19 Vaccines Among the Respondents.

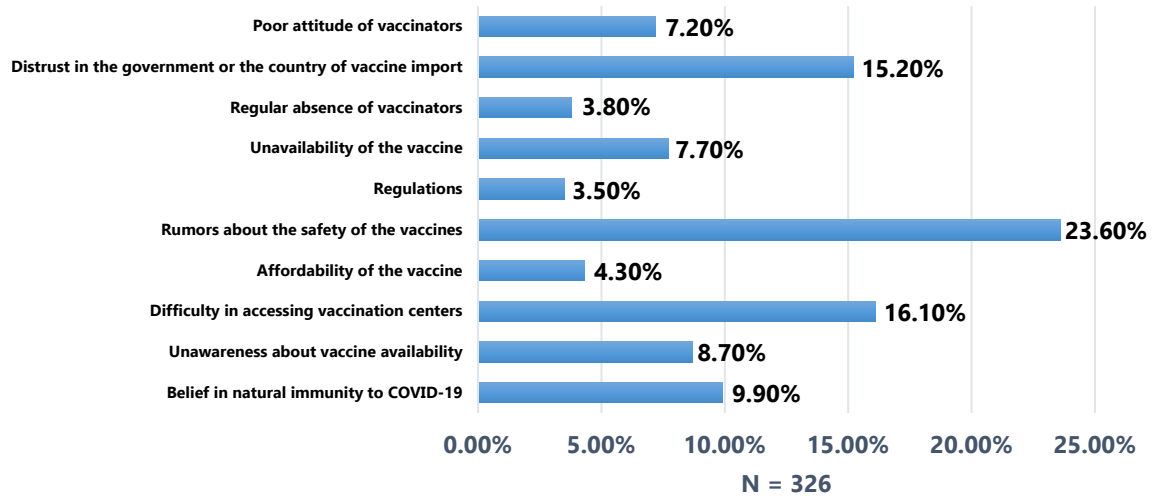
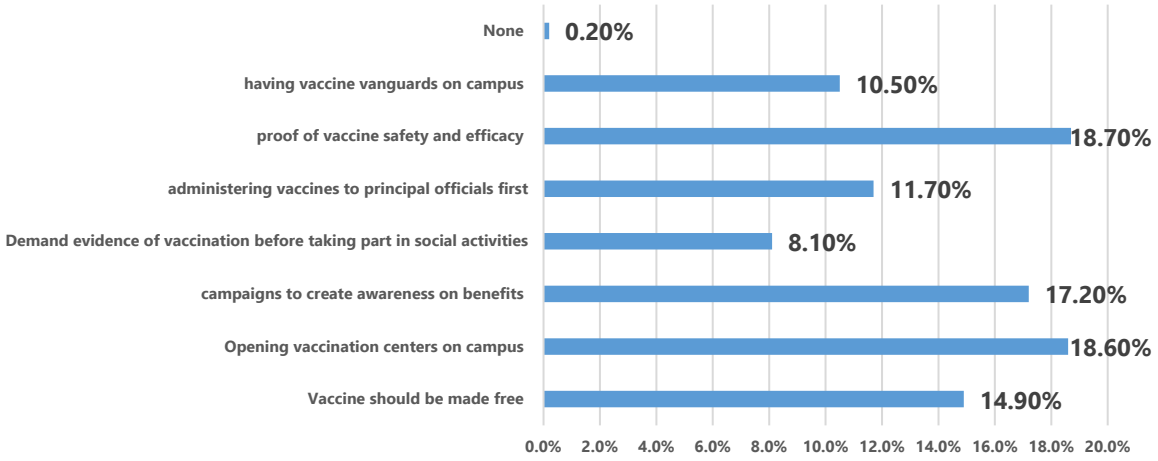


Figure 2b. Recommendations for Improving Vaccination Uptake Among Tertiary Students



Legend: **a)** Safety concerns and inaccessibility top the list of barriers to COVID-19 vaccination among respondents. **b)** Tested recommendations to improve COVID-19 vaccination uptake among tertiary-level students in Nigeria

Discussion

The extent to which an individual perceives the risk of an infectious disease and comprehends the potential benefits of vaccination influences their attitude toward vaccination.[23-25] Findings from our study indicate an association between the knowledge of COVID-19 vaccines and vaccination coverage i.e. individuals who demonstrate a high level of knowledge of COVID-19/COVID-19 vaccines are more likely to take the vaccines than those with poor knowledge. This suggests that understanding the risk of COVID-19 spread and the benefits of vaccination can increase the willingness to be vaccinated. Several studies have supported this assertion. A study in Jordan, for example, found that 76% of respondents had a good understanding of the vaccine, with 72.4% having a favorable attitude toward it and 71.3% intending to use it.[23] Also, a community-based survey in Ethiopia found that people with a good understanding of the vaccine were more likely to accept the COVID-19 vaccine.[26] Furthermore, in Bangladesh, vaccine acceptability among the 605 adults included in a study was found to be significantly related to their knowledge of the COVID-19 vaccine, with up to 60% of the respondents willing to be vaccinated and those with good understanding of COVID-19/COVID-19 vaccines showed 22.23 times higher odds of accepting the COVID-19 vaccine compare to people with lower knowledge.[27] A study in Malaysia, however, contradicts these findings. The web-based cross-sectional study, which assessed

the knowledge, perception, and acceptance of the COVID-19 vaccine among 1,406 Malaysians, found that even though 62% had little or no knowledge of the vaccine, 65% were still willing to take it.[28] This could be due to the population's perception of the infection's risk.

According to our findings, the majority of undergraduates (83.2%) are aware of the availability of the COVID-19 vaccines at the designated vaccination centers and potential benefits of the COVID-19 vaccine. However, coverage remains very low (18.7%). This suggests that willingness to take the vaccine does not always translate into actual vaccination. Although increased knowledge can increase the willingness to get vaccinated, other identified vaccination barriers must be overcome to improve vaccine coverage. The fear of vaccine side effects emerged as the most significant barrier in this study. Similarly, according to the Ipsos survey, the top three barriers were "worry about side effects," "doubt about vaccine effectiveness," and "perception of not being sufficiently at risk from COVID-19".[29] Furthermore, a survey conducted by Africa CDC in 15 African countries revealed that the reasons for not accepting COVID-19 vaccines were primarily based on trust in vaccines and perceptions of their safety and efficacy.[8] Access to vaccination centers is another significant barrier to COVID-19 vaccination among these students (16.1%). Access to vaccination centers can be challenging, leading to low vaccine uptake and vaccine hesitancy.[24] Low vaccine uptake is especially problematic in low and middle-income countries, where factors such as a lack of resources, poor roads for transporting vaccines, insufficient cold-chain and storage, and limited funds for surveillance all play a role.[29-32] A study of COVID-19 vaccination disparities among low-, middle-, and high-income countries found that the national economic level of low and middle-income countries, as well as other socioeconomic factors, have a negative impact on vaccination levels and access to vaccination in these countries.[31] Findings from our study further identified belief in natural immunity, lack of knowledge about vaccine availability, vaccine affordability, rumors about vaccine safety, regulations, vaccine unavailability, regular absence of vaccinators, distrust in the government, and vaccinators' poor attitude as potential barriers to COVID-19 vaccination. These reported barriers are consistent with studies in China,[33] Zambia,[22] Malaysia,[34] and six Southeast Asian countries,[35] in addition to Nigerian studies.[8,21]

To overcome vaccine hesitancy caused by the fear of vaccine side effects, our respondents suggested that stakeholders demonstrate proof of vaccine safety, such as displaying scientific evidence of successful vaccinations. The students also suggested that various awareness campaigns should be developed to increase the knowledge of the vaccine's benefits while emphasizing the pandemic's perceived risk. This can be achieved via targeted educational interventions and/or media promotions: e.g. as described by Lessard and colleagues, which may include convening symposia with the students, where the benefits and safety concerns about the vaccines can be addressed by trusted healthcare professionals; and through the use of broadcast and outdoor media tools like flyers, billboards, wallscapes etc. sited strategically in the institutions.[36] Furthermore, establishing vaccine advocacy groups on campuses was popular among the respondents and we predict this to be suitable and effective in promoting COVID-19 vaccine acceptance among the students. Starting a new student club or leveraging existing public health-leaning clubs on campus to disseminate sound information about COVID-19 vaccines and encourage vaccine uptake may be an efficient way to implement this. Studies have underscored the critical role students can play in response to the pandemic outbreak, from awareness creation to contact tracing, screening, and vaccine promotion.[37-39] Additionally, in Nigeria, student-led advocacies and peer educator initiatives have been shown to promote positive beliefs and attitude toward disease prevention and vaccination among students.[40,41]

To address the challenges with COVID-19 vaccine accessibility among undergraduate students, the students proposed that vaccination centers should be established on campus. Availability of on-campus vaccination centers can ameliorate the difficulty in accessing vaccination centers. Existing health centers or clinics in the institutions can be used for this purpose, although necessary infrastructure such as cold chain storage facilities and trained personnel must be provided. Scheduled visits to campus using mobile vaccination teams may also work where permanent maintenance of cold chain and other infrastructure on-campus is not feasible due to cost.[42] Administering vaccines first to principal officers was recommended, which is expected to boost the confidence of the students in the safety of the vaccine. Providing vaccines at no cost to the student was also suggested as a means of increasing vaccine uptake. Willingness to pay for the COVID-19 vaccines has been generally low in the Nigerian populace, with some early surveys citing as much as three-quarter of respondents preferring the vaccines to be offered for free.[43,44] Along this line, the government of Nigeria through the primary health care program have made the COVID-19 vaccines available free of charge for all citizens; the policy could have encouraged earlier receivers of the vaccines, including some of our vaccinated study respondents. Furthermore, demanding proof of vaccination as a ticket to important activities, such as examinations and convocations, was also recommended. Notably, this is the least popular recommendation among our respondents and it likely reflects the bigger controversy about the acceptance and justification of the mandatory vaccination policies in the public. Vaccine mandates can be an effective means to improve vaccination coverage among students, for example, Couture and colleagues (2023) demonstrated in one American college that mandating vaccination on campus increased the likelihood of taking the COVID-19 vaccine among the students.[45] Smith and Emanuel (2023) had further argued that vaccine mandate policies serve greater public health good and the policies are not necessarily coercive, discriminatory nor infringing on civil liberties as claimed by opponents.[46] They maintained that the policies are not uncommon e.g. among health workers, and are justifiable given the exceptions for medical and religious objections,

communal benefits similar to tax and speed limit laws, and individual free will to disengage from circumstances or settings where vaccine mandates apply.[46] However, the WHO in its 2022 policy brief on mandatory vaccination has cautioned policymakers to balance vaccine mandate considerations with other values such as necessity for a defined objective, evidence of efficacy and safety, accessibility, public trust, and ethical procedures to prevent negative societal outcomes.[47] Overall, policies and strategies that encourage voluntary participation in vaccination such as educational and accessibility measures should be prioritized over intrusive means like a mandate, especially in complex settings like a tertiary institution.[47]

Limitations

The main strength of our study is in capturing the Nigerian tertiary students' perceived barriers to vaccine uptake and their recommendations for improving the prevalent low vaccine uptake. Our study allows students to suggest how health policies should be implemented and improved. Furthermore, our findings showed that increased vaccination knowledge does not always translate into increased coverage. Vaccination barriers must be overcome for coverage to increase.

The main limitation of our study is the small sample size. This may limit the generalizability of our result, which might to totally represent the opinions of the entire undergraduate population in Nigeria and may warrant confirming the findings and recommendations in subsequent studies among a larger cohort of Nigerian undergraduates. However, we believe that the inclusion of our study participants from across the different regions of the country may enhance the representativeness and applicability of our findings. Also, we acknowledge that the reality of the COVID-19 pandemic in Nigeria may have changed over the periods between data collection and final publication. While this may determine the urgency with which the recommendations given should be applied, we are convinced that the recommendations can contribute to future pandemic preparedness or response among the study population.

Conclusion

This study found a link between good knowledge of COVID-19 and its vaccines and the uptake of the COVID-19 vaccines among Nigerian undergraduate students. However, safety concerns about the vaccines and inaccessibility of vaccination centers are barriers strong enough to cause vaccine hesitancy and low vaccine uptake among students. Thus, to improve vaccine uptake, the safety of the vaccines needs to be demonstrated to the students by health authorities. Additionally, student-centered campaigns and initiatives should be launched to promote the benefits of vaccination and raise the awareness of the risks of the pandemic and vaccine hesitancy. Importantly, vaccines should be provided at no cost, and vaccination centers should be opened on campuses to improve accessibility. Future vaccination programs and related health interventions should consider target population peculiarities for effective implementation.

Summary – Accelerating Translation

This study titled "Awareness, Coverage, and Barriers to COVID-19 Vaccination among Undergraduate Students in Nigeria" is an observational study aimed at generating the necessary data required to design an effective COVID-19 vaccination program for undergraduate students in Nigeria.

The COVID-19 pandemic is still at force in Nigeria with reports of new variants of the virus. Since December 2021, the Nigerian Center for Disease Control and Prevention (NCDC) has been monitoring various emerging sub-lineages and variants of the virus in the country. Also, the COVID-19 vaccines have been rolled out since the second quarter of 2021 but uptake and coverage are still far below the needed threshold. About a third of the 207 million Nigerians are currently fully vaccinated. The resumption of physical learning activities in various tertiary institutions presents a need to prevent fatal outbreaks at the institutions. Studies have shown that places with a large number of inhabitants, such as school campuses, are potential hotbeds for COVID-19 virus spread. The WHO has also recognized this and has specified that tertiary students should be prioritized in vaccine allocation. Hence, the study is focused on this sector of the Nigerian population.

Hesitation towards getting vaccinated is a global problem that is prevalent in Nigeria, particularly among the large youthful populations, which includes tertiary students. This study investigated the knowledge (awareness), coverage (how much utilized), and barriers to the uptake of vaccines among tertiary students in the country. We conducted an online survey, where electronic questionnaires were administered to willing undergraduate students (respondents) in Nigeria and the data obtained were analyzed.

From the results of our study, we observed that a large proportion of our respondents were well aware of the availability and benefits of the COVID-19 vaccine. Yet, approximately 4 of every 5 respondents had not received a dose of the vaccine. The main reasons cited by the respondents were the fear of side effects and unavailability of vaccination centers on their campuses. To this end, most of the respondents agreed that providing proof of vaccine safety, opening vaccination centers on campus, and promoting the vaccine through tertiary students are viable ways to improve the acceptability and uptake of the COVID-19 vaccine among tertiary institutions students.

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Original Article

The Effect of Spaced Repetition Learning Through Anki on Medical Board Exam Performance

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Abstract

Background: Spaced repetition learning is a method of learning that relies on a fixed formula for spacing out flashcards to ensure long term retention of a topic. Anki is one such application available online that utilizes spaced repetition learning. This retrospective cohort study analyzed incorporating Anki with medical school curriculum and its effect on board examination scores. The hypothesis is that students who engaged in spaced repetition learning through Anki scored higher on licensing board exams and achieved higher GPAs than students who did not engage with this method. **Methods:** The hypothesis was tested through comparison of USMLE Step 1 scores, COMLEX Level 1 scores, and GPA. The samples were selected from the Rocky Vista University Class of 2023 and split between 35 students in the Anki Cohort and 268 students in the non-Anki cohort. **Results:** 1 (2.8%) student failed USMLE Step 1 in the Anki cohort compared to 28 (10.94%) students who failed Step 1 in the non-Anki cohort ($p > 0.05$) The Anki cohort achieved a higher mean USMLE Step 1 (223.71 versus 222.58) and COMLEX Level 1 (569.51 versus 559.99). The non-Anki cohort had a higher GPA (85.60) than the Anki cohort (83.82) ($p < 0.01$). **Conclusion:** This is the first study to evaluate for a correlation between COMLEX level 1 scores with use of spaced repetition learning. Although this study was unable to find any significant correlation between Anki use and licensing exam scores, further investigations with better control and sample size are needed.

Introduction

Medical school is a unique challenge due to the growing amount of basic science and clinical knowledge that students are responsible for retaining. In the United States, medical knowledge is assessed with the use of standardized multiple-choice examinations in both osteopathic and allopathic medical schools. Allopathic students are required to take the United States Medical Licensure Examination (USMLE) Step exams 1 and 2 clinical knowledge (CK), while osteopathic students are required to take the Comprehensive Osteopathic Medical Licensing Examination (COMLEX-USA) Level exams 1 and 2 CK. Passing either set of exams is required for medical licensure. In 2022, USMLE Step 1 and COMLEX-USA Level 1 transitioned to a pass-fail model from a numerical score. Gauer et al. found a statistically significant difference between numerical USMLE Step 1 and USMLE Step 2 CK and specialties in the residency match, with Dermatology having the highest mean score and Family Medicine having the lowest mean score.[1] In the past, the numerical USMLE Step 1 score was weighted more heavily in garnering residency positions in competitive specialties.[1] With the transition to pass-fail it is thought that residencies will ultimately look to USMLE Step 2 CK instead. Guiot et al. demonstrated that USMLE Step 1 score is a predictor of USMLE Step 2 performance.[2]

Enhancing medical student performance on medical school board exams by increasing retention of basic science medical knowledge is a challenge that medical educators still face.[3] One such way to improve retention of medical knowledge is using retrieval practice also known as testing effect.[4] Retrieval practice is the idea that testing one's knowledge will lead to gains in memory retention. This method of knowledge retention is often paired with another modality known as spaced repetition. Spaced repetition stems from the idea of spacing effect. The spacing effect is the idea that educational encounters spaced and repeated over time, results in improved and efficient knowledge retention.[5,6] Kerfoot et al. demonstrated that spaced repetition in medical students significantly improves long-term memory of medical knowledge.[7] This idea of spaced repetition was further demonstrated by Karpicke et al. to have powerful effects on retention regardless of the schedule of repeated tests.[8]

One way to implement spaced repetition with retrieval practice into study routine is to use flash cards. Senzaki et al. demonstrated that flashcards can be an effective way to retain long-term knowledge as long as they are utilized with the intent to practice retrieval of knowledge with emphasis on retention, comprehension, and application of knowledge.[9] For medical students, a popular way to implement flash cards into their routine is with online applications such as Anki (https://apps.ankiweb.net/). Anki is a flashcard application that can be downloaded on to computers, phones, and tablets. It allows students to create their own flashcards quickly and download flashcards that other students have created. There is a

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growing number of free flash card decks related to medical school board exams including both the USMLE Step 1 and Step 2CK as well as COMLEX-USA Level 1 and Level 2CK.

The purpose of this study is to analyze the effect of correlating outside spaced repetition learning through Anki synchronized with medical school curriculum on board examination scores. We hypothesized that the cohort of students using Anki for lecture and board studying would ultimately perform better and achiever higher marks on USMLE Step 1, COMLEX-USA Level 1, and grade point average (GPA).

Methods

This retrospective cohort study was performed using institutional data from Rocky Vista University College of Osteopathic Medicine (RVUCOM). The Institutional Review Board for RVUCOM approved the study protocol (IRB #2021-0047). The data was de-identified before being provided to the researchers through the office of the registrar at Rocky Vista University.

The population selected to analyze the effect of spaced repetition learning consisted of the Rocky Vista College of Osteopathic Medicine Class of 2023 and were split into two cohorts. The Anki cohort consisted of a collaborative group of students who separated flashcards that correlate with the curriculum and studied for both licensing board exams and exams based on lecture materials through the Anki platform. A different member of the group was assigned to each lecture given in the Rocky Vista curriculum and tagged the relevant Anki cards from that lecture. The second cohort consisted of the remaining members of the Class of 2023. The students in the Anki cohort were committed to keeping up with the responsibility of separating flashcards and therefore Anki was incorporated into their study plans. The non-Anki cohort used a variety of methods to study for both board and class exams. The two cohorts took the exams at the same time of year (May to August 2021) reducing any potential bias based on variations in the annual test forms and board preparation materials.

The inclusion criteria for the Anki cohort included students who participated in separating flashcards from the beginning of the second year (July 20, 2020) through an end date of March 5, 2021. This was chosen as an end date to include students who participated during a majority of the second-year curriculum. The exclusion criteria included any student under the age of 18 at the time of enrollment in medical school to meet standard IRB guidelines for research on adults. The final sample selected for the Anki cohort included 35 students (27 males and 8 females). The inclusion criteria for the non-Anki cohort included students aged 18 and older who did not participate the flashcard collaboration. The exclusion criteria again included any student under the age of 18. There were 268 students who matched the inclusion criteria for the non-Anki cohort, however there were 20 students in the non-Anki cohort who did not have a score available for the USMLE Step 1. Therefore, there were 248 students in the non-Anki cohort for the USMLE Step 1 comparison (136 males and 112 females), and there were 268 students in the non-Anki cohort for the COMLEX Level 1 comparison (144 males and 124 females).

To compare performance on USMLE Step 1 and COMLEX Level 1, the primary outcomes investigated were score attained and pass or fail on first attempt. For the Class of 2023, the passing scores were 194 or above on USMLE Step 1 or a score of 400 or above on COMLEX Level 1. The raw board scores of the Anki and non-Anki cohorts were compared through two sample unequal variance t-tests. The number of failures per cohort were analyzed through direct comparison with a chi-square test.

For performance in the school curriculum, the grade point average (GPA) and number of courses failed were the primary outcomes examined. GPA was compared through a two-sample unequal variance t-test and the number of courses failed were compared with a chi-square test. GPA was calculated from the scores of individual courses in the cohorts and were cumulative through the end of the second year of the curriculum. The total amount of courses failed were calculated for each cohort and included courses that were withdrawn from or dropped.

Results

For the fail rate of USMLE Step 1 in the Anki cohort, 34 subjects (97.1%) passed the exam and 1 (2.9%) student failed. In the non-Anki cohort, 228 students (91.94%) passed the exam and 20 students (8.06%) failed (*Table 1*). This difference was not significant ($p > 0.05$). Both sample sizes were sufficiently large to assume normality within the data, and this assumption allowed mean scores to be compared directly. When comparing numerical USMLE Step 1 scores, the mean of the non-Anki cohort was 222.58 and the mean of the Anki cohort was 223.71 (*Figure 1*). However, the difference was not significant ($p < 0.05$, 95% CI -7.27, 5.01).

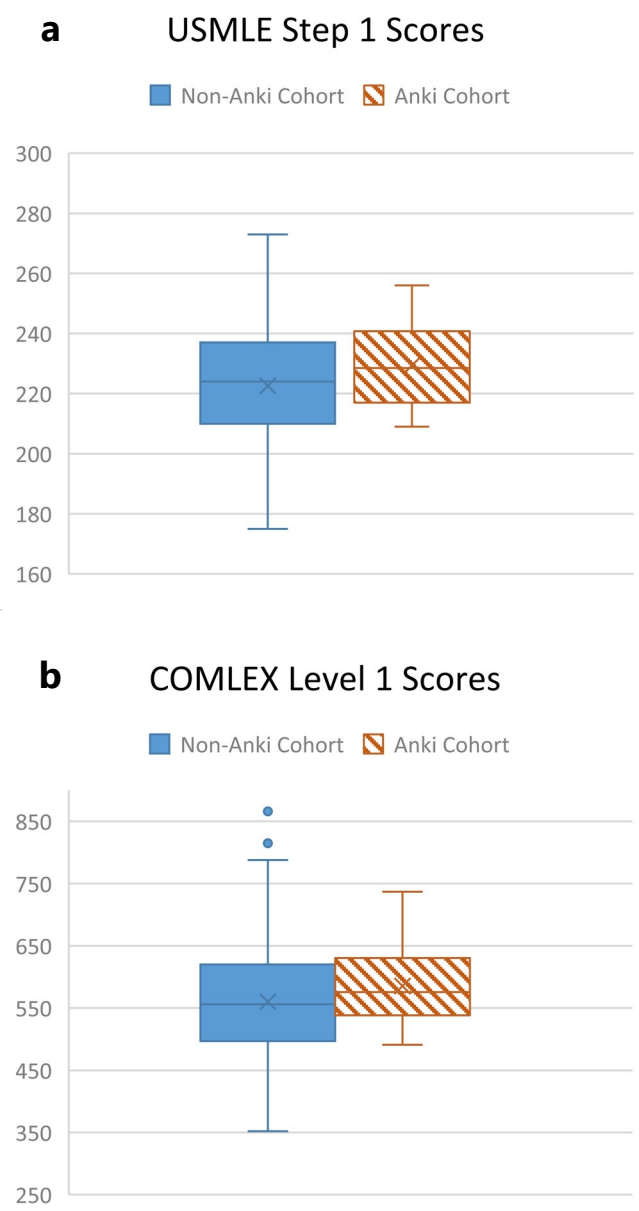
When comparing COMLEX scores, the mean score of the non-Anki cohort was 559.99, and the mean of the Anki cohort was 569.51 (*Figure 1*) ($p > 0.05$, 95% CI -34.78, 15.73). No subjects within either cohort failed COMLEX, so there is no comparison in that category for COMLEX as they were equal.

Table 1. Comparison of USMLE Step 1 Examination Passing Rate.

Cohort	Passed (%)	Failed	P-Value
Anki Cohort	34 (97.1%)	1 (2.9%)	p > 0.05
Non-Anki Cohort	228 (91.9%)	20 (8.1%)	

Legend: Passing rates of the Anki cohort compared to the non-Anki cohort

Figure 1. USMLE Step 1 and COMLEX Level 1 Scores.

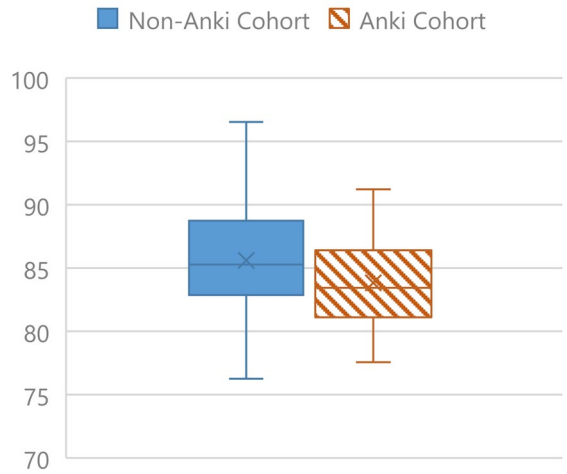


Legend: USMLE Step 1 scores (a) and COMLEX Level 1 scores (b) of the Non-Anki cohort compared to the Anki cohort.

When comparing the course results, the cumulative number of passed courses in the non-Anki cohort was 8567 and the number of failed courses was 113. In the Anki cohort, there were 1109 courses passed and 11 failed. When comparing failed courses, the percent of failed courses in the Anki cohort was 1.3% and the percent of failed courses in the non-Anki cohort was 0.99% ($p > 0.05$, 95% CI 0.66, 2.25).

In terms of the GPA of subjects in the non-Anki vs the Anki cohort, the non-Anki cohort had a higher GPA at 85.60 than the Anki cohort at 83.82 (***Figure 2***). The grade difference was statistically significant ($p < 0.01$, 95% CI -3.10, -0.45).

Figure 2. Career GPA.



Legend: Career GPA in grade point average of the Anki cohort compared to the Non-Anki Cohort

Discussion

Several studies have demonstrated the benefit of using spaced repetition for improved board score performance. The Anki cohort in this study committed to using spaced repetition flashcards that associated with what was being taught in the school curriculum. The students in the Anki cohort used the same uniform set of flashcards to study for each exam and their board exams. In dividing the work of finding relevant Anki flashcards between the 35 participants in the Anki cohort, there may have been a theoretical benefit of more free time to spend studying leading to potentially higher board scores. The method presented is novel to board exam studying in connecting outside resources with what is taught in the curriculum. The results of the study could not confirm a benefit of using Anki spaced repetition to pass the USMLE examination. However, the results suggest a benefit of increased board scores that may be confirmed in a follow-up study. Students who fail the USMLE exam on their first attempt may have difficulty matching into residency programs. One study found that 5/64 students who failed USMLE Step 1 on their first attempt failed to match into a residency program compared to all students in the pass group who matched for residency.[12]

This is the first study to evaluate for a correlation between the osteopathic medical school (COMLEX) board examination scores with use of Spaced Repetition memory aids such as Anki. This study was unable to confirm the benefit of Anki in improving COMLEX board scores, nevertheless the board scores of those in the Anki cohort were higher on average compared to the non-Anki cohort (569.51 versus 559.99). Further analysis will be required to verify these findings as there are several limitations to this study that are discussed later.

An interesting result found was that those in the Anki cohort had a lower GPA compared to the non-Anki cohort. This may be due to the spaced repetition goal of the Anki program. Using Anki to

study requires students to be reviewing information on a variety of subjects, while the classroom examinations were systems focused. Therefore, the students in the Anki cohort were spending time learning/reviewing information and topics every day that were not related to upcoming material tested on the systems-based examinations. If course tests and quizzes are given at relatively shorter intervals there is less time for spaced repetition learning to occur. In recent years, more literature has come out in search of correlating flashcard use with academic performance in medical school. The findings are consistent with a study conducted by Sun et al. which showed that first year medical students enjoyed using flashcards to study, but did not show an association with higher class exam scores.[10]

There were several limitations in conducting this study that may have led to a lack of statistical significance comparing the USMLE or COMLEX examination scores. First, this study would have been better performed as a prospective cohort study instead of a retrospective cohort study. This would have allowed for stratifying the students into cohorts that definitively differentiate the study materials used by subjects in both groups. The study described in this paper relied on comparing a cohort where Anki use was emphasized to a different cohort that had no data on study materials used. Second, the sample size of the students who were in the Anki cohort was much smaller than the non-Anki cohort which could have influenced the power of the results. Third, there was no way to measure daily compliance to the Anki flashcards, and the settings of each Anki program were up to the individual user with no standardized format. Finally, there was no way to control for extracurricular activities and if there was any influence on course or licensing exam performance.

In the future, subsequent studies designed as a prospective cohort study or randomized control trial may benefit from improved stratification of those who used spaced repetition software, such as Anki, who were not in the Anki cohort to determine whether their board scores, GPA, or pass rates differ from those in the Anki cohort. As Step 1 and Level 1 move to pass fail, the effect could be targeted for the subsequent licensing exams that are still scored: Step 2, Step 3, Level 2, or Level 3.

Conclusion

The results indicated a higher pass rate, but showed lower GPA compared to those who were not in the Anki cohort. The difference in GPA could be partially explained by the wide variety of flashcards reviewed each day compared to the more focused nature of examinations that the GPA relied on. There was a difference suggested in USMLE Step 1 or COMLEX Level 1 scores, although this difference was not statistically significant. Future studies with more robust controls will be able to further define improvements in exam scores.

Summary – Accelerating Translation

The Effect of Spaced Repetition Learning Through Anki on Medical Board Exam Performance

Medical school is a unique challenge due to the growing amount of basic science and clinical knowledge that students are responsible for retaining. Spaced repetition learning is a method of learning that relies on a fixed formula for spacing out flashcards to ensure long term retention of a topic. Anki is one such application available online that utilizes spaced repetition learning. This retrospective cohort study analyzed incorporating Anki with medical school curriculum and its effect on board examination scores. The hypothesis is that students who engaged in spaced repetition learning through Anki scored higher on licensing board exams and in their overall career GPA than students who did not engage with this method. The hypothesis was tested through comparison of USMLE Step 1 scores, COMLEX Level 1 scores, and GPA. The samples were selected from the Rocky Vista University Class of 2023 and split between 35 students in the Anki cohort 268 students in the non-Anki cohort. 1 (2.8%) student failed USMLE Step 1 in the Anki cohort compared to 28 (10.94%) students who failed Step 1 in the non-Anki cohort (P-value 0.13) The Anki cohort scored higher on both USMLE Step 1 (223.71 versus 222.58) and COMLEX Level 1 (569.51 versus 559.99) ($p>0.05$). The non-Anki cohort had a higher GPA (85.60) than the Anki cohort (83.82) ($p<0.05$). The difference in GPA could be partially explained by the wide variety of flashcards reviewed each day. This study was unable to find a benefit of using spaced repetition to pass the USMLE examination. This is the first study to evaluate for a correlation between COMLEX level 1 scores with use of spaced repetition learning. Additionally, the study pointed towards an improvement in USMLE Step 1 and COMLEX Level 1 scores that can be investigated in the future.

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Original Article

Evaluating Medical Students' Knowledge of Medical Malpractice: A Pilot Study

Nia Nikkhahmanesh,[1] Paul Kang,[2] Eric vanSonnenberg.[3]

Abstract

Background: Although medical malpractice lawsuits are common and have a tremendous financial and psychological impact on physicians, education about medical malpractice is almost non-existent in most medical school curricula around the world. Nonetheless, medical students are concerned about looming legal lawsuits during their careers and have expressed desire to become educated. The objective of the present study is to evaluate and gauge baseline medico-legal knowledge of medical students. **Methods**: A survey with 25 multiple-choice quiz questions regarding malpractice risks, standards of care, and malpractice premiums was prepared with information obtained from peer-reviewed articles after a thorough literature review failed to produce a validated questionnaire for medical students. The survey was distributed to medical students across 5 consecutive years at our medical school, totaling 420 students. Data from the survey was collected via Qualtrics before undergoing statistical analysis. **Results**: The completion rate for the survey was 110/420 (26.2%). The results showed that no group of students scored greater than 50% correct on the survey, with an overall median score of 40% correct for all students combined. Fourth year medical students correctly answered 1.77 more questions, on average, than first year medical students. There were no statistically significant differences in survey score between students with a personal or familial medical malpractice involvement. **Discussion**: The results are an indication that students are not well-educated about medical malpractice, and that medical malpractice education should be implemented in medical school to help prepare future physicians to protect their patients and hopefully avoid malpractice lawsuits.

Introduction

Medical malpractice is an unfortunate reality in medicine that can affect any physician. A survey conducted in 2016 found that 50% of physicians aged 55 and over reported being named in a malpractice suit at some point in their careers, and for surgeons, that number rises to 63%.[1] Therefore, medical malpractice education for medical students is critical as most students who enter medical training lack appropriate knowledge regarding the legal aspects of practicing medicine. Nonetheless, medico-legal education in medical school curricula typically receives little attention.

Medical malpractice lawsuits are extremely prevalent throughout medicine. Among physicians in surgical specialties such as general surgery, orthopedics, and neurosurgery, 80% faced a medical malpractice claim by the age of 45 years.[2] A survey in 2016 found that 67.4% of surgical sub-specialists were named in a lawsuit, compared to 50% of primary care physicians.[1] Data in 2016 documented that for every 100 physicians, 68 liability claims were filed.[3] Among physicians trained in internal medicine and its subspecialties, 55% faced a malpractice claim by the age of 45, with the probability increasing to 89% by the age of 65.[2]

Premiums for malpractice insurance can be formidable as well. A report of manual premiums reported by the Medical Liability Monitor (MLM) reveals that general surgeons in 2021 paid malpractice premiums ranging from $41,775 to $215,649 depending on their geographic location of practice in the United States.[4]

Currently, medical students have a negative perception of the medical malpractice system. A study conducted at Brown University Medical School revealed that 75% of their surveyed student body opined that the current medical malpractice system was either functioning poorly or in crisis. Results also showed that 35% of students were either seriously or tremendously concerned with medical malpractice in the future.[5] Another survey of medical students found that 51% of students believed that their satisfaction in practicing medicine would be decreased by their concern for medical malpractice and lawsuits.[6]

Teaching of health law in medical school comprises less than 2% of the total hours in American medical curriculum.[7] Johns Hopkins School of Medicine and the University of Baltimore School of Law

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in 2016 experimented with different methods of incorporating legal information into medical education. They concluded that the current model of medical education leaves little, if any, room for medical students to learn about the legal system.[8] This dearth of medical malpractice education leaves medical students vulnerable to the distressing and potentially shocking reality of a medical malpractice lawsuit during their eventual careers as physicians.

The lack of medical malpractice education for students is global as well. Further evaluation of the UK medical student malpractice survey indicated that 89% of the fifth-year students and 91% of the first-year students specified that they would like to have more teaching on legal issues throughout their medical school curriculum.[9] Medical schools in the Middle East fail to provide legal education training to their students, which has a negative impact on the knowledge and attitudes of future physicians in regards to the legal aspects of their medical practice.[10] Medical students and physicians are not the only healthcare professionals at risk. A study in Turkey found that 93.6% of nursing students reported never having received training or education regarding legal liability in medical interventions.[11]

Since medical students seemingly are not well-informed about basic aspects of medical malpractice, we prepared a survey to gauge baseline students' knowledge of medical malpractice during their undergraduate years. The aim of this study is to assess medical students medico-legal knowledge through administration of a medico-legal survey designed to test specific concepts via multiple choice questions. The goal of creating this study is to help initiate further research and education to provide medical students relevant medico-legal knowledge that, hopefully, will help them avoid medical malpractice lawsuits, protect themselves and their patients, and to better prepare them if a lawsuit does occur when they become physicians.

Methods

This is a cross-sectional study evaluating medical students at a single institution utilizing a survey containing multiple choice questions designed to test medico-legal knowledge. The survey was emailed to all 1st, 2nd, 3rd, and 4th year medical students through class listservs, which are electronic mailing list software containing email contact information for all medical students, at our medical school, The University of Arizona College of Medicine – Phoenix, and was also sent to the entire class that had graduated in 2020. A total of 420 survey invitations were sent. The email invitation was re-sent after a period of 4 weeks to potentially increase the number of respondents. The survey was available to students over a course of six months, afterwards the data was collected and statistically analyzed. We excluded from the study incomplete surveys. No sample size calculations were performed. Students were not provided any resources prior to administration of the survey as one of the main goals of the study is to establish a baseline of medical student medical malpractice knowledge.

An initial thorough search of PubMed, Google Scholar, Embase, and Ovid was performed for a validated questionnaire to effectively gauge medical malpractice knowledge using the search terms "medico-legal," "medical student," "education," and "medical malpractice." While some studies regarding medical student opinions and experiences regarding medical malpractice education have been published, there have been no validated medical malpractice questionnaires constructed.

A web-based survey software developed by Wharton School of the University of Pennsylvania, called Qualtrics, was utilized to create the survey. After the Qualtrics survey was constructed, Institutional Review Board approval was granted (protocol number: 2010159388). Six demographic questions queried year in medical school, gender, medical doctors, or attorneys in the family, and personal or family involvement in a previous medical malpractice lawsuit. Twenty-five multiple choice quiz questions then addressed medical-legal topics such as legal definitions, standards of care, malpractice risks in various specialties, types of medical malpractice, trends in malpractice data, and expert witness information (***Figure 1***). Each multiple-choice quiz question only contained one correct answer among four answer options with two quiz questions containing five answer options and one quiz question containing eight answer options. Questions were created by referencing research articles, peer-reviewed publications, and academic websites that discussed the legal aspects of medicine and healthcare.[2,4,12-23] The references to journal articles utilized for survey questions were omitted while participants completed the survey. The questions were designed to enumerate or enlist those major concepts and physician viewpoints to create a broad scope of queried information (*Supplementary file 1*). The Qualtrics software calculated the estimated time to complete the survey would be around five to seven minutes, however the software did not record the length of time it took each participant to complete the survey. The survey was reviewed by a medical malpractice attorney and was presented at both local and national conferences with feedback included to help refine and tailor questions appropriately to medical students.

Data were stratified into each class of medical students, gender, presence of medical doctor in the family, presence of lawyer in the family, and familial or personal involvement in medical malpractice. Number of correct and incorrect responses per question, and total median number correct in each stratified group were then compared for statistical significance. For data analysis, statistical significance was determined using α = 0.05, and 95% confidence intervals (CI) were utilized.

Fisher's Exact Test was used to compare correct and incorrect answers for each individual question for the stratified groups. The Kruskal-Wallis Test was used to compare the total median number correct of each medical student class, and the Mood's Median Test was used to compare the total median number correct for the other groups.

Univariate linear regression models were utilized to determine median number of greater correct answers, standard errors, p-values, and 95% CI based on stratification criteria. Each medical student class's median number correct was compared to the first-year medical student class's median number correct. The other groups were compared to their counterpart.

Results

Of the 420 surveys that were sent to the medical students, 110 completed the survey; 13 surveys were started, but not completed. Overall, a completion rate of 26.2% (110/420) was achieved (*Table 1*).

The median number of correct answers for all medical students was 10/25 (40% correct). There was a trend that showed a higher percentage correct with increasing year in medical school. Both first- and second-year medical students scored a median of 9/25 (36% correct), third year students scored a median of 10/25 (40% correct), and both 4th year students and 2020 graduates scored a median of 11/25 (44% correct) (p = 0.051) (*Table 2*). A univariate linear regression model showed that 4th year medical students correctly answered 1.77 questions more than first year medical students (p = 0.014, 95% CI = 0.36-3.19). There were no statistically significant differences in overall performance between males and females, presence or absence of a lawyer or medical doctor in the family, or personal or familial involvement in a medical malpractice lawsuit.

When stratifying performance profiles based on year in medical school, there were no statistically significant differences between percent correct for questions 1-18 and 20-25. However, there was a statistically significant difference for which classes answered question number 19 correctly. The question was about which pair of specialties had the highest combined risk of a malpractice lawsuit. The correct answer was OB/GYN and General Surgery. 22/36 (61.1%) 1st year students, 21/27 (77.8%) 2nd year students, 18/21 (85.7%) 3rd year students, and 18/20 (90%) 4th year students answered the question correctly. However, only 2/6 (33.3%) of 2020 graduates answered correctly (p = 0.02).

When stratifying based on gender, questions 1-17 and 19-25 showed no statistically significant difference. There was a statistically significant difference for question 18, that asked about who would rarely be deposed in a medico-legal deposition, with the correct answer being the opposing attorney. For this question, 17/48 (35.4%) males answered correctly compared to 5/62 (8.1%) females (p<0.001).

When stratifying for the presence of lawyers in the family, there were no statistically significant differences for questions 1-19, 21, or 23-25. For questions 20 and 22 there were statistically significant differences for which groups answered the questions correctly. Question 20 asked about the most common reason why physicians are sued for malpractice; the correct answer is failure to diagnose or delay in diagnosis. For question 20, 23/89 (25.8%) medical students without a lawyer in the family answered correctly compared to only 1/21 (4.8%) student with a lawyer in his or her family (p = 0.04).

Question number 22 asked about what percentage of physicians believe the lawsuit was unwarranted, with the answer being 89% of physicians. Question 22 was answered correctly by 48/89 (53.9%) medical students without a lawyer in the family compared to 17/21 (81.0%) students with a lawyer in the family (p = 0.03). Stratification of the data by whether medical students had a medical doctor in the family resulted in no statistically significant differences. In addition, stratifying the results based on whether the student was involved in a malpractice lawsuit him or herself, or had a family member involved in a malpractice lawsuit, also showed no statistically significant differences.

Table 1. Demographic Data about Respondents of the Medico-Legal Qualtrics Survey.

Demographic Data	n(%)
1st Year Medical Students	36 (32.7%)
2nd Year Medical Students	27 (24.5%)
3rd Year Medical Students	21 (19.1%)
4th Year Medical Students	20 (18.2%)
2020 Graduates	6 (5.45)%
Male	48 (43.6%)
Female	62 (56.4%)
Medical Doctors in Family	31 (28.2%)
Lawyers in Family	21 (19.1%)
Personal or Relatives Involved in Malpractice Lawsuit	7 (6.36%)

Discussion

The results of the survey demonstrated that no student class scored even 50% correct. This is an indication that students are not knowledgeable about the looming litigation that statistically will occur in their careers. Similar results to our survey were reported in a UK study that showed that only 7% of first year, and 40.5% of fifth year, medical students provided the correct response to the definition of standard of care.[9] Three different studies have also highlighted the dearth of medico-legal knowledge among medical students and interns. One such study queried 50 medical students at Banaras Hindu University Medical School and found that only 20% of students reported awareness of laws regarding consent. Additionally, only 2% were aware of laws that protected them as medical professionals, and only 10% of students correctly defined medical negligence.[24] Another study involved constructing a questionnaire with 30 questions about basic knowledge of medical law, informed consent, and negligence and had 300 participants consisting of interns and residents at Srimathi Bhikiben Kanjibhai Shah Medical College complete the questionnaire. This study found that only 60% of practicing interns correctly answered a question about informed consent and 65% correctly answered a question regarding medical negligence.[25] The last study tested medical malpractice-related scenarios in 63 3rd semester MBBS students at Believers' Church Medical College Hospital and found that only 54% could

correctly identify the tested medico-legal concepts.[26] Prior surveys found that medical students are both very concerned about medical malpractice lawsuits in their careers, and that they are not knowledgeable.[5] Our study provides more information regarding specific medical student gaps in medico-legal knowledge and underscores the students' concerns. The results of the study can be used to guide the establishment of effective educational material for medical students that could also apply to medical training internationally.

Not only are medical students not educated about the law in healthcare, but they are also worried about how it will impact their careers. A study in the UK noted that 88% of first year and 99% of fifth year medical students felt that medical malpractice would be of increasing concern over the next 10 years.[9] Another study highlighted that 95% of pediatric residents believed that medical malpractice should be taught during residency, and 69% believed that a fear of medical malpractice affected their practice as resident physicians.[27] In addition, 70% of medical students who were taught medical law through an innovative curriculum agreed that the course was useful.[28] Teaching medical students about pertinent information regarding medical malpractice and the law may help mitigate their fear about medical malpractice, and have them eventually learn practices that may help prevent lawsuits. In addition, students are open to the idea of learning about medicolegal topics, as they believe that the information will be essential to becoming a physician.[29]

Table 2. Percent Correct of Each Survey Question by Stratification Criteria

Question Number	First-Year Students	Second-Year Students	Third-Year Students	Fourth-Year Students	2020 Grads	p-value	Female	Male	p-value	Medical Docs in Family	No Medical Docs in Family	p-value	No Lawyer in Family	Lawyer in Family	p-value	Not Involved in Lawsuit	Involved in Lawsuit	p-value
Q1	38.9	40.7	52.4	70.0	83.3	0.07*	50.0	50.0	1	48.1	54.8	0.67	47.2	61.9	0.33	51.5	28.6	0.55
Q2	69.4	59.3	81.0	80.0	100.0	0.19	71.0	75.0	0.67	69.6	80.6	0.34	73.0	71.4	1	73.8	57.1	0.58
Q3	36.1	22.2	47.6	45.0	16.7	0.27	29.0	43.8	0.16	36.7	32.3	0.83	37.1	28.6	0.61	35.0	42.9	0.96
Q4	19.4	3.7	14.3	20.0	16.7	0.44	8.1	22.9	0.06	13.9	16.1	0.77	13.5	19.0	0.5	13.6	28.6	0.57
Q5	36.1	40.7	42.9	55.0	50.0	0.73	43.5	41.7	1	43.0	41.9	1	39.3	57.1	0.15	42.7	42.9	0.26
Q6	63.9	85.2	71.4	60.0	100.0	0.12	77.4	64.6	0.2	70.9	74.2	0.82	74.2	61.9	0.29	71.8	71.4	0.96
Q7	2.8	0.0	0.0	10.0	0.0	0.24	3.2	2.1	1	2.5	3.2	1	3.4	0.0	1	2.9	0.0	0.45
Q8	55.6	70.4	81.0	65.0	66.7	0.39	69.4	62.5	0.54	65.8	67.7	1	64.0	76.2	0.44	65.0	85.7	0.71
Q9	47.2	22.2	38.1	25.0	16.7	0.19	32.3	35.4	0.84	36.7	25.8	0.37	34.8	28.6	0.8	32.0	57.1	0.43
Q10	50.0	48.1	66.7	60.0	33.3	0.51	53.2	54.2	1	51.9	58.1	0.67	53.9	52.4	1	53.4	57.1	0.81
Q11	36.1	44.4	38.1	45.0	66.7	0.68	38.7	45.8	0.56	39.2	48.4	0.4	40.4	47.6	0.63	41.7	42.9	0.96
Q12	44.4	25.9	38.1	40.0	16.7	0.52	38.7	33.3	0.22	41.8	22.6	1	32.6	52.4	0.11	37.9	14.3	0.34
Q13	36.1	25.9	23.8	35.0	33.3	0.84	33.9	27.1	0.53	29.1	35.5	0.65	29.2	38.1	0.44	29.1	57.1	0.37
Q14	25.0	33.3	9.5	15.0	33.3	0.29	17.7	29.2	0.17	24.1	19.4	0.8	24.7	14.3	0.39	24.3	0.0	0.35
Q15	50.0	29.6	47.6	65.0	66.7	0.14	43.5	54.2	0.34	48.1	48.4	1	50.6	38.1	0.34	48.5	42.9	0.73
Q16	8.3	7.4	9.5	10.0	0.0	0.95	12.9	2.1	0.08	10.1	3.2	0.44	9.0	4.8	1	8.7	0.0	0.55
Q17	55.6	77.8	81.0	80.0	66.7	0.16	69.4	72.9	0.83	73.4	64.5	0.36	68.5	81.0	0.3	68.9	100.0	0.38
Q18	27.8	18.5	9.5	15.0	33.3	0.43	8.1	35.4	<0.001*	17.7	25.8	0.43	18.0	28.6	0.36	21.4	0.0	0.3
Q19	61.1	77.8	85.7	90.0	33.3	0.02*	75.8	70.8	0.66	70.9	80.6	0.34	73.0	76.2	1	71.8	100.0	0.44
Q20	16.7	33.3	9.5	20.0	50.0	0.12	21.0	22.9	0.82	25.3	12.9	0.2	25.8	4.8	0.04*	23.3	0.0	0.28
Q21	27.8	29.6	42.9	35.0	50.0	0.68	29.0	39.6	0.31	38.0	22.6	0.18	29.2	52.4	0.07	34.0	28.6	0.096
Q22	58.3	55.6	61.9	50.0	100.0	0.28	50.0	70.8	0.03*	57.0	64.5	0.52	53.9	81.0	0.03*	58.3	71.4	0.7
Q23	52.8	48.1	42.9	65.0	50.0	0.69	51.6	52.1	1	53.2	48.4	0.68	50.6	57.1	0.63	51.5	57.1	0.58
Q24	25.0	29.6	23.8	40.0	33.3	0.78	32.3	25.0	0.53	27.8	32.3	0.65	29.2	28.6	1	31.1	0.0	0.055
Q25	36.1	33.3	42.9	35.0	33.3	0.97	37.1	35.4	1	34.2	41.9	0.51	40.4	19.0	0.08	35.9	42.9	0.52

Legend: * $p < 0.05$

An issue regarding medical malpractice education is that there are no requirements for students to have any medico-legal education, as this information is not tested on any standardized examination.[30] It is likely that medical students obtain medico-legal information during their 3rd and 4th clinical years, as evidenced by the trend of increasing scores in the later years in our survey. This is most likely why there was a statistically significant difference between each class's percent correct for question 19, that asked about combined malpractice risk for different specialties; each class performed better than the previous one.

Physicians who have been targeted in a malpractice lawsuit often are emotionally traumatized[31] and may not be willing to speak about their experiences, especially to medical students who are just beginning their careers. Nonetheless, it is likely that the time spent in hospitals or clinics working with physicians who have an understanding about medical malpractice make a significant contribution to acquiring medico-legal knowledge.[6] Medical students not only learn about practicing medicine in a clinical setting, but also have reported learning about practicing defensive medicine.[6]

Teaching of medical malpractice is a challenge in medical school because: **1)** medical schools already incorporate an enormous volume of medical information, and/or **2)** some medical schools have shortened their preclinical years from the traditional 2 years to 1.5 years.[29] Thus, it is problematic for medical schools to add more material to their already crowded curricula.

Table 3. Correlational Analysis of Stratification Criteria.

Total Correct	Coefficient	Std. Error	p-value	95% CI
2nd years	0.21	0.65	0.73	-1.07, 1.51
3rd years	0.83	0.69	0.23	-0.54, 2.22
4th years	1.77	0.71	0.01*	0.36, 3.19
2020 grads	1.89	1.12	0.09	-0.33, 4.12
Gender	0.68	0.49	0.17	-0.30, 1.67
Med Docs in Fam	-0.01	0.57	0.98	-1.14, 1.12
Lawyers in Fam	0.11	0.65	0.85	-1.18, 1.41]
Med Mal Inv.	0.48	1.05	0.64	-1.61, 2.5]

Legend: * $p < 0.05$

This study has limitations. First, there are no standardized questions to test our hypothesis. To address this barrier, the survey's knowledge-based questions were constructed from recent peer-reviewed medical malpractice literature and evaluated by an attorney to improve the study's reliability. Secondly, the sample size for completion of the survey consisted of 110 medical students from one medical school, and the survey was emailed on three separate occasions to each student to improve the overall participant response rate. Since only 26% of the student population completed the survey, the validity of the study is less robust as the sample of students who chose to complete the optional survey may have differed from the sample of students who chose not to complete the survey. This limits the study's internal validity which would be improved by including more students, in addition to more medical schools, to provide further data. Lastly, theoretically, students may have researched the answers to the survey questions while completing the survey, and this could falsely increase correct responses. To prevent this potential issue, references to journal articles utilized for survey questions were omitted while participants completed the survey. Future studies should focus on constructing a validated medical malpractice survey that can accurately assess medical student knowledge about medico-legal concepts while also collecting qualitative data such as interviews or open-ended questions that could uncover reasons behind students' knowledge gaps and their perceptions of medical malpractice education. In addition, the time required to complete the survey should be recorded and/or administration of an in-person or proctored survey should be implemented to prevent bias from students searching for answers online.

In conclusion, the results of the study indicate that medical students are not knowledgeable about fundamental medico-legal information that will become important, not only in their careers as physicians, but also in their medical specialty selection process. These results can help create relevant and necessary educational material for medical students that would better prepare them to practice medicine throughout their training and for the rest of their careers. Ultimately, medico-legally-educated medical students should become better-equipped to protect themselves and their patients. Medical school curriculum committees can begin educating medical students by first distributing recently published medical malpractice studies to familiarize medical students with medical malpractice statistics. To further medico-legal knowledge discussion among students, a potentially effective method would be to offer accessible medical malpractice information via pre-recorded lectures or optional information sessions with law professors or medical malpractice attorneys well-versed in recent malpractice trends. These steps would provide necessary student feedback to curriculum committees to facilitate the incorporation of essential medico-legal information into medical school education.

Summary – Accelerating Translation

Although medical malpractice lawsuits are common and have a tremendous financial and psychological impact on physicians, education about medical malpractice is almost non-existent in most medical school curricula around the world. Nonetheless, medical students are concerned about looming legal lawsuits during their careers and have expressed desire to become educated. The objective of the present study is to evaluate and gauge baseline medico-legal knowledge of medical students. A multiple-choice survey with 25 questions regarding the legal aspects of medicine was prepared and administered to medical students across 5 consecutive years of our medical school. The results showed that no group of students scored greater than 50% correct on the survey, with an overall median score of 40% correct for all students combined. 4th year medical students scored only slightly higher, on average, compared to 1st year medical students. The results are a strong indication that students are not well-educated about medical malpractice, and that medical malpractice education potentially should be implemented in medical school to help prepare future physicians to protect their patients and hopefully avoid malpractice lawsuits.

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Conceptualization: NN, and EV. Methodology: NN, and EV. Formal Analysis: PK. Data Curation: NN, and EV. Investigation: NN, and EV. Resources: NN, and EV. Writing – Original Draft: NN, and EV. Writing – Review & Editing: NN, and EV.

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Supplementary Material

Medico-Legal Survey

General Information

What year are you currently in medical school? Year 1, 2, 3, 4, or 2020 Graduate
Gender? Male/Female/Other
Do you have any medical doctors in your family? y/n
Do you have any attorneys in your family? y/n
Have you ever been involved in a medical lawsuit? y/n
Have any of your relatives been involved in a medical lawsuit? y/n

Survey

Choose the single best answer.

1) What constitutes medical malpractice?[12]

A) The doctor made an error in the patient's medical treatment
B) The patient experienced a complication during surgery
C) The doctor caused the patient to experience emotional or physical hardship/trauma
D) The doctor deviated from the standard of care*
E) The doctor's diagnosis and/or therapy was incorrect, and the patient died

2) Who can be involved in a medical malpractice lawsuit?[13,14]

A) Faculty attending
B) First-year Resident
C) Medical student
D) Any of the above*

3) What is the likelihood that a highly experienced 65-year-old physician has been involved in a medical malpractice lawsuit, based on being in a high-risk specialty?[2]

A) 90%*
B) 75%
C) 50%
D) 25%

4) What is the likelihood that a highly experienced 65-year-old physician has been involved in a medical malpractice lawsuit, based on being in a low-risk specialty?[2]

A) 75%*
B) 50%
C) 35%
D) 15%

5) Suppose a malpractice claim goes to trial. What is the likelihood the physician will be exonerated?[2]

A) 91%
B) 78%*
C) 53%
D) 37%

6) If a patient experiences a complication during a routine operation, does this mean that the patient will most likely sue the surgeon?[12]

A) Yes, complications are not common in routine surgeries and provide grounds for a claim
B) No, complications can always arise, and the patient signed a consent form for the procedure
C) Depends, if the surgeon did not proceed how a typical surgeon in his/her field would have done*
D) Depends on whether or not the patient died

7) Paid malpractice claims in the past 30 years have been…[15]

A) Decreasing*
B) Unchanging
C) Increasing
D) Fluctuating

8) Of the following specialties, when a medical malpractice case is lost by the physician, which specialty has the highest mean payouts?[15]

A) Obstetrics and gynecology*
B) Radiology
C) Anesthesiology
D) Emergency Medicine

9) What is the nearest estimate of the average claim that is paid to patients if they win a medical malpractice lawsuit?[15]

A) $50,000
B) $100,000
C) $300,000*
D) $1,000,000

10) Which specialty has the highest risk of having a medical malpractice claim against the physician?[2]

A) General Surgery*
B) Diagnostic Radiology
C) Orthopedic Surgery
D) Internal Medicine
E) Emergency Medicine

11) Approximately, how many attorneys practice in the US directly?[16]

A) 500,000
B) 750,000
C) 1.3 million*
D) 2.4 million

12) Approximately, how much money is typically spent on defensive medicine in the U.S.?[17,18]

A) $100 billion
B) $50 billion*
C) $10 billion
D) $100 million

13) In the year 2019, what was a medical specialist's annual medical malpractice premium cost?[4]

A) $9,000
B) $21,000*
C) $34,000
D) $56,000

14) A patient signs an informed consent for surgery on her right ear. The surgeon operates on the left ear by mistake. What can the surgeon be sued for?[19]

A) battery*
B) misrepresentation and nondisclosure
C) harm
D) assault

15) With respect to informed consent,[20]

A) the physician should tell the patient all possible complications
B) the patient can sue despite being informed about complications*
C) clear informed consent provides assurance against a malpractice suit
D) medical students can provide the informed consent

16) Expert witnesses in medical malpractice…

A) are for plaintiffs only
B) are for defendants only
C) meet the criteria to be deemed experts
D) should not be ultracrepidarians*

17) For the majority of healthcare, is an increased risk of being sued for medical malpractice associated with better quality of care?[21]

A) Yes

B) No*
C) Depends on the geographic state
D) Depends on the specialty

18) In a medico-legal deposition, who would very rarely be deposed?[22]
A) the physician
B) the plaintiff expert witness
C) the defense expert witness
D) the nurse
E) the medical student
F) the opposing attorney*
G) All of the above
H) None of the above

19) Which pair of medical specialties have the highest combined risk of receiving a medical malpractice lawsuit?[23]
A) Radiology & Emergency Medicine
B) Urology & Anesthesiology
C) General Surgery & OB/GYN*
D) Internal Medicine & Orthopedic Surgery

20) What is the most common reason why physicians are sued for medical malpractice?[23]
A) Failure to diagnose/delayed diagnosis*
B) Complications from treatment/surgery
C) Poor outcomes/disease progression
D) Failure to treat/delayed treatment

21) Among physicians who have been sued for medical malpractice, what percentage have also been named in 2-5 other medical malpractice lawsuits?[23]
A) 14%
B) 23%
C) 49%*
D) 76%

22) Among physicians who have been sued, what percent believe that the medical malpractice lawsuit was unwarranted?[23]
A) 21%
B) 47%
C) 64%
D) 89%*

23) Which pair of specialties is least likely to be sued?[2]
A) Family Medicine & Radiology
B) Psychiatry & Dermatology*
C) Pediatrics & Internal Medicine
D) Neurology & Dermatology

24) What is the highest level of medical malpractice insurance premiums that some physician specialties must pay?[4]
A) $20,000
B) $50,000
C) $100,000
D) $200,000*

25) What is the annual risk of facing a medical malpractice lawsuit for physicians in high-risk specialties?[2]
A) 5%
B) 20%*
C) 40%
D) 60%

***Correct answers bolded**

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Original Article

Prognostic Factors of Survival in Veno-Arterial ECMO Patients: A Multivariable Logistic Regression Analysis

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Abstract

Background: Several models exist to predict mortality in patients on Veno-arterial (VA) extracorporeal membrane oxygenation (ECMO). Whether expanded demographic data points have prognostic implications is less understood. This study assessed the prognostic value of demographics in patients on VA-ECMO. **Methods**: This retrospective cohort study investigated 410 patients who received VA-ECMO. Survival to hospital discharge, survival to intensive care unit discharge, and survival to ECMO explantation were examined. A multivariable logistic regression was performed incorporating 11 demographic variables. **Results:** 44% (181/410) of patients survived to ECMO explant, 37% (152/410) of patients survived to ICU discharge, and 36% (146/410) of patients survived to hospital discharge. There was a statistically significant increase in odds of survival to hospital discharge in older patients. Within the age range of the study population, for each additional year of age there was a 1% increase in odds of survival. There was a decrease in odds of survival to hospital discharge in patients who had a prior cardiac arrest (OR = 0.82 p = 0.0003). Patients who survived to hospital discharge less frequently had a history of dialysis (OR = 0.81, p = 0.0348). **Conclusion:** Older age was a prognostic indicator of survival to hospital discharge following VA-ECMO, while a history of dialysis and history of cardiac arrest were associated with mortality. Sex, BMI, atrial fibrillation, hypertension, DM, and COPD were not significant indicators. These data may help guide optimal patient selection for VA-ECMO support.

Introduction

ECMO is used as a temporary adjunct for respiratory and cardiac support in patients with either severe respiratory failure or cardiogenic shock.[1] Featuring large bore cannulas, an external oxygenator, a temperature control unit, and a pump circuit, ECMO has been used increasingly in intensive care unit settings for patients refractory to conventional therapeutics. This highly invasive procedure requires substantial training in the initiation and maintenance of ECMO physiology. Veno-Venous ECMO (VV-ECMO) continues to be used for patients in respiratory failure with preserved cardiac function,[2] treating acute respiratory distress syndrome (ARDS) patients, where it has been instrumental in providing lung rest, while Veno-Arterial ECMO (VA-ECMO) has allowed for both cardiac rest and end organ resuscitation.

As ECMO has grown in prevalence due to its ability providing to support patients until more definitive, durable cardiac recovery can be achieved.[3] The prognostic implications of this increase in prevalence, however, hinge on a multitude of factors, especially as higher risk cohorts with additional comorbidities are provided ECMO support.[4] Both the ethical concerns of poor ECMO candidate selection, and the resource requirements make identifying optimal candidates for ECMO a critical, and practical part of any successful ECMO program. Giving clinicians tools to predict who will be successfully bridged to recovery is of paramount importance. Several studies have described prognostic factors associated with VV or VA-ECMO, but due to the differences in indications, optimal candidates for VV or VA-ECMO differ significantly.

The COVID-19 pandemic has spurred research in selecting candidates for VV-ECMO,[5-7] with 2020 yielding more ECMO research than any year prior, but questions remain about the optimal VA-ECMO candidate.[8] The Survival After Veno-Arterial ECMO (SAVE) score,[9, 10] duration of ECMO support,[11] and other lab values have been used to describe the prognosis of candidates for VV-ECMO, and VA-ECMO, but additional demographic, comorbidities, and disease factors are not well understood or described.[12,13] Identifying these traits to help better identify optimal candidates for limited availability[14] going forward is of central importance to ensuring positive patient outcomes, safe staffing ratios,[15,16] and managing goals of care. This study seeks to help bridge that gap.

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Methods

We performed a retrospective cohort analysis of a major heart failure center for patients who received veno-arterial extracorporeal membrane oxygenation (VA-ECMO) between 2016-2020. We identified 545 patients over the age of 18 who underwent all categories of ECMO. 122 patients were excluded because they underwent veno-venous ECMO, while an additional 13 were excluded for receiving a configuration of ECMO which was not considered to be purely veno-arterial throughout their ECMO duration (e.g., VA-ECMO to right ventricular assist device or mixed Veno-arterial-venous ECMO). This study was approved by University of Rochester's RSRB (ID: STUDY00007291).

We utilized retrospective electronic medical record chart review in conjunction with data collected through the University of Rochester Medical Center (URMC) ECMO QA/QI database previously validated in prior research[17,18] to build a dataset including demographic, clinical, and outcome data for this patient population. Specifically, age, sex, body mass index (BMI), history of hypertension, history of diabetes mellitus (DM), history of chronic obstructive pulmonary disease (COPD), history of atrial fibrillation (AF), history of smoking, history of dialysis, origin of cardiomyopathy (ischemic vs nonischemic vs mixed) and history of prior cardiac arrest were collected by a trained data abstraction team from EMR. The authors standardized training between abstractors to ensure homogeneous data definitions, and criteria, but abstractors were not blinded to the hypothesis.

The primary outcome of interest was survival to discharge from the hospital. Secondary outcomes included ECMO explantation and discharge from the intensive care unit (ICU). Explantation was defined as removal of ECMO without replacement for greater than 24 hours. Discharge from the ICU was defined as removal of ECMO with stable hemodynamics (further defined as not requiring vasoactive chemotherapeutics) and otherwise meeting clinical criteria for floor status. Discharged from the hospital was defined as discharge from the floor with placement being either home, physical medicine rehabilitation (PM&R) center, or skilled nursing facility (SNF).

A multivariable logistic regression was also performed to analyze outcomes at three different clinical endpoints (explantation of ECMO support, ICU discharge, or hospital discharge) incorporating 11 variables selected by the authors as likely to have a direct physiologic impact on prognosis. Variables were selected based on previously validated models such as the SAVE score.[19] Additional variables were selected based on biologic plausibility; variables that do not have a clear biological mechanism were excluded. For completeness of prognostic information, all patients were included in all phases of analysis. Patients who died prior to explantation were also counted in those who died prior to ICU discharge. Each clinical endpoint was analyzed separately, preventing censuring, or competing risk.

After performing multivariable logistic regression, we performed bidirectional stepwise selection of models. The final models including the statistically significant prognostic values are included in *Table 3*.

For univariate analysis, Shapiro-Wilkes test was used to test for normalcy. Normal variables were tested with a Welch two-sample two-sided t-test. Variables found to be non-normal were tested using a Mann-Whitney U test. An additional Welch two-sample two-sided t-test or chi squared test was performed for variables that arose during the patient's ECMO course such as time on VA-ECMO support and location of ECMO cannulas. As these are not factors present prior to cannulation, these variables were not included in the multivariable logistic regression analysis. A significance threshold of 0.05 was chosen. The C statistic of the model generated was measured to compare to the C statistic of the SAVE score. R Studio Software (Version 1.4.1717) was utilized for data analysis. Google Documents and Microsoft Word were used for generating tables and figures.

Results

Of 410 patients who were included in the study, the mean age was 55.2 years old (range: 19 years to 90 years). 32% of patients were female. The average BMI was 31 kg/m2. 26% (107) of patients had a history of atrial fibrillation, 63% (260) has a history of hypertension, 33% (134) had a history of diabetes mellitus, 15% (62) had a history of COPD, 60% (247) had a history of smoking, 6% (24) had a history of dialysis, and 23% (96) had a history of cardiac arrest. Demographics and descriptive characteristics were also stratified by survival to hospital discharge. Complete demographic characteristics are found in *Table 2*.

Table 1. Protective Prognostic Factors v. Harmful Prognostic Factors in Discharge from Hospital.

Protective Factors	Harmful Factors
• Older age	• Younger age
• No history of dialysis	• History of dialysis
• No history of cardiac arrest	• History of cardiac arrest

Of 410 patients, 44% (181/410) of patients survived to ECMO explant. 37% (152/410) of patients survived to ICU discharge. 36% (146/410) of patients survived to hospital discharge. (*Figure 1*) For the following analyses, findings reaching significance are described textually while complete findings (significant and non-significant) are reported in *Tables 3-4*.

After the stepwise model was built predicting survival to ECMO explant, the following variables remained: prior cardiac arrest, and age. There was a slight decrease in odds of survival to explantation in patients who were younger (Odds Ratio (OR) = 0.99, $p<0.0001$). There was a decrease in odds of survival to explantation in patients who had a prior cardiac arrest (OR = 0.77, $p <0.0001$). A t-test or chi-squared test was performed to further

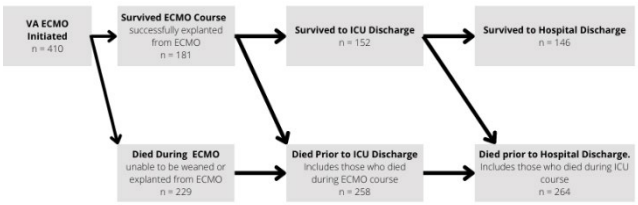
characterize associations between survival to ECMO explantation (for continuous variables and categorical variables respectively) (age and prior cardiac arrest). Of patients who survived to explantation, the mean age was 53.3+/-14.8 years; of patients who did not survive to explantation, the mean was 56.8+/-16.6 (p = 0.030). Patients who survived to explantation were less likely to have a history of cardiac arrest when compared to patients who did not survive to explantation (13% (23) v.32% (73), respectively; p <0.0001).

Table 2. Demographics and Descriptive Characteristics of Patient Cohort.

	All Patients (n=410)	**Survived to Hospital Discharge** (n = 146)	**Died in Hospital** (n = 264)	**p-Value**
Age at Hospitalization (Mean; Years Old) +/- std dev [min, max]	55.2 +/- 15.93 [19, 90]	51.4 +/- 14.03 [19, 79]	57.3 +/- 16.54 [19, 90]	**< 0.0001*** #
Female (%)	31.7	30.1	32.6	0.61
BMI (kg/m^2)	30.9 +/- 7.25	30.6 +/- 6.74	31.0 +/- 7.53	0.78 #
Atrial Fibrillation (%)	26.1	24.0	27.3	0.53
Hypertension (%)	63.4	62.3	64.0	0.73
Diabetes Mellitus (%)	32.7	31.5	33.3	0.71
COPD (%)	15.1	11.6	17.1	0.14
Smoking (%)	60.2	51.4	65.2	**0.006***
Dialysis (%)	5.9	3.4	7.2	0.12
Cardiac Arrest (%)	23.4	13.0	29.2	**0.0002***
Non-Ischemic Cardiomyopathy (%)	43.92%	56.25%	37.07%	0.001*

Legend: * Indicates statistical significance of p-value. # indicates continuous variables that were determined to be non-normally distributed and thus tested with a Mann-Whitney U test instead of a Welch two-sample two-sided t-test.

Figure 1. ECMO Course Flowsheet.



Legend: for completeness of prognostic information, all patients were included in all phases of analysis. Patients who died prior to explantation, were also counted in those who died prior to ICU discharge. Each clinical endpoint was analyzed separately, preventing censuring, or competing risk.

An additional stepwise multivariable logistic regression was run to investigate survival to ICU discharge. There was a decrease in odds of survival to ICU discharge in patients who were younger (OR = 0.99, p <0.0001). There was a decrease in odds of survival to ICU discharge in patients who had a prior cardiac arrest (OR = 0.35 p = 0.0002). A t-test or chi-squared test was performed to further characterize associations between survival to ECMO explantation (for continuous variables and categorical variables respectively). Of patients who survived to ICU discharge, their average age was 51.6 +/- 14.2 compared to an average age of 57.4+/- 16.5 in folks who did not survive to ICU discharge (p = 0.0002). Patients who survived to ICU discharge were less likely to be receiving dialysis (4% (6) v. 7% (18)), but this association was only present in multivariate analysis (univariate p = 0.18). Similar to ECMO explant, patients who survived to ICU discharge were less likely to have a history of cardiac arrest compared to patients who did not survive to ICU discharge (13% (20) v. 29%, (76) respectively; p <0.0001).

A third stepwise multivariable logistic regression was examining survival to hospital discharge. There was an increase in odds of survival to hospital discharge in patients who were older (OR = 0.99, p<0.0001). There was a decrease in odds of survival to hospital discharge in patients who had a prior cardiac arrest (OR = 0.82, p = 0.0003. There was also a decreased odds of survival to hospital discharge in patients with a history of hemodialysis (OR = 0.81, p = 0.0348). Of patients who survived to hospital discharge, their average age was 51.4+/-14.0 compared to those who did not survive, with an average age of 57.3+/-16.5 (p = 0.002). Rates of dialysis were lower among those who survived to hospital discharge as well (7% (19 v. 3% (5)), but this association is only significant in the multivariate model (p = 0.107). Similarly, patients who survived to hospital discharge had lower rates of cardiac arrest compared to patients who did not survive to hospital discharge (13% (19) v. 29% (77), respectively; p = 0.0002). No other statistically significant associations were noted. Of note, the SAVE score is quoted as having a C statistic of 0.68, while the calculated C statistic of this new model is 0.708.

When comparing time on VA-ECMO support by all outcome variables, there were no correlations found between length of VA-ECMO run time and outcome. Specifically, those explanted had a similar time receiving ECMO support to those who were not explanted (205 v. 174 hours, respectively; p=0.09). Additionally, those who were discharged from the ICU had a similar time receiving ECMO support to those who were not discharged from the ICU (191 v. 185 hours, respectively; p=0.77). Lastly, those who were discharged from the hospital had a similar run time to those who were not discharged from the hospital (182 v. 191 hours, respectively; p=0.65).

Utilizing findings from both the multivariable logistic regressions and t-tests, we summarized the protective prognostic factors versus the harmful prognostic factors of discharge from the hospital following VA-ECMO (*Table 1*). This study found older age to be protective in predicting discharge from the hospital following VA-ECMO. History of smoking, dialysis, or cardiac arrest were found to be harmful in predicting discharge from the hospital following VA-ECMO.

The location of ECMO cannula was also investigated. Central ECMO placement (in the thorax, rather than peripherally in femoral/axillary arteries) was associated with increased survival to hospital discharge (79.7% (51) v. 61.6% (213); p = 0.005), with a lower rate of cardiac arrest noted (12.5% (8) in central cohort, 25.43% (88) in peripheral cohort; p = 0.024) in those receiving central ECMO. Conversely, central ECMO was associated with no difference in duration of ventilator support, (12.94 v. 13.70 days; p = 0.715), or duration of ECMO support (193.66 hours peripheral v. 154.31hours central; p = 0.137). There was a difference in rates of cardiomyotomy between central and peripheral cohorts (p <0.0001), but of note cardiomyotomy was not associated with a differential in survival to hospital discharge (p = 0.051).

Table 3. Multivariable Logistic Regressions of Survival to Various Endpoints.

Characteristic	ECMO Explant		ICU Discharge		Hospital Discharge	
	OR (95 CI)	p value	OR (95 CI)	p value	OR (95 CI)	p value
Younger Age	**0.99 (0.989-0.996)**	**<0.0001**	**0.99 (0.988-0.994)**	**<0.0001**	**0.99 (0.987-0.994**	**<0.0001**
Female	Not Significant		Not Significant		Not Significant	
BMI	Not Significant		Not Significant		Not Significant	
Atrial Fibrillation	Not Significant		Not Significant		Not Significant	
Hypertension	1.11 (1.00-1.24)	0.05	0.90 (0.998-1.228	0.06	1.11 (0.998-1.23)	0.06
Diabetes Mellitus	Not Significant		Not Significant		Not Significant	
COPD	Not Significant		Not Significant		Not Significant	
Smoking	Not Significant		0.93 (0.85-1.02)	0.14	0.93 (0.85-1.02)	0.11
Dialysis	Not Significant		0.84 (0.69-1.01)	0.07	**0.82 (0.68-0.98)**	**0.03**
Cardiac Arrest	**0.77 (0.69-0.86)**	**<0.0001**	**0.82 (0.73-0.91)**	**0.0002**	**0.82 (0.74-0.91)**	**0.0003**
Ischemic vs Nonischemic Cardiomyopathy	Not Significant		Not Significant		Not Significant	

Legend: Bold indicates significance. 95 CI = 95% Confidence Interval. p values represent the p value associated with the odds ratio of the associated variable. "Not significant" values are values that were not selected in the bidirectional stepwise selection process.

Discussion

Advancing the predictive power of ECMO prognostic models continues to be important for critical care clinicians. Since ECMO is designed only for short-term intervention, appropriate allocation of resources is necessary as institutions seek to bridge patients capable of recovering cardiac function to recovery, destination, or transplant for definitive support. Given limited resources now more than ever during the time of pandemics, ethical discussions have led to the need for clarification regarding patient selection for ECMO.[5] Prolonged use of VA-ECMO causes significant hemolysis, inflammation, and other adverse complications.[20,21] Because of this, patients who have a low likelihood of a good outcome, and little chance of recovery should be considered poor candidates for this technology, further highlighting the importance of accurate prognostic information as part of ECMO candidate selection processes.

Published data on pre-ECMO risk factors have aided in the creation of Survival After Veno-Arterial ECMO (SAVE), a risk prediction model of mortality for patients requiring ECMO.[9] This clinical tool is limited to the specific risk factors included in the study and shows an association between these variables with mortality. Specifically, history of smoking, dialysis status, BMI, atrial fibrillation, hypertension, diabetes mellitus, and COPD were not explored in the study; factors we believe may provide additional cohort prognostication. Studies allude to the SAVE score underestimating the probability of survival, while showing no clear trend of survival between the different risk groups classified within SAVE.[19] This research supports that idea, with a

slightly larger C statistic (0.708 vs 0.68) with fewer variables of interest, suggesting that additional prognostic markers may be fruitful in improving this further.[9] Thus, further research is needed to discern additional demographics to provide better prognosis of ECMO patients. This study seeks to add to the SAVE score, and help clinicians choose optimal ECMO candidates.

While some might question these findings, with an OR of 0.99 for age, it is important to remember that this represents an OR of 0.99 for each year older. With the large age range captured in this study. By nature, age should not have a large magnitude effect per year, and we see that in the modest, but statistically significant OR consistently present in all models. Of note: in calculating the OR between the minimum age in this study (19 years old) and the maximum years of age (90 years old), based on this model, there is an OR of 4.73.

This study is not without limitations. This study is limited by its retrospective nature at a single center. This also opens the potential for specific provider bias, as there are only a few providers who initiate ECMO cannulation at this institution. Future studies should seek to replicate these findings in a prospective design across multiple centers and obtain provider information for each patient. Logistic regression is a robust statistical method, but other studies should seek to integrate these findings into existing prognostic tools mentioned above to further isolate the impact of the significant predictors mentioned here. These data did not find a correlation between the duration of VA-ECMO and survival, in contrast to other studies findings, suggesting that further investigation is needed to identify the differences in ECMO use across different centers. While the indications for ECMO can be clear, provider judgment still plays an important role in candidate selection, further emphasizing the importance of multi-center trials, where differences at particular centers can be identified. Similarly, as these data were collected from a wide range of dates, there is a risk of variable clinical practice over time influencing these results, particularly during the COVID-19 pandemic.

This study shows older age, no history of dialysis, and no history of cardiac arrest as protective prognostic factors leading to discharge from the hospital. In comparison, older age, history of dialysis, and history of cardiac arrest were identified as harmful prognostic factors (*Table 2*). The univariate difference between ischemic and non-ischemic cardiomyopathy outcomes did not retain significance when controlling for other factors, highlighting the importance of robust, clinically oriented patient considerations during candidate selection. While the positive association between age and mortality is surprising, the effect size is small and may not be clinically significant. This surprising difference may be due to congenital, or unmeasured comorbidities, suggesting that provider judgment in ECMO candidate selection may not be effective, as providers may overvalue certain demographic factors, such as age, in selecting patients to cannulate for ECMO. This further emphasizes the need for systematic models and evidence-based candidate selection, rather than relying on individual provider judgment. In today's resource-limited ICUs, this data is of increasing importance to help providers be aware of the differences between their expectations, and true clinical prognosis of survival. These findings are in direct contrast to the SAVE score. This serves to emphasize the role provider judgment plays in ECMO initiation and emphasizes the necessity for more objective, quick, and accessible clinical tools in candidate selection. Larger studies should seek to unpack specific disease processes in younger ECMO candidates to identify which disease processes are associated with improved or worsened outcomes.

Differences between central and peripheral ECMO are surprising. These differences may be due to the selection of candidates for cardiac surgery prior to initiation of ECMO or may be due to differences in artery and vein selection. It is possible that central ECMO offers reduced rates of complications that have been shown to increase mortality, as lack of differential in ventilator support, and duration of ECMO support suggest that this difference in mortality is not secondary to variance in underlying disease severity, but this is in contrast with prior research that showed increased rates of limb ischemia in central VA-ECMO.[22] This difference may be due to differences in fluid dynamics, leading to improved coronary perfusion,[23] or higher rates of post-transplant ECMO support but the small patient population in this cohort receiving a heart transplant (n = 19) and durable mechanical support (n = 7) suggests that a different mechanism underlies this difference in survival. Additionally, the difference in rates of cardiomyotomy are understandable, due to the nature of central ECMO, but due to the lack of association with survival, this difference alone does not explain the difference in survival to hospital discharge between central and peripheral ECMO support. Further research is necessary to elucidate the mechanism of this differential.

Although providers may be hesitant to initiate ECMO on obese patients due to difficulty in cannulation, and high rates of comorbidities,[24] prior studies on VV-ECMO have shown no difference in survival to discharge based on BMI classification.[24,25] This study further adds to that body of evidence, evaluating the role of VA-ECMO, and showed no significance in outcome prediction on BMI. (*Table 3*) This is important as it rejects the stigma associated with obese patients, allowing for optimum care. Further research also needs to be done to support this finding within additional patient cohorts. In this study, sex did not show a significant prediction in outcome. Such findings are consistent with other ECMO predictor models, ENCOURAGE, where they found no difference in survival between sexes.[26]

This study adds to the ability of providers to make evidence-based decisions during candidate selection for VA-ECMO cannulation. Itsupports the idea that BMI may not be an independent factor associated with outcome prognosis, while other pertinent medical history, smoking history, and dialysis history may be important in selecting patients who will have favorable outcomes after VA-ECMO support.

Summary – Accelerating Translation

Title: Prognostic Factors of Survival in Veno-Arterial ECMO Patients: A Multivariable Logistic Regression Analysis

Problem to Solve
Extracorporeal membranous oxygenation (ECMO) is a method of providing support to a patient in heart failure, who's heart has a weakened ability to circulate blood. This support, however, is invasive, risky, and is associated with a high rate of mortality. Additionally, due to the complexity of ECMO, it requires higher than normal levels of staffing, and training. Due to the resource limitations on the medical system, identifying patients who will benefit from ECMO support, and are most likely to survive is of critical importance. These limitations are at odds with the increasing need for ECMO support. As a result of this conflict, novel strategies must be developed to identify ideal candidates for ECMO support, and elucidate prognostic markers for favorable patient outcomes.

Aim of Study
This study seeks to use demographic and medical history to identify patients who are most likely to survive and benefit most from ECMO support. The importance of creating a model that is based on readily available patient information prior to ECMO initiation rather than variables that present during the duration of the support is central to the aims of this research.

Methodology
All patients who received ECMO support between 2016 and 2020 at a single large center were retrospectively included in this study. A model to isolate the effect of each variable on patient survival was generated, allowing the researchers to identify the impact of each variable individually on the outcome.

Results
There was an increase in odds of survival to hospital discharge in patients who were older. There was a decrease in odds of survival to hospital discharge in patients who had a prior cardiac arrest. Of patients who survived to hospital discharge, their average age was 51.4+/-14.0 compared to those who did not survive, with an average age of 57.3+/-16.5, a statistically significant difference. Patients who survived to hospital discharge were less likely to have smoked. Patients who survived to hospital discharge had lower likelihood of a prior cardiac arrest (13.0% v. 29.2%, respectively; p = 0.0002). No other associations were noted.

Conclusion
This study shows older age, no history of dialysis, and no history of cardiac arrest as protective prognostic factors leading to discharge from the hospital. Differences between central ECMO placed in the chest and peripheral ECMO placed in limbs and neck are surprising. It is possible that that central ECMO offers reduced rates of complications that have been shown to increase mortality, as lack of differential in ventilator support, and duration of ECMO support suggest that this difference in mortality is not secondary to variance in underlying disease severity, but this is in contrast with prior research that showed increased rates of limb ischemia in central VA-ECMO.

This study supports existing predictors of survival in patients receiving ECMO, and importantly notes poorer survival in patients with an age greater than 55, history of smoking, history of dialysis, and history of cardiac arrest. These factors can potentially help guide selection of patients for ECMO in the current resource limited ICU setting.

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Supplementary Material

Further Univariate Testing and Normalcy Testing

Supplementary Table 1. Survival to ECMO Explant: Univariate Analysis

Characteristic	All Patients (n=410)	Survived to ECMO Explant (n = 181)	Died on ECMO support (n = 229)	p-Value
Age at Hospitalization (Mean; Years Old) +/- std dev	55.2 +/- 15.9	53.3 +/- 14.8	56.8 +/- 16.6	**0.0005* #**
Female (%)	31.71%	28.73%	34.06%	0.249
BMI (kg/m^2)	30.9 +/- 7.3	30.7 +/- 6.7	31 +/- 7.7	0.79 #
Atrial Fibrillation (%)	26.10%	24.86%	27.07%	0.612
Hypertension (%)	63.41%	64.64%	62.45%	0.647
Diabetes Mellitus (%)	32.68%	34.25%	31.44%	0.547
COPD (%)	15.12%	12.71%	17.03%	0.225
Smoking (%)	39.76%	43.65%	17.03%	0.152
Dialysis (%)	39.76%	43.65%	36.68%	0.801
Cardiac Arrest (%)	76.59%	87.29%	68.12%	< 0.0001*
Nonischemic Cardiomyopathy (%)	43.92%	51.11%	38.12%	0.032*

Legend: * Indicates statistical significance of p-value. # indicates continuous variables that were determined to be non-normally distributed and thus tested with a Mann-Whitney U test instead of a Welch two-sample two-sided t-test.

Supplementary Table 2. Survival to ICU Discharge: Univariate Analysis.

Characteristic	All Patients (n=410)	Survived to ICU Discharge (n = 152)	Died in ICU (n = 258)	p-Value
Age at Hospitalization (Mean; Years Old) +/- std dev [min, max]	55.2 +/- 15.9	51.6 +/- 14.2	57.4 +/- 16.5	**< 0.0001* #**
Female (%)	31.71%	29.61%	32.95%	0.483
BMI (kg/m^2)	30.9 +/- 7.3	30.7 +/- 6.8	31 +/- 7.5	0.832 #
Atrial Fibrillation (%)	26.10%	25.66%	26.36%	0.876
Hypertension (%)	63.41%	62.50%	63.95%	0.768
Diabetes Mellitus (%)	32.68%	33.55%	32.17%	0.773
COPD (%)	15.12%	11.84%	17.05%	0.155
Smoking (%)	39.76%	48.03%	17.05%	0.009*
Dialysis (%)	39.76%	48.03%	34.88%	0.207
Cardiac Arrest (%)	76.59%	86.84%	70.54%	< 0.0001*
Nonischemic Cardiomyopathy (%)	43.92%	54.67%	37.55%	0.004*

Legend: *Indicates statistical significance of p-value. # indicates continuous variables that were determined to be non-normally distributed and thus tested with a Mann-Whitney U test instead of a Welch two-sample two-sided t-test.

Normalcy Testing for Univariate Continuous Variables:
Age:
Shapiro Wilkes: W = 0.96458, P < 0.0001
BMI:
Shapiro Wilkes: W = 0.94943, P < 0.0001

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Review

A Review of Palliative Care Service Delivery Models and Patient Outcomes for Adults with Cancer in Selected East and Southeast Asian Countries

Chun-Yi Tseng,[1] Natalia Calanzani.[2]

Abstract

Cancer is one of the key leading causes of deaths worldwide, with a disproportionately high burden in Asia in terms of incidence and mortality. Guidelines and recommendations published by the World Health Organization (WHO) state palliative care as an essential service for patients with cancer and other chronic diseases. Currently, there is extensive evidence regarding different models of palliative care delivery. However, development of palliative care services remains fragmented in Asia, and more research is needed to synthesize available models of care in this region and provide the latest evidence-based information for healthcare providers. This narrative review identified 11 peer-reviewed studies published after 2017 that reported both on models of palliative care service delivery and outcomes for adult patients with cancer in selected East and Southeast Asian countries. This review is beneficial by providing a detailed summary of the models of care adopted by these countries, and their impact on patient outcomes. It is hoped that the evidence will also generate momentum for continued conversation around palliative care development in Asia.

Introduction

Palliative care (PC) is defined by the World Health Organization (WHO) as an approach aiming to prevent and relieve suffering for patients and their families who are facing problems associated with life-threatening illness.[1] In 2017, the Lancet Commission on Global Access to Palliative Care and Pain Relief petitioned for a new working definition of PC to increase conceptual clarity and facilitate PC implementation. A consensus definition was then produced by the International Association for Hospice and Palliative Care (IAHPC): 'active holistic care of individuals across all ages with serious health-related suffering due to severe illness and especially of those near the end of life' with the goal to 'improve the quality of life of patients, their families, and their caregivers'.[2] Current guidelines and recommendations such as from the Enhanced Supportive Care (ESC) in the UK,[3] and the European Society for Medical Oncology (ESMO)[4] state that supportive and palliative care services should be initiated at cancer diagnosis until end-of-life or survivorship.

Palliative care has been associated with positive outcomes, such as improved advanced care planning, higher satisfaction with care for both patients and caregivers, and reduced utilization of health services with a resulting decrease in costs.[5] Additionally, early palliative care has been shown to improve symptom management and patient mood.[6] Meta-analyses of studies regarding the effects of early palliative care on patients with incurable diseases found that more evidence is needed to establish the link between early intervention and improved patient quality of life due to the degree of high heterogeneity in pooled studies.[5-6]

Multiple studies have been conducted on types of PC delivery models. These can be summarized based on location of care (embedded, independent free-standing clinic, home-based, telehealth) or referral method (oncologist clinical judgment, based on criteria, automatic referral).[7] Other models of integration such as conceptual (time based, provider based, issue based, system based) or clinical models also exist.[8-9] The attributes of a practical model of PC for a given patient with cancer are likely to be heavily dependent on the healthcare system, accessibility to PC services and availability of trained professionals.[10] Further discussions about models of PC delivery are imperative to facilitate the provision of efficient and effective PC care that matches the unique social and cultural needs of different countries.[11]

Identifying such PC models for cancer patients is also vital as cancer remains a leading cause of death in the population below the age of 70 years in 112 out of 183 countries.[12] The burden of cancer incidence and mortality is disproportionately high in

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Asia.[12] About half of all cancer cases and 58.3% of cancer deaths are estimated to have occurred in the continent in 2020.[12] For example, malignant tumor was the leading cause of death in both urban and rural areas from 2000 to 2017 in China.[13] Unfortunately, the level of PC development in Asia remains largely fragmented, with only six countries/regions (China-including Hong Kong and Macao, Japan, Singapore, South Korea, Taiwan, and Thailand) classified under Category 4, denoting a certain degree of integration to health care services.[14] Box 1 highlights key PC developments in the above six Asian countries/regions. We focused on the specific East and Southeast Asian region/countries due to the availability of information regarding PC services and that they are all classified as having similar degrees of PC integration to healthcare services.

Current research on models of care is mostly carried out in Europe and North American countries.[15] There is limited evidence comparing the effectiveness of different PC service delivery models in Asia.[16] More evidence synthesizing the models of palliative care service delivery is imperative given the high burden of cancer patients in this region. Therefore, this narrative review aimed to synthesize such evidence for selected East and Southeast Asian countries/regions: Mainland China, Hong Kong, Taiwan, Macao, Japan, Singapore, South Korea and Thailand.

Methods

Search Strategy and Selection Criteria

We conducted a systematic literature search on Ovid-Medline and Google Scholar in July 2022. Medical subject headings (MeSH) and keywords used for the Ovid-Medline search are shown in *Supplementary 1.* Search terms conducted in Google Scholar are available in *Supplementary 2*.

We also searched the following palliative care journals: Asia-Pacific Journal of Oncology Nursing (APJON), BMC Palliative Care and BMJ Supportive and Palliative Care (*Supplementary 1* for search terms). In order to provide context about levels of palliative care development in the investigated countries/regions, evidence identified during literature searches was also used to create *Box 1* in the Introduction.

We selected studies published in English between the years 2017-2022 (latest 5 years) to include the most up-to-date evidence following groundbreaking developments in palliative care in Asia. In 2017, The National Health and Family Planning Commission of the People's Republic of China (NHFPC) stipulated guidelines for health providers and standards for the structure, environment, and human resources aspects of hospice care services in China.[17] Furthermore, member countries of Asia Pacific Hospice Palliative Care Network (APHPCN), including Japan, Singapore, South Korea, Taiwan, and Thailand, met in Singapore in July 2017 to discuss shared concerns, and offer support to countries and groups which were interested in developing hospice and palliative care in the region.[21]

We included primary studies (descriptive, quantitative, qualitative and mixed-methods) published in peer-reviewed journals. Reference lists of identified relevant systematic reviews were also checked. Identified studies were first screened by title and abstract, followed by full-text screening by the two authors. Full inclusion and exclusion criteria are shown in *Table 1* below.

A data extraction template (*Table 2*) was developed; data were retrieved on country, author, year, type of study, participants and diagnosis, professionals involved and setting of providing care, comparator, and patient outcomes.

Results

The results yielded by the searches are presented in the PRISMA flow chart (*Figure 1*). The search in Ovid-MEDLINE yielded 127 results. After title and abstract screening and full text screening, six eligible publications were included. The search in Google Scholar yielded 537 results, two were included after screening. Finally, additional searches through lateral searching palliative care journals and reference lists of relevant systematic reviews resulted in additional three eligible publications. A total of 11 publications corresponding to nine studies were included in this narrative review, and their content is summarized in *Table 2.*

Characteristics of Included Studies

The included papers were from China (n=5), Singapore (n=2), South Korea (n=2), and Taiwan (n=2). No eligible papers from Macao, Japan nor Thailand were identified in the searches. The two papers from Singapore were about a single study on the development of a co-rounding model.[32-33] The two papers from South Korea form part of a single study on the development of a home-based community-led PC service delivery model in Busan.[40-41] The majority of the studies adopted a quantitative approach (n=10); one was a qualitative study[41] (interview).

The most frequently investigated patient outcomes were Quality of Life (QoL) (n=4)[31,34,39,40] and severity of symptoms (n=4) [35,36,39,40] (*Table 2*). Inventories used to measure QoL, and severity of symptoms varied across different countries and studies.

A multidisciplinary team provided care in all included studies (as specified by our inclusion criteria), although the type of healthcare professionals involved differed (*Table 2*). Most studies included a specialist PC physician as well as another physician providing oncology or primary care (n=5).[31-34,37] With regards to the setting of PC service delivery, most papers evaluated inpatient hospital-based PC Models (n=5).[31-34,39] Other papers evaluated home-based community led PC Models (n=3)[36,40-41] an outpatient PC Model (n=1)[35], and a home-based PC Model that is not community led (n=1).[38] One study mentioned a "hybrid" service across different care settings as part of a standardized national model.[37] The identified PC service delivery models are further described below.

Inpatient Hospital-based PC Models

These models refer to PC services delivered within a hospital setting for hospitalized patients. We identified five papers

evaluating models in hospitals across China, Singapore, and Taiwan.[31-34,39] Even within hospitals, the setting and the way in which PC services were delivered varied greatly. In Taiwan, inpatient PC services can be provided within specialized palliative care units (PCU) or in general wards in the format of palliative consultation services (PCS).[34] Care by the multidisciplinary team is provided directly to patients in PCU, while patients in PCS often receive visits by the multidisciplinary team once or twice per week.[34] The PCS model offered in Taiwan is similar to the "consultative service with oncologist-driven referral" model currently offered in Singapore.[33] A new form of service provided for inpatients in Singapore is the "co-rounding model" which offers the same content but differs with regards to the degree of integration between oncologist and the PC team.[32] The "co-rounding model" involves joint morning rounds, and produces a coordinated decision with inputs from both oncology and palliative team, which is in contrast to the "consultative model" in which communication occurs in the form of written referrals with no direct communication between the oncology and palliative team. The model evaluated in China is situated within a "Palliative Care and Oncology Department" which is described as involving two relatively independent units in which oncologists manage patients and refer patients to PC supportive care in a specialized palliative ward when the patient has a predicted remaining lifespan of 6-12 months.[31]

Table 1. Inclusion and Exclusion Criteria.

Criteria	Inclusion	Exclusion
Population	Adults: defined as individuals above 18 years old AND Patients described as having cancer or advanced/metastatic cancer AND Receiving PC in Mainland China, Hong Kong, Taiwan, Macao, Japan, Singapore, South Korea or Thailand.	Non-adult population described as children, adolescents or below the age of 18 OR Patients with end- stage or debilitating non-malignant chronic diseases such as COPD, heart failure, emphysema, dementia, among others. OR Receiving PC in other countries
Intervention	Intervention describing a service delivery model that is focused on or provides information on location of delivery (embedded, independent freestanding clinic, home-based, telehealth, community based etc.). AND Service delivery model that comprises a multidisciplinary team with more than one healthcare professional delivering the PC service. National models carried out in a consistent and standardized manner across different settings met criteria if standardization was clearly stated by the authors.	Intervention describing a service delivery model that is not focused or without information on the location of delivery. OR Service delivery model that does not comprise a multidisciplinary team or comprises a single healthcare professional. OR Models focusing on post death intervention/bereavement studies. OR Large national database studies without description of service models, i.e. there was no explicit mention that PC service provided was consistent or standardized or similar across settings.
Outcome	Outcomes focused on patients including Quality of Life (QoL), Quality-adjusted life year (QALY), length of hospitalization, hospital admission, readmission, severity of symptoms, reasons for emergency department visits, degree of pain, and use of aggressive treatments.	Outcomes focused on caregivers, family members, or services provided as part of palliative care (such as uptake of do not resuscitate (DNR) orders, recording of advanced-care planning, rehabilitation, inclusion of additional healthcare professionals, etc.), health economic evaluations that did not include quality of life or preference of place of death[2]

Legend: Recent discussions elaborate on how preference of place of death on its own should not be considered a good indicator of end-of-life quality measure.46 Therefore, we opted for not including this outcome in this review

In terms of the type of healthcare professionals involved in the delivery of PC services, the study in Taiwan involves "hospice palliative care (HPC) specialists, HPC nurses, social workers and a chaplain".[34] The integrated team in the co-rounding model from Singapore includes doctors and nurses specializing in palliative care.[32-33] The study conducted in China involves a multidisciplinary team involving "surgeon, radiotherapist, interventional radiologist, interventional sonographer, pain physicians, psychologists, nutritionist, and nurse specialists".[39]

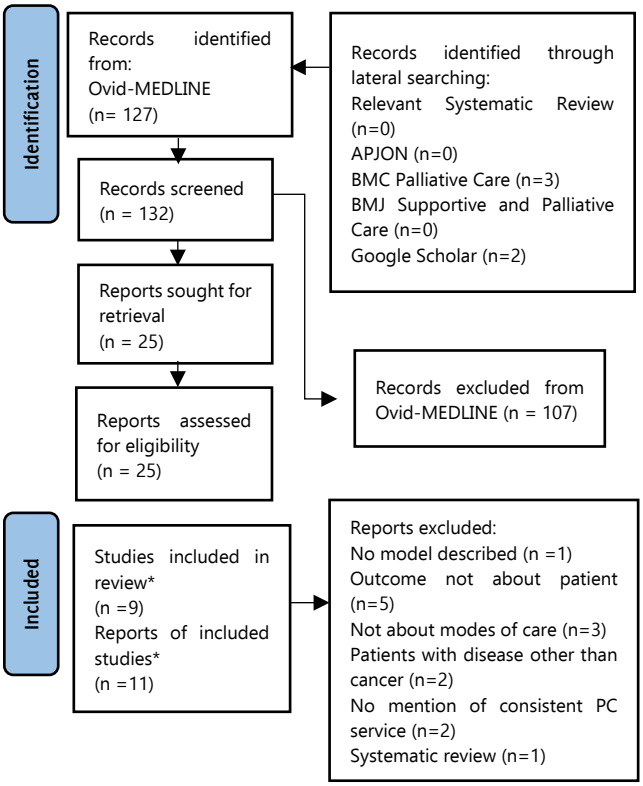
The study in Taiwan comparing PCU and PCS found no statistically significant differences in quality of life (QoL) between

those who received PCU and those who received PCS care.[34] However, there was a statistically significant improvement of QoL in both groups of patients who received either PCU or PCS compared with pre-care levels($p<0.001$).[34] The two papers from Singapore evaluated length of hospital stay and difference in proportion of patients readmitted within 7 and 30 days of discharge.[32-33] The length of hospital stay was found to be 0.85 days shorter for patients with advanced cancer if they received the co-rounding model(95% CI 0.05 to 1.65 days, $p=0.038$). There was no significant difference between the proportion of patients readmitted between patients receiving the consult model and those receiving care via the co-rounding model (OR 1.03, 95% CI 0.79-1.35, $p=0.822$). One paper from China focused on QoL and pain control[39] and the other focused on QoL[31]. An inpatient hospital-based PC model involving a multidisciplinary team reported a statistically significant improvement in QoL ($p<0.001$) but not in pain[39] compared to before intervention. The second paper involving a team situated within "Palliative Care and Oncology Department" found a statistically significant improvement in QoL compared to anti-cancer treatment ($p<0.05$).[31]

Outpatient PC Models

These models referred to provision of PC services for non-hospitalized patients in a healthcare setting such as in clinics or hospitals. One paper from Hong Kong was included.[35]

Figure 1. PRISMA flow chart of search strategy.[1]



Legend: No duplicates were identified in Ovid-MEDLINE *A total of 9 studies were included in this review; and the study by Yang et al. includes two separate reports.[32,33] Similarly two separate reports by Choi et al.[40] and Kim et al.[41] constitute one single study.

The model described involves the establishment of an outpatient clinic Hematology Comprehensive Care Clinic (Hema-CCC) for patients (n=38) with hematological malignancies such as myelodysplastic syndrome (66%), acute myeloid leukemia (26%), and others (8%)

Patients were referred to Hema-CCC when there was refractory symptom control or symptoms were associated with poor prognostic factors. The provision of PC services in this model occurs over a few standardized steps. First, patients with hematological cancer are prioritized remotely over the phone to evaluate severity of symptoms, psychological or social needs and availability of support at home. The initial visit to the clinic is expected to take an hour, and the patient can receive inputs from an oncologist regarding curative treatments followed by consultations with the PC team in the same setting. Depending on the needs of the patient, subsequent visits can be arranged, and regular communication is maintained with the PC nurses in between visits. There was statistically significant improvement in pain ($p=0.017$), depression ($p=0.023$), anxiety ($p=0.003$), and appetite ($p=0.007$) compared to baseline values.[35]

Home-based PC Models

We identified two variations of service delivery models providing home-based PC. The first type refers to PC services for non-hospitalized patients in a home setting which involve healthcare professionals visiting patients. One paper from Taiwan was included.[38] Two models were described, and both included a team including family doctors, nurse practitioners specializing in home care, social workers and chaplains aimed at reducing dyspnea in cancer patients. The paper included patients (n=762) with cancer (in situ lung cancer (22%), metastatic lung cancer (24%), other cancer (54%)) in emergency department who received home palliative care during the final 6 months of life. The nurse practitioner provided house visits once or twice per week while the doctor visited once per month along with the nurse. Both models provided the same service and differed by the service time and training of the home care nurse. One model involved the provision of care from Monday to Friday and the other model was in the form of enhanced care including services provided during weekends and implemented with a set of protocols outlined for nurses to be completed during visits. The model with enhanced care was found to be effective in reducing the number of emergency department visits due to dyspnea by 30.7% ($p\leq0.05$). Effective home palliative care significantly reduced emergency department visits related to controllable dyspnea.

The second variation of service delivery model aimed at providing community led home-based PC services to patients requiring care at home. These patients were referred to a team of professionals from decentralized setting such as the community hospital, public health centers or community health sectors. We identified three papers evaluating models in community hospitals across South Korea and Hong Kong.[36,40-41] Two papers from South Korea form

part of a single study on the development of a community led home-based PC service delivery model in Busan.[40-41] The community care model in Hong Kong was provided for patients in a home setting and involved an experienced nurse and social worker.[36] The model proposed in Busan, South Korea involves care for home-based cancer patients requiring PC services and a multidisciplinary service team including a physician, palliative nurse, officer in charge of family health, officer in charge of home-based cancer patients, officer managing home visit nurses, social worker, chaplain, and volunteer, all based in or affiliated with public health centers in Busan.[41] Both models aimed to provide care in the comforts of home and reduce hospitalizations.

Table 2. Evidence of Palliative Care Service Delivery Models and Outcomes in Selected East and Southeast Asian Countries.

Country or Region/Author (Year)	Type of Study	Participants and Diagnosis	Clinicians involved and setting of palliative care	Comparisons	Results
China/ Wu et el. (2021)[31]	Quantitative Retrospective	Patients (n=248) hospitalized and diagnosed with advanced cancer (Stage IV with estimated lifespan between one to 12 months) such as breast, prostate, lung, colorectal and other malignancies.	*Inpatient hospital based Interdisciplinary PC team*: PC doctor and specialist nurse work with the oncologist to provide consultative and assessment according to patient's situation. PC doctors make supportive intervention plans, including analgesic treatment, symptom management, palliative sedation, spiritual support, and acupuncture. Specialist nurses provide patients with lymphedema massage, psychosocial and spiritual support, comfort care, health education and other supportive care services.	Patients receiving conventional anticancer treatment (CAT) such as chemotherapy, immunotherapy, targeted and radiation therapy.	QoL assessed using Chinese Quality of Life Questionnaire (CQLQ) scale: PC patients reported significant increases in QoL ($p<0.05$). PC had significant improvements in all sub items, while CAT had improvements only in items of Pain ($p<0.05$) and side effects ($p<0.05$). No significant difference in QoL between the two groups. Quality-adjusted life year (QALY): For patients in PC, the QALY (days) increased by 55.9 days, and for patients in CAT, the QALY increased by 24.0 days.
Singapore/ Yang et al. (2021)[32]	Quantitative Open-label, cluster-randomized trial with stepped-wedge design	Patients (n=3167) admitted to the oncology inpatient service of acute hospitals with Cancer stage I, II, III and IV. Cancer type: Lung and pleura, Lip, oral, pharynx, Male genital organs, Urinary tract, Colorectal, Hepatobiliary, Upper GI, Pancreas, Others	*Inpatient hospital-based Consult model*: Consultation services with oncologist driven referrals. Oncologist provides general palliative care to address common problems and initiates a referral to specialist palliative care doctor and nurses for patients with complex symptoms not adequately managed by general palliative care. *Co-rounding model*: Specialist care doctors and nurses manage patient's issues collaboratively with oncology healthcare professionals. Includes weekly combined ward round and daily discussion of all patients by integrated oncology-specialist palliative care team before joint decision reached whether specialist palliative care was required.	Consult model	Co-rounding model: shorter hospital length of stay of 0.70 days than consult model but not statistically significant (95% CI -0.04 to 1.45 days, p=0.065). In patients with stage III to IV cancer sub-group, length of stay was 0.85 days shorter than the consult model (95% CI 0.05 to 1.65 days, p=0.038). No statistically significant difference in the proportion of patients who were readmitted within 30 days of discharge in patients with Stage III to IV cancer and among all admissions of cancer (OR 1.03, 95% CI 0.79-1.35, p=0.822).

Table 2. (Continued).

Singapore/ Yang et al. (2017)[33]	Quantitative Pre-post intervention Study	Patients received consult model (n=352): Lung and pleura (55.97%), Genitourinary (19.32%), Head and Neck (17.05%), Others (7.67%). Patients received co-rounding model (n=243): Lung and pleura (51.03%), Genitourinary (20.16%), Head and Neck (18.52%), Others (10.29%).	*Inpatient hospital-based Co-rounding model* where oncology and palliative teams engage in morning rounds together and make a joint decision of which patients require direct palliative input. Palliative team includes a 0.5 full time specialist palliative care physician and one full time advanced practice nurse (APN).	Consult model	Length of hospital stay: Duration of hospital stay was significantly shorter for the co-rounding group (median 3 days, interquartile range 2-7 days) compared to the consultative group (median 4 days, interquartile range 2-7 days)(p=0.025). Proportion of patients readmitted within 7 and 30 days of hospital discharge: No significant difference in proportion of patients readmitted within 7 and 30 days of hospital discharge (consultative model 29.78%, co-rounding model 28.90%, p= 0.773). Differences in place of death: No significant difference in place of death between patients who received co-rounding model and those who received consultative model (p=0.601).
Taiwan/ Chang et al. (2021) [34]	Quantitative Prospective Longitudinal Study	Patients (n=105) Terminal Cancer with life expectancy less than 6 months, >20 years old	Inpatient hospice *palliative care unit (PCU)* and Inpatient hospice *palliative consultation services (PCS*) include a multidisciplinary team: Hospice Palliative Care specialist, nurses, pharmacists, social workers, psychologists, chaplain. PCU is received in a special hospice palliative care unit while PCS is received in the general ward. PCU team directly provides care and assess patients' and their families' conditions directly. PCS team visits patients once or twice per week.	NA	Comprehensive Quality of Life Outcome (CoQoLo) which measures good death: No differences in the levels of CoQoLo between the PCU and PCS groups. CoQoLo levels of terminally ill cancer patients significantly improved in both PCU group and PCS group over time following care (p<0.001).
Hong Kong/ Chan et al. (2021) [35]	Quantitative Retrospective study	Patients (n=38) with advanced hematological cancer referred to Hematology Comprehensive Care Clinic (H-CCC). Myelodysplastic syndrome (66%),	*Palliative Outpatient Service*: team consists of a palliative care physician, hematologist, nurse, and clinical psychologist. Patients can be referred to a clinical psychologist, social worker, physiotherapist, and pain clinic. Hema-CCC provides on-site palliative care consultation and can allow patients to have earlier advance care planning (ACP)	NA	Edmonton Symptom Assessment Scale (ESAS) uses an 11-point Numerical Rating Scale and assesses • Pain • Fatigue • Depressed mood • Anxiety • Somnolence • Anorexia • Decreased sense of well-being

Table 2. (Continued).

		Acute myeloid leukemia (26%), Others (8%)	discussions while the hematologist is mainly responsible for the disease treatment in the clinic sessions. Subsequent clinic visit appointments are based on the patient's needs, wishes and prognosis.		• Insomnia After 4th follow-up, the mean symptoms scores for pain (p=0.017), depression (p=0.023), anxiety (p=0.003), and appetite (p=0.007) were significantly improved.
Hong Kong/ Chan et al. (2021) [36]	Quantitative Prospective cohort Study	Patients (n=48) with predominance of cancer diagnosis. Cancer (95.8%) and chronic renal failure (4.2%) Cancer include lung (n=9), colorectal (n=5), liver (n=5) and breast (n=4)	*Community interdisciplinary palliative care program.* Team consists of registered nurses and social workers who are experienced in case management, medical and community care. Team liaises with hospital healthcare team if urgent medical follow up or medical investigation was needed. Services provided include medication review, various non-pharmacological strategies for symptom management and health maintenance such as aromatherapy, massage, oral supplements, home-based occupational therapy, and dietician consultation	NA	Integrated Palliative Care Outcome Scale (IPOS) used for assessing symptoms monthly via home visits or phone contacts in three domains: physical, emotional, and communication/practical issues. Rating on a five-point Likert scale was also done for 13 physical symptoms, 4 emotional symptoms and 3 items about communication or practical problems. There was a decrease in subscale in the three domains, but only emotional and communication/ practical issues domain saw significant improvement at one month follow up (p<0.001) and both one (p<0.001) and two months follow up (p=0.005) respectively.
Hong Kong/ Lam et al. (2021)[37]	Quantitative Retrospective Cohort Study	Patients (n=2800) who died from cancer in all local hospitals managed by Hospital Authority (HA) of Hong Kong from 4 years (2006, 2009, 2012, 2015). Lung (32.2%), Colorectal (17%), Liver (13%), Pancreas (4%), Stomach (5.7%), Breast (5%), Prostate (2.6%), Lymphoma (0.1%), Leukemia (0.05%),	*Oncology and palliative service integrated model (National Model)* across palliative wards, hospice, outpatient ambulatory palliative care clinic or palliative care home team. Multidisciplinary team led by consultant oncologists with dual specialist qualifications of oncology and palliative medicine. Palliative care teams also under the same administration department of oncology team, enabling smooth transition of patients from active oncological treatment clinics to palliative care services. The combined oncology service with integrative palliative service is characterized by close cooperation between oncologists and palliative care physicians.	Patients who did not receive any form of specialist palliative care	End-of-life care outcomes indicated by: • Performance of CPR • Strong opioids use • ICU admission within 30 days of death • Chemotherapy within 30 days of death • Systemic anticancer treatment within 30 days of death Significant results were obtained for the following: less CPR done (p≤0.001), more likely to be prescribed strong opioids to control pain (p≤0.001), less likely to be admitted to ICU within 30 days of death (p≤0.001)and less likely to receive chemotherapy or systemic cancer treatment within 30 days of death (p≤0.001).

Table 2. (Continued).

		Nasopharyngeal (2.3%), Head and Neck (1.5%), Esophagus (3.1%), Others (13.3%)			Overall survival: Median overall survival was significantly better for patients who received palliative service (5.10 months, 95% CI 4.52-5.68 months) compared to those without (1.96 months, 95% CI 1.66-2.27 months) (p≤0.001).
Taiwan/ Hsu et al. (2021) [38]	Quantitative Retrospective Cohort Study	Patients (n=762) with cancer in emergency department who received home palliative care during the final 6 months of life. In situ lung cancer (22%), metastatic lung cancer (24%), other cancer (54%)	*Home palliative care team:* family physicians, home care nurses, social workers, chaplains. 24-hour call line available for phone consultations. Depending on clinical requirements and clinical conditions, home care nurse visits once or twice a week and the family physician will visit with a nurse once a month. Nurses provide consciousness assessment, vital sign check, pain assessment, adjustment of drug, respiratory tract symptom assessment, gastrointestinal symptom assessment, urinary tract symptom assessment, nutritional status and assess IV fluid supplement, catheter renewal, wound or ostomy nursing and blood test. Group A: Basic home palliative care occurred for 5 days a week Group B: Enhanced home palliative care extended service time to 7 days a week with trained nurses in standard operating procedures for dyspnea care.	NA	Reasons for emergency department visits: percentage of ED visits for dyspnea was significantly reduced by 30.7% in Group B (p<0.05) compared to patients receiving basic home palliative care services in Group A. Effective home palliative care significantly reduced ED visits related to controllable dyspnea.
China/ Yang et al. (2020) [39]	Quantitative Prospective study	Patients (n=438) aged 18 years or above scheduled for cancer pain management. Liver (31.5%), Lung (30.4%), Gastric (8.7%), Colorectal cancer (7.6%), Pancreatic cancer (6.5%), Others (15.2%),	Inpatient hospital based multidisciplinary palliative care interventions from inter-professional team including surgeon, radiotherapist, interventional radiologist, interventional sonographer, pain physicians, psychologists, nutritionist, and nurse specialists. Oncology management was done by physician, surgeon, radiotherapist, interventional radiologist, and interventional sonographer.	NA	Brief Pain Inventory (BPI) used to calculate pain response and changes in pain intensity score. MD Anderson Symptom Inventory (MDASI) a validated 19 item questionnaire to rate symptoms and functional interference on an 11-point scale was used: Both pain (p=0.017) and symptom severity (p=0.03) were improved, as demonstrated by lowered BPI worst and average pain scores, as well as symptom

Table 2. (Continued).

		Metastasis (53.3%)	The pain physician mainly focused on pain assessment, analgesic prescription, evaluation of responses, and drug adjustment. Nutrition assessment was performed by nutritionists according to the nutritional risk screening tool 2002 (NRS-2002). Nutrition support was offered for patients with an NRS Score ≥3. Treatment plans were proposed and discussed by the specialists, and the definitive treatment plans were then decided and performed by a multidisciplinary team.		severity score (p=0.011). The pain and symptom interference scores were also found to be lower after treatment with the multidisciplinary team, however, the data did not reach statistical significance. European Organization for Research and Treatment of Cancer Quality of Life Core 30 (EORTC QOL-C30) used to measure QoL: Function and symptom scores in the individual scales were significantly improved after interventions by multidisciplinary team (p<.001), although there was no obvious improvement in the global QoL scores of the cancer patients during study (p=0.749).
South Korea/ Choi et al. (2018)[40]	Quantitative Longitudinal and cross-sectional	Patients (n=65) who received continual service for at least 6 months and were newly registered between January and March 2015 to analyze symptom change. Patients (n=50) who continuously received palliative care services for a minimum of 3 months who were registered at 2 PHCs and n=50 patients with terminal cancer without receiving palliative care services. Digestive cancer (44.6%), Lung (16.9%), genitourinary (15.4%), breast (9.2%)	*Community interdisciplinary palliative care project.* Service provision teams comprised a public health center (PHC) manager, physician, palliative nurse, social worker, chaplain, and volunteers. Service provision team members carried out palliative care services concurrently with other health affairs at the PHCs. Team meetings were conducted on a quarterly basis, and palliative nurses reported on the patient status and discussed various important issues. The service teams used community networks to maximize resources and manpower. Palliative nurses and social workers were responsible for case management. Palliative nurses visited patients based on the initial assessment forms and symptom scores. After assessing patients' symptoms and needs, nurses provided palliative care, including pain and symptom management, comfort care, psychological support, counseling, and education.	Patients in non-palliative care group	QoL measured using the Korean version of the Good Death Index, short form: BCPCP patients had higher QoL compared with a control group (p=0.039): "trusting medical staff" (p=0.09) and "receiving help in all areas where I need it" (p=0.003) were noted areas. Patients' symptoms were measured using the Edmonton Symptom Assessment Scale which measures pain, nausea, loos of appetite, constipation, shortness of breath, fatigue, sleep disorder, anxiety and depression. Pain, appetite, anxiety, and depression were significantly improved at 3 and 6 months compared with the baseline (p≤0.05). There were no statistically significant results for the other outcomes.

Table 2. (Continued).

			Social workers provided community socioeconomic support, resource development, and bereavement services.		
South Korea/ Kim et al. (2017)[41]	Qualitative description	NA	Community interdisciplinary palliative care project. Teams consist of public health center manager, physician, palliative nurse, social worker, chaplain, and volunteers. Public health center managers oversee administration. Physicians provided medical services, while officers responsible for family health performed administrative tasks. Staff working on the project for home-based cancer patients planned and executed the budget, handled the business aspects of palliative care provision in public health centers, and managed volunteers. Manager of the healthcare home-visit team and home-visiting nurses identified and referred home-based cancer patients requiring palliative care to the palliative care team, and a chaplain provided spiritual support. Palliative nurses and social workers were in charge of case management.	NA, see Choi et al. (2018) for outcomes	NA, see Choi et al. (2018) for outcomes.

The study conducted in Hong Kong was interested in the severity of symptoms experienced by patients evaluated using the Integrated Palliative Care Outcome Scale (IPCOS), which evaluates physical symptoms, emotional symptoms, and communication or practical issues. There was a statistically significant improvement in emotional symptoms, which includes patient anxiety and depression, one month after receiving the community care model ($p<0.001$).[36] There was also a statistically significant improvement in communication or practical issues, which includes sharing feelings, information, and practical matters, one month ($p<0.001$) and two months ($p=0.005$) after receiving the community care model.[36] The community model adopted in Busan looked at patient symptom changes using Edmonton Symptom Assessment Scale (ESAS) and QoL evaluated using the short form version of the Good Death Index. There was statistically significant improvement between palliative care and non-palliative group for the items "trusting medical staff"($p=0.009$), "having left behind what I wanted to leave with my loved ones"($p<0.001$), "having been told in detail what will happen in the future" ($p<0.001$) and "being able to share my difficulties related to the illness with others" ($p<0.001$), which are part of the QoL evaluation.[40] With regards to symptom control, there was a significant reduction in pain, anxiety, and depression, and improvement in appetite both three- and six-months post-intervention compared to pre-intervention levels ($p\leq0.05$).[40]

Hybrid Standardized Model

One paper described a model that provided PC services irrespective of the setting of care. It referred to the establishment of a standardized model across all medical and healthcare institutions and at home. This paper from Hong Kong adopted a retrospective study design to evaluate the integrated territory-wide PC model.[37] Despite a difference in settings, the service was described to be consistent across these, with a multidisciplinary team led by a dual qualified specialist oncologist. The model demonstrated an improvement in medium survival outcomes. In addition, statistically significant results were reported for all aspects of end-of-life care outcomes including a decrease in CPR

performance (p≤0.001), increase in use of strong opioids(p≤0.001), decrease ICU admission within 30 days of death (p≤0.001), decreased chemotherapy within 30 days of death(p≤0.001), and decreased systemic anticancer treatment within 30 days of death (p≤0.001).[37]

Summary

The inpatient hospital-based PC models were evaluated from reports in China, Singapore, and Taiwan with slight variations in how they are delivered. The multidisciplinary services offered by a inpatient hospital based model provides improvements in QoL. Home-based PC models can be found in Taiwan, Hong Kong, and South Korea. This model was developed to provide care in the comforts of home and reduce hospitalizations. One paper regarding outpatient model of care was included from Hong Kong, which showed statistically significant in physical symptoms such as pain, depression, anxiety, and appetite. Lastly, the hybridized model delivers PC services irrespective of the setting of care. An improvement in end-of-life outcomes was seen from the one paper included in this review.

Discussion

This review of palliative care service delivery models in selected countries/regions in East and Southeast Asia identified four different models in four countries/regions. A range of outcomes were reported for patients, with mixed results.

PC delivery models

Results indicate an increased recognition of the importance of cooperation and multidisciplinary intervention for PC service delivery in the countries presented. We find this trend reassuring: PC should focus on all aspects of the patient's well-being such as psychological, social, and spiritual health in addition to physical health.[4] There seems to be a movement towards integrating oncology and PC services in Singapore where patients can receive PC care in early stages of cancer (Stage I and II)[32], though most patients receiving PC services had advanced cancer (Stage III and IV). This movement towards early PC provision is encouraging. The recognition of early PC is corroborated by a set of policy briefs prepared by the Lien Centre for Palliative Care (LCPC) that highlighted the use of high-cost and invasive treatments near the end-of-life in patients with advanced cancer in Singapore.[42] Out of the recommendations provided, two focused on improving awareness of PC among the community and to incentivize physician referrals to PC services, so essential care can be provided as early as possible.[42]

Inpatient Model

We believe the model described by Yang et al[39] in China regarding inpatient hospital-based PC care is similar to the PCS model in Taiwan outlined by Chang et al[34] and consultative model in Singapore by Yang and colleagues.[32] All three models involved referring patients in oncology wards to specialist care provided by a separate PC team, hence there is no integration of services (i.e. the PC team works in conjunction with oncology team in evaluating and providing care together for patients).

Outpatient Model

The outpatient model in Hong Kong for patients with non-solid tumors described by Chan et al[35] is a study we found of particular importance as patients with hematological malignancies or those receiving hematopoietic stem cell transplant have been described as "special populations" who benefited less from models integrating specialist PC services and oncology care due to a focus on solid tumors.[8] Although there is limited evidence on incidence and survival rates of patients of blood related malignancies in Asia-Pacific, the incidence of lymphoma is shown to be increasing in the region.[43] Similar to services delivered for hospitalized patients, the outpatient model described in this study also involves a multidisciplinary team including doctors, nurses, social workers, and psychologists. An outpatient model seems to improve accessibility to services and demonstrate positive outcomes for patients with hematological cancer in Hong Kong. With misconceptions involving hematological cancer common in the Asia-Pacific region, this model is of a high value to engage healthcare professionals in Asia for more in-depth studies.

Hybrid Model

For the Lam et al paper (included under the hybrid standardized model)[37], we were aware that the provision of services across multiple settings might have concealed variations in the care provided, potentially confounding results. However, this paper was valuable in attempting to evaluate the effectiveness of a model that is rolled out nationally and can provide beneficial insights for smaller Asian countries that are planning to adopt similar models of care.

Home-based Model

We anticipate that more studies on community care models or home care models that move away from a centralized, hospital-based PC delivery will emerge in the future. This fits in with WHO's framework on "integrated, people-centered health service" adopted by the 79th World Health Assembly in 2016, where PC is integrated in primary health care (PHC) systems and services are made accessible in communities and in the comfort of the patient's home.[19] We believe that more studies evaluating home-based PC services, outpatient PC care and community-based service delivery models will emerge in the future.

Patient Outcomes

There was a statistically significant improvement in QoL in all the studies included in this review that assessed this outcome, be it in an inpatient hospital-based PC model[31,34,39] or through a home-based community led model.[40] This is reassuring as it seems to demonstrate that palliative care is effective in improving the quality of life in patients with cancer despite the model of care or country in which the services are provided, or the measures used to assess quality of life.

For symptoms, pain was the most frequently investigated outcome in the included studies. However, the effect of different PC service delivery models on pain were inconsistent. A statistically significant decrease in pain was reported in one study from Hong Kong[35] by Chan et al. (outpatient PC model) and

another from South Korea[40] by Choi et al. (home-based community led model) after receiving care. However, there were mixed responses for the control of pain in different groups of patients in the study evaluating pain management by a multidisciplinary inpatient hospital-based care in China[39] highlighted by Yang et al., and outlined in a study by Chan et al. in Hong Kong[36]. Hence, we are unable to make a conclusion about which models of PC service delivery are best suited to reduce pain or whether PC is effective in the reduction of pain.

Box 1. Key Palliative Care Development in Selected East and Southeast Asian Countries/ Region.

Mainland China: PC development remains crucial, with an expected 87% increase by the year 2060 in serious health-related suffering at the end of life.[53]The majority of hospice and PC services are provided in secondary and tertiary hospitals, and a top priority in the future is to expand services beyond formal hospice or hospital settings by establishing community-based hospice and PC services across different settings and facilities so that preferences for dying at home can be respected.[17]

Hong Kong: Integrated territory-wide palliative care services were available since 2006.[37] Health service delivery is associated with a high degree of hospital resource utilization in Hong Kong, with 90% of deaths occurring in hospitals[18], necessitating an improvement in community care in aspects such as day care, home care and residential care.

Singapore: The country recognized palliative medicine as a medical subspeciality in 2006.[20] As Singapore slowly integrates PC services into the community, the first community hospital Bright Vision Hospital, commenced in 2003. The Singapore Ministry of Health (MOH) commissioned the drafting of a national strategy for palliative care delivery models based on best clinical evidence, and the National Strategy for Palliative Care was formulated in 2014 (Singapore).[21] There is a study investigating the needs of cancer patients receiving PC and caregivers in Singapore, and models of care specifically addressing these needs in the unique Singaporean cultural context are likely to be tested in the future.[22]

Japan: PC specialty was established in 2009 in this country.[20] Currently, hospice/ palliative care units (PCU) and hospital palliative care consultation teams are available.[23] There is currently a lack of home-based services[20] and there is a need to increase the number of community palliative care teams, which remains a challenge. [24] More establishment of home-based models is imperative as up to 44% of participants in a population based nationwide survey revealed home as their preferred place for end-of-life care.[25]

South Korea: Hospice and PC services are mainly available in hospital settings, in the form of specialized PCUs. [26] PCUs remain the most common setting where PC services are delivered for terminal cancer patients. Currently, challenges for PC development in South Korea include raising awareness of end-of-life care and improving accessibility. A study analyzing death registration databases revealed that hospitals remained the most common place of death in South Korea and unnecessary hospitalization nearing end-of-life needs to be avoided through more comprehensive non-hospital-based PC centers. [27]

Taiwan: PC was recognized as a specialty in Taiwan in 2000.[20] PC services in Taiwan include inpatient PCUs, hospital based palliative care teams and hospice home care programs.[28] Despite the expansion of various forms of PC services, one challenge that Taiwan faces is the lack of infrastructure for home care as well as high rates of readmission to hospitals after discharge.[28] Greater collaboration between hospitals as well as community health service providers is expected as there is currently a lack of day palliative care centers in Taiwan.[20] There is also a lack of long-term facilities, and hospital based palliative care services are the predominant model.

Thailand: Current study suggests there is a need for services provided to be more structured.[30] Generally, there is good accessibility to PC services as majority of hospital settings in provide interdisciplinary palliative care consultation services. Home based PC services are also available for discharged patients across all levels of healthcare services.[20] However, there seems to be a lack of inpatient hospital-based PC services in the form of specialized PC units and hospices[20], with a single tertiary level hospital and religious organization providing a "private space" dedicated for PC services.[30]

Since dyspnea is a common symptom[44] seen in cancer patients, we believe the paper by Hsu et al. evaluating a home-based non community led model focused on alleviating dyspnea[38] is important to provide useful evidence for the development of models of care that address this symptom – even though it was only one study, with significant results for patients.

We also found studies that provided valuable information on PC models but did not provide any information on patient outcomes or meet our inclusion criteria. The information can be found in the *Supplementary 3*.

Strengths and limitations

This narrative review provides some of the most up-to-date evidence published in English in peer-reviewed journals on models of care in selected Asian countries. This paper also systematically lists these models in detail, based on setting of provision as well as team members involved in each service, with a brief overview of how each service is run and the outcomes measured. By doing so, we aimed to enhance reproducibility across settings. To our knowledge, this is the first review to do so for the selected countries/regions in Asia. We hope this paper continues the much-needed conversation on the importance of developing palliative care service delivery models that fit with the unique health settings and patient needs in each country. The Scale for the Assessment of Narrative Review Articles (SANRA) tool was utilized to ensure rigor and quality of this narrative review.

This review also has some limitations. First, we only included two databases in this study as this paper was written as part of an intensive one-month research program at Pembroke College,

University of Cambridge, with limited time availability and logistic constraints. For a more comprehensive search on the models of PC service delivery, we could have included more databases. However, we performed searches in palliative care journals and APJON, a major journal focused on oncology issues in Asia to identify further evidence. We also checked reference lists of two relevant reviews.[47,48]

Second, due to time and resource limitations we restricted the searches to papers written in English. This might have resulted in missing papers published in other languages and may help to explain why we did not identify any evidence from Macao. However, PC development in Macao is still in its nascent stage, with limited advancements since 2000 when the first hospice was established.[45] Future reviews should aim to include evidence published in other languages if feasible. Searches performed identified papers published in Thailand and Japan, but these were not included because they did not meet the inclusion criteria. Nonetheless, ***Box 1*** summarizes some key evidence regarding PC delivery in these two countries.

Conclusion

This narrative review describes the significance of cancer in Asia and the role of PC in ensuring the psychological, spiritual, and physical well-being of patients. It then outlines different models of care adopted in the selected Asian countries/regions. Models of care showing statistically significant improvement in QoL include inpatient hospital-based PC model and a home-based community led model. The effect of different models of PC service delivery model on pain is inconclusive due to mixed results. As PC development in Asia varies greatly, a focus on the selected countries allowed us to go in-depth by considering the unique challenges facing each country as seen in ***Box 1.*** We documented the models of service delivery comprehensively and focused on the setting as well as team members involved. By doing so, we hope that this much needed information is more readily available, and reproducibility/adaptability of models can be considered in the future. We anticipate that more studies on community care models or home care models, moving away from a centralized, hospital-based PC delivery, will emerge in the future. We are optimistic about developments of PC in the region and hope services can be expanded in the form of different models of care in view of increasing demand and the improvements in QoL for patients.

Summary – Accelerating Translation

Title: A Review of Palliative Care Service Delivery Models and Patient Outcomes for Adults with Cancer in Selected East and Southeast Asian Countries

Main problem to solve: There is limited evidence comparing the effectiveness of different palliative care (PC) service delivery models in Asia. More evidence synthesizing the models of PC service delivery is imperative given the high burden of cancer patients in this region.

Aim of study: This narrative review aimed to synthesize evidence for selected East and Southeast Asian countries/regions: Mainland China, Hong Kong, Taiwan, Macao, Japan, Singapore, South Korea, and Thailand. By doing so, we hope the study can contribute to conversations about PC models in this region and help to encourage new research on the development and adaptations of models relevant to Asian contexts.

Methodology: We conducted a systematic literature search on Ovid-Medline and Google Scholar in July 2022. The following palliative care journals: Asia-Pacific Journal of Oncology Nursing (APJON), BMC Palliative Care and BMJ Supportive and Palliative Care were also searched. We selected studies published in English between the years 2017-2022 (latest 5 years) to include the most up-to-date evidence following groundbreaking developments in palliative care in Asia.

Results: This review of PC service delivery models in selected countries/regions in East and Southeast Asia identified four different models: inpatient hospital-based, outpatient, home-based, and hybrid standardized PC model. A range of outcomes were reported for patients, with mixed results.

Conclusion: Models of care showing statistically significant improvement in QoL include inpatient hospital-based PC model and a home-based community led model. The effect of different models of PC service delivery model on pain is inconclusive due to mixed results.

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Supplementary Material

Supplementary Table 1. Search Strategy for Ovid-Medline

Line	Search Term
1	exp Palliative Care/
2	exp Palliative Medicine/
3	Palliative treatment.mp
4	(End?of?life or End-of-life care).tw
5	Terminal care.tw
6	(Hospice care or Hospice).tw
7	1 or 2 or 3 or 4 or 5 or 6
8	hospitals/ or exp hospitals, community/ or exp hospitals, general/ or exp hospitals, high-volume/ or exp hospitals, low-volume/ or exp hospitals, private/ or exp hospitals, public/ or exp hospitals, rural/ or exp hospitals, teaching/ or exp hospitals, urban/ or exp secondary care centers/ or exp tertiary care centers/
9	exp Home Care Services/
10	exp Caregivers/
11	exp Hospices/
12	exp Nursing Services/
13	exp Patient Care Team/
14	exp Home Nursing/
15	Service delivery.mp
16	Multidisciplinary team.mp
17	integrated care.mp
18	nursing home.mp
19	community?based.tw
20	Home visit*.tw
21	community health worker*.tw
22	8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21
23	Exp Neoplasms/
24	Tumo$r.mp
25	Malignan*.mp
26	oncolog*.mp
27	cancer*.tw
28	23 or 24 or 25 or 26 or 27
29	exp Hong Kong/
30	exp Macau/
31	exp China/
32	Macao.mp
33	Mainland China.mp
34	Western Pacific.mp
35	Greater China.mp
36	Chinese.mp
37	Peoples Republic of China.mp
38	asia, southeastern/ or exp singapore/ or exp thailand/
39	Thai*.mp
40	Japan*.mp
41	(Taiwan* or Formosa).mp
42	Singapore*.mp
43	exp "Republic of Korea"/
44	(Korea* or South Korea).mp
45	29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44
46	7 and 22 and 28 and 45
47	limit 46 to (english language and yr="2017 - 2022" and english and last 5 years)

Supplementary Table 2. Search Strategy on Journals and Google Scholar.

Summary Table		
Database/ Journal/ Paper	Search Terms	Number of Hits (n= included articles)
Palliative Care in the Greater China Region: A Systematic Review of Needs, Models, and Outcomes.	N/A	20 (n=0)
A systematic review and meta-analysis of randomized controlled trials of palliative care for pain among Chinese adults with cancer.	N/A	10 (n=0)
Asia-Pacific Journal of Oncology Nursing (APJON) APJON	China OR "Hong Kong" OR Macao OR Taiwan OR Singapore OR "South Korea" OR Korea OR Thailand OR Japan	281 (n=0)
	palliative OR hospice OR "terminal care" OR "palliative care" or "end of life care"	40 (n=0)
	"hospice" OR "hospital" OR "community" OR "home" OR inpatient OR outpatient OR	444 (n=0)
BMC Palliative Care	China OR Hong Kong OR Macao OR Macau OR Chinese OR Greater China	75 (n=1)
	Singapore OR Singaporean	45 (n=0)
	Japan OR Japanese	126 (n=0)
	Taiwan OR FORMOSA OR Taiwanese	70 (n=2)
	Korea OR Republic of Korea OR South Korea OR Korean	60 (n=0)
	Thailand OR Thai	15 (n=0)
BMJ Supportive and Palliative Care (ProQuest)	China OR "Hong Kong" OR Macau OR Macao OR Greater China OR Chinese OR Taiwan OR Formosa OR Taiwanese OR Singapore OR Singaporean OR "South Korea" OR Korea OR "Republic of Korea" OR Thailand OR Thai OR Japan OR Japanese	215 (n=0)
Google Scholar	palliative OR hospice OR end-of-life OR terminal care China OR "Hong Kong" OR Macao OR Macau OR Chinese OR Taiwan OR Formosa OR Taiwanese OR Singapore OR Singaporean OR "South Korea" OR Korea OR Thailand OR Japan OR "Republic of Korea" OR Thai	537 (n=2)

Supplementary 3

Relevant developments not included in this narrative review

We also found studies that provided valuable information on PC models but did not provide any information on patient outcomes such as ENABLE-SG Model1, which attempts to make the ENABLE model (originally developed in Canada2) more culturally relevant for patients with advanced cancer and their caregivers by considering their inputs using a qualitative formative evaluation approach.

Another relevant study that did not meet our inclusion criteria was the protocol for the Outreach Palliative care Trial of Integrated Model (OPTIM Study) by Morita et al.3 Published prior to 2017, it describes the development of a regional palliative care model in Japan that can be adapted from current systems such as establishment of a "regional palliative care center", and guidelines to direct community-based models, including what outcomes to measure. Therefore, it provides a comprehensive structure for evaluation of a region-based palliative care intervention program.

Another relevant but ineligible study was a paper by Sakashita et al on the development of guidelines for hospital-based PC consultation teams (PCCT) using a modified Delphi approach.4 Even though the paper did not evaluate patient outcomes of a hospital based PCCT model, it methodically detailed the process of formulating guidelines to evaluate and safeguard the quality of PC services for patients and their families. The comprehensive list provided is likely to benefit healthcare institutions and countries/ region in Asia looking to develop, improve and evaluate hospital based PCCT models.

As described in our exclusion criteria, we excluded papers analyzing large national healthcare databases without describing models, and papers that did not explicitly specify that PC services were carried out in a consistent setting or with standardized services. This was necessary as it would have been difficult to draw any conclusions on the effectiveness of the models of care provided. One example was a paper from Taiwan by Chiang et al. evaluating the impact of hospice care on aggressiveness of end-of-life care in advanced ovarian cancer patients.5 We also identified a paper by Pitanupong et al. providing information on PC development and knowledge advancement in Thailand6 that had to be excluded as it did not mention any models of care.

Both the paper by Yang et al on the ENABLE-SG Model1 in Singapore and the study by Sakashita et al. in Japan reporting on the modified Delphi method4 emphasized the importance of cultural relevance in models of care – this was not highlighted in any of the included studies. We believe that given the diverse cultural and social conditions in Asia, future papers need to consider this aspect when assessing models of care.

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Review

A Narrative Review on Quality Improvements for Radiology Clerkships from Medical Student

Star Chen, [1] Maruti Kumaran.[2]

Abstract

Radiology clerkships have the potential to give medical students a better appreciation of a radiologist's responsibilities toward patient care while raising interest and improving student confidence in diagnostic imaging skills. Unfortunately, many radiology clerkships across the US have developed a reputation for being unorganized and unengaging. This narrative review is focused on summarizing various clerkship practices performed across the US that have been well received by students, as well as specific weaknesses of the traditional clerkship format from the student perspective, with the aim of effective approaches to revamping electives to showcase the realities of the specialty while also attracting bright and motivated students. This narrative review examined 28 studies that gathered survey responses from medical students who completed radiology clerkships to determine their perceptions towards the clerkship. Major findings to be discussed in detail include weaknesses with the traditional format related to passive learning through observing, unclear expectations for medical students, and certain challenges that clerkship directors may face while attempting to implement changes to their clerkship. This narrative review will also discuss specific well-received practices involving more active learning, including interactive workstations, interactive simulators, flipped classrooms, case banks, and online learning modules.

Introduction

Advancements in medical technology have made diagnostic imaging much more widely available than it once was. As a result, clinicians can rely more heavily on diagnostic imaging as compared to previous years to help guide patient management, and the need for radiologists who are both well-trained and dedicated to the field continues to grow. Surprisingly, there is a deficit in the required radiology clerkships across United States (US) medical schools. One study surveying multiple Canadian and US medical schools noted that only about 20% of US medical schools and only 1 of 17 Canadian medical schools require their medical students to take a radiology clerkship, a number which did not change between 2011-2018.[1] This deficit may be further demonstrated by a separate study that found that only 49% of medical schools taught radiology during the 3rd and 4th years. These lessons were often taught by non-radiologists even though 98% of radiology department chairs do not believe these physicians can adequately teach medical students imaging concepts.[2]

For the medical students who do choose to pursue elective radiology clerkships, they face additional challenges. Radiology clerkships have developed a reputation for being disorganized, having little hands-on learning, and relying mostly on passive shadowing without adequate structured teaching.[3,4,5] These practices will often fail to keep students engaged,[4] which could ultimately lead to decreased long-term learning retention, decreased interest from students that are undecided about which specialty to pursue, and failure to dispel rumors and misconceptions about the specialty.[6] The effects of this education disparity compared to other clerkships may be seen bleeding into the newer generation of practitioners, as a recent study surveyed 175 post-graduate year-1 (PGY-1) residents across multiple specialties regarding their radiology education and their confidence, and found a concerning mismatch between their radiology-related responsibilities and perceived confidence in their diagnostic imaging skills.[7] Although 63.7% of the interns were frequently asked to preview radiology studies independently, only 60.2% reported having high confidence in their ability to recognize common/emergent pulmonary findings on chest imaging. Only approximately 33% had high confidence when ordering oral/IV contrast with a computer tomography (CT) study.

With the recent changes to the US medical education and licensing exam practices, it is becoming increasingly difficult to predict how new residency criteria may impact undergraduate radiology education. In one study, the authors suggest that removing a scored Step 1 exam will shift the emphasis toward applicants' numerically scored Step 2CK and likely focus more on other parts of the application, including letters of recommendation, research, and extracurricular achievements.[8] These authors believe that with fewer schools offering any

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dedicated Step 2CK study time, many medical students may soon flood radiology electives due to the general reputation of them being easier and having decreased time commitments to maximize study time. They also suggest that more students may apply to radiology residencies due to the uncertainty of where they stand in competitiveness without a scored Step 1 score. Both shifts may significantly increase the number of students opting for radiology electives, thus increasing teaching responsibilities for the already busy radiologists. This will require a drastic restructuring of radiology elective curriculums.[8]

The utility of a well-structured and actively engaging radiology elective would be incredibly valuable for the next generation of physicians. To our knowledge, there does not seem to be an existing comprehensive review of medical student perspectives toward the curriculum and structure of radiology electives across the United States. The purpose of this literature review is to summarize certain radiology clerkship practices that have been well-received from the medical student perspective. Specifically, the primary goal of this study is to identify many of the shared limitations of various radiology electives as described by medical students while also identifying certain radiology clerkship practices that were appreciated by the medical students. The secondary goal is to identify certain challenges that clerkship directors may face while attempting to implement favorable changes to the clerkship.

Methods

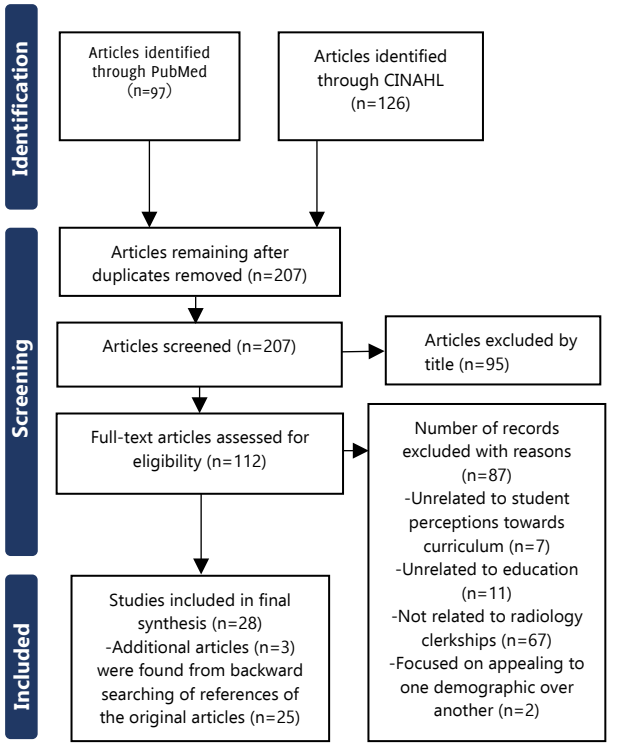
Search strategy

A literature search was conducted within PubMed and CINAHL databases. Search terms used included 'radiology,' 'clerkship,' 'elective, 'medical student', 'perception,' and 'preference.' Articles were then obtained from the databases using these search strings: radiology clerkship, radiology clerkship student, radiology elective, medical student preference radiology, and medical student radiology education. Articles were obtained between 1990 to 2023 and included article subtypes such as case reports, commentaries, educational perspectives, randomized clinical trials, meta-analyses, reviews, and systematic reviews.

Inclusion and exclusion criteria

Articles were selected based on their relevance towards formal radiology clerkships as opposed to longitudinal or preclinical radiology education. Articles that specifically discussed student perceptions towards the clerkship were preferentially chosen. In addition, articles that looked at mentorship practices or resident teaching methods during the radiology clerkship were also included if student perceptions to the practices were discussed. Articles that reviewed limitations or challenges that clerkship directors faced when attempting to build or modify their radiology elective courses were also included. To limit the scope of this review, articles that focused on integrated curriculums over four years as opposed to focused electives were excluded. Articles that proposed structural changes to radiology clerkships without data discussing student opinions or perceptions of said changes were excluded. Studies that looked solely at medical students' radiological competence/knowledge after the elective without considering student attitudes or perceptions towards the elective were excluded to keep the article focused. Any articles that did not pertain to the specific specialty of diagnostic radiology, including solely interventional radiology or radiation oncology clerkships, were excluded. As one of the goals of this study is to examine clerkship practices that medical students viewed favorably or unfavorably, articles that only examined faculty or resident perspectives without discussing medical student perceptions were also excluded. Any articles that focused primarily on professionalism, academic dishonesty, or ethics, as opposed to the educational structure of the elective, were excluded as they did not seem relevant to the goals of this study. Lastly, any articles that primarily focused on evaluating match rates into radiology, applying to radiology residency, appealing to one gender over another to the field, or training medical students in single modalities (e.g., ultrasound) were excluded.

Figure 1. PRISMA Flowchart Demonstrating the Selection Process During the Literature Search.



Data extraction

All articles were independently reviewed by the primary investigator to ensure relevancy. Ninety-seven articles were found on PubMed, and 126 were found on CINAHL. These articles were screened with the inclusion and exclusion criteria and duplicates (*Figure 1*). Additional articles (n=3) were found from searching through references of the original articles found from the database search that met the selection criteria (n=25), for a total of 28 articles.

Table 1. Primary Literature Sources Included in Review, Detailing the Sample Size, Survey Methodologies, Study Intervention, and Study Type.

Reference	Population	Data collection method	Study intervention	Research design
Belfi et al. (2021)	26 4th year students	5-point Likert test for perception, unpaired t-test for pre-post intervention	Two-week in-person elective converted to virtual elective	case study
Belfi et al. (2015)	101 3rd year students	Post completion ranking survey of preferred learning method	different learning methodologies (traditional, blended, independent)	case study
Belfi et al. (2022)	95 students enrolled in clerkship	5-point Likert scale survey to test student perception	ICARUS interactive gaming modules	case study
Benedetti et al. (2014)	5 medical students	10-point Likert scale and open response	Newly designed radiology elective focused on career development	case study
Darras et al. (2019)	95 medical students and 31 faculty	5-point Likert scale and open response comments	survey assessed student perceptions towards the elective for (1) goal orientation, (2) organization/regulation, and (3) relationships	case study
Desai et al. (2016)	35 medical students	5-point Likert scale survey to test student perception	Integrated website built for elective	case study
Friedman et al. (2017)	40 medical students	5-point Likert scale survey to test student perception	Set up an interactive workstation with anonymized cases for MSK-related pathology	case study
Gomez et al. (2020)	116 medical students enrolled	Likert scale survey and open response feedback	switched to a virtual elective in the setting of COVID-19 pandemic	case study
Huang et al. (2021)	34 medical students	A combination of a 100-point Likert scale and open response	flipped classroom approach	case study
Larocque et. al (2018)	36 surveyed of 58 students who completed elective,	Survey items: dichotomous, ranking, 5-point Likert-type scale questions, as well as open-ended questions	Two studies. The first study is a needs assessment survey, and the second study implements changes to meet those needs.	case study
Mauro et al. (2021)	120 medical students surveyed, 97 were in elective	student satisfaction surveys, including Likert scale and narrative comments	built a cost-effective website	case study
Mullins et al. (2005)	13 medical students surveyed prior to elective start	Open response survey	Survey was conducted to determine the objectives students want met for radiology electives	Observational study
Newbury et al. (2021)	Fourth-year medical students	Entrance and exit surveys given to medical students	Medical students were given PGY-1-level responsibilities	case study
O'Connor et al. (2016)	175 medical students	Likert scale questionnaires evaluating task value, enjoyment, anxiety, boredom, etc.	Alternated flipped learning with didactic lectures	Prospective cohort study
Poot et al. (2012)	Third and fourth-year medical students	questionnaires composed of Likert, free response, and multiple choice	optional survey distributed to third and fourth year medical students	Observational study
Redmond et al. (2020)	91 4th year medical students	Likert scale questionnaires to assess attitudes toward radiology	Active learning (integrated) vs. traditional passive method	Prospective cohort study
Smith et al. (2022)	80 medical students	post-clerkship surveys consisting of multiple choice, ranking, Likert scale, and open response	Surveys were given during COVID-19 pandemic to assess how students perceived radiology virtual training	Observational study
Strickland et al. (2015)	25 medical students who completed the elective	post-clerkship survey of Likert scale questions to assess perceptions	Virtual MSK radiology workstation	Case study
Visccher et al (2017)	28 medical students across all years	multiple choice, audio recordings, and open-response surveys	Surveyed medical students to assess exposure, perceptions, and suggestions for positive change	Observational study
Webb et al. (2016)	medical students who completed elective	10-point Likert scale and narrative comments questionnaire given to students	new "teaching resident" role developed	Case study
Wu et al. (2021)	23 medical students	post-clerkship survey composed of a 5-point Likert scale	newly added online learning platform and e-book	Case study
Zou et al. (2011)	74 3rd and 4th year medical students	post-conference questionnaire composed of ranking choices	didactic lecture format vs. active participation	case study

Results

Of the 28 articles reviewed, there were 5 review articles, 1 editorial piece, 2 prospective cohort studies, 4 observational studies, and 16 case studies (*Table 1*). By far, the most common method used to assess student feedback and perceptions towards the clerkship was a 5- or 10-point Likert scale (e.g., surveyors were asked to rate how much they agree with a statement, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree), which was implemented in 13 of the 28 articles. Nine articles used a mixed-method approach to assess student perspective by including both a Likert scale and other questionnaire methodologies (ranking, open response, multiple choice), and 4 articles used methodologies that did not include the Likert scale. Of the 16 case studies, 14 were conducted while researchers implemented a new intervention to their radiology clerkship, allowing them to collect data on student perspectives toward said changes. Various new teaching methods were implemented, including switching to virtual options considering the COVID-19 pandemic,[19,20] flipped classroom teaching,[14,15,16,29,31] interactive workstations,[18,26] and interactive websites[17,28] and simulators[27].

The two prospective cohort studies compared how students performed and responded to learning from an integrated or flipped classroom modality to the traditional didactic format of radiology learning.[14,16] All four observational studies did not involve the researchers implementing new interventions to their existing radiology elective. Instead, they focused on assessing students' ongoing perceptions and suggestions for improvement of radiology electives via qualitative surveys.[2,11,22,30] One editorial was included as it provided additional perspective to some of the challenges and mindsets that students have during a radiology elective.[4] The 5 reviews provided summaries on various topics, including recommendations on how to structure radiology electives in the context of student values,[9,13,30] current novel teaching methods that are well received by faculty,[32] and various challenges that are experienced by radiology educators.[23]

Given the context of this study, the literature search findings were organized into sections: current state of radiology clerkships, the traditional format of many radiology electives, problems with the traditional format, barriers to improvement, and possible solutions to improving clerkships.

Discussion

Current state

In undergraduate medical education, imaging is taught in numerous ways. While many curriculums attempt to integrate diagnostic imaging lessons into preclinical courses, most notably anatomy and other third-year core clerkships, such as internal medicine and surgery, most academic radiologists across the US rely on radiology or fourth-year electives to teach diagnostic imaging concepts to medical students. In a recent survey conducted across US medical schools, approximately 48 of the 54 (89%) radiology department chairs stated they used radiology electives to teach medical imaging, with the second most common method being integration into other courses such as anatomy (44, 81%).[9]

Many medical students enrolling in radiology electives share specific educational goals they hope to achieve by the end of the elective. In a recent survey, researchers at a single institution conducted a needs assessment of medical students (n=36) who completed the radiology elective to determine students' most common goals for the elective.[10] The top educational goals were to learn about the specialty (n=13, 37%), how to approach various CT scans (n=13, 37%), improve on chest X-ray interpretation (n=10, 29%), and to understand indications for various imaging (n=11, 31%). Researchers also asked students what activities they would like to see incorporated into future electives. The most selected choices were participating in procedures and scanning (96%), interpretation of cases and reviewing with residents or staff (93%), participating in exercises that focused on imaging work-up/appropriate ordering of imaging (91%), and being assigned with a resident mentor during the elective (82%), which was more popularly selected than being assigned with a faculty mentor during the elective (77%). A separate study created a questionnaire for medical students who completed the radiology elective at their institution, and found that these students were motivated to learn about appropriateness criteria for ordering imaging, improve their imaging interpretation skills, increase their confidence, and learn about the science behind technology with regards to protocol, contrast, and techniques.[11] These findings demonstrate that many medical students come into radiology electives with specific goals to learn about the field and improve their clinical skills. They are highly motivated to become more involved during the elective.

Traditional format of radiology electives

Across US medical schools, many radiology electives have been structured similarly. Traditionally, radiology electives tend to occur in either 1-week, 2-week, or 4-week blocks during the 3rd or 4th year of medical school.[2] Prior to starting the rotation, medical students are often given a set of learning objectives, detailing their expectations and roles in the reading room.[2,12,13] Following this, the traditional radiology elective involves many forms of passive learning by having students observe readouts,[12,14] attend didactic lectures,[14,15,16] and have students rotate through different radiology subspecialties.[17,18] Certain rotation directors have also begun implementing newer practices, such as adding flipped classroom instruction[15,16] or online learning modules during the pandemic.[19,20]

Problems with the traditional format

Medical students have reported multiple issues with the traditional structure of radiology electives. Most commonly, the issues seem to relate to the extremely passive observer role students are given, the inaccurate representation of what radiologists do, and unclear communication between students and faculty.

The skillset required to effectively and efficiently interpret and order diagnostic imaging is incredibly high and beyond the skills of medical students.[13] That, in tandem with the job students are

often given in the reading room of simply observing, results in many medical students feeling unengaged and unsure of their expectations. Researchers in a single institution surveyed 95 medical students who completed their radiology elective and found that the most common themes students had issues with were the lack of autonomy, lack of structured teaching, and lack of preceptor continuity.[3] In a different qualitative study at a separate institution, narrative feedback from students centered towards feelings of isolation, feeling like there was no accountability, and feeling of little value, with one student commenting he just felt "like a bother.[21]"

Issues with the traditional format of radiology electives can also lead to failures in dissolving misconceptions medical students may have towards radiologist and their field. Currently, many medical students view radiology electives as easy and flexible, which does not accurately represent the daily practice of radiology.[13] A recent educational perspective helps to further highlight many of the ongoing misconceptions about radiology,[6] stating that radiologists may be seen as being socially inept, are only interested in financial incentives, that the reading room is a boring place, and that radiologists might soon be replaced by artificial intelligence.[4] Considering most medical students' passive observer role in the room, sitting silently while watching radiologists dictate studies, it is not far-fetched to understand why several misconceptions are still prevalent across US medical schools.

Problems with communication between students and faculty are also prevalent. Researchers at one institution surveyed thirty-one radiologist faculty. They found that the radiologists lacked clarity regarding learning objectives and what level of knowledge to expect from the medical students.[3] Suggestions for improvement have been made in the past, with researchers from one study surveying 28 medical students at their institution and finding proposals that medical students be treated like residents and thus be given responsibilities to review/dictate cases with faculty and have more teaching time with faculty.[21] So, with these suggestions, why not give medical students more responsibility and have faculty spend more time with them across US medical schools?

Challenges

Many radiology clerkship coordinators will inevitably face similar issues while designing their courses, with most coming from similar themes: (1) faculty don't have time,[9,13,22] (2) no financial motivation to teach,[22] (3) no suitable entry-level tasks for students.[13] The daily responsibilities of an attending radiologist make it difficult to accommodate extra teaching roles. One review article notes how radiologists often have shift-like rotations and are often at the whims of their scheduling, which ultimately prevents faculty from taking ownership of supervising individual students.[13] Currently, most US radiologists are compensated on a fee-for-service model, with each study carrying an associated relative value unit (RVU) that determines their reimbursement. Thus, their salaries are heavily reliant on their ability to read high volumes of imaging studies per day. In addition to their ever-increasing clinical responsibilities of interpreting images leading to their unavailability[9,22] and little financial incentive to support education as less income is generated due to lower clinical productivity,[22] there is decreased motivation for faculty to focus more of their time on teaching medical students.

As one study demonstrates, simply increasing clinical responsibilities for medical students on electives may not address issues of available time for faculty. One institution implemented a novel hands-on elective where fourth-year medical students were given resident-level responsibilities to dictate studies.[23] While this likely led to better learning for the students and was ultimately deemed a success by researchers, they acknowledged that the course was incredibly time-consuming for faculty since each student had to receive individualized education from faculty based on their strengths/weaknesses. So, what are some ways to approach these limitations?

Solutions

Throughout the current literature, numerous teaching modalities were implemented and well-received by medical students. These modalities can be organized into common themes: (1) supplemental online modules and case banks, (2) interactive workstations or simulators, (3) consistent teaching and feedback from residents, and (4) flipped classroom learning.

One well-received modality was with online learning modules, particularly using case banks. In two separate institutions, researchers developed an interactive, electronically available case bank that medical students in the radiology elective could access and use to supplement their learning.[10,24] At one of the institutions, students responded well to the case bank, giving a median Likert score (5 = excellent, 4 = very good, 3 = good, 2 = fair, 1 = poor) of 4.5.[24] At the other institutions, researchers implemented three changes to their clerkship, including the development of resident-led rounds, a new case bank, and a more structured schedule. Satisfaction surveys were then administered to students who had completed the revised radiology clerkship, and those results were compared with surveys from the students who had completed the original elective without the changes.[10] The mean Likert score (ranging between 1=poor and 5=excellent) given by medical students for overall elective experience was significantly higher after implementing the changes compared to before the changes (4.2 $\pm$ 0.90, 3.3 $\pm$ 1.28, P=0.022), with the case bank getting a mean score of 4.7 $\pm$ 0.49.

Other institutions employed active learning methods in the form of simulation-based learning. Medical students in radiology electives in two medical schools were allowed to work with a newly implemented interactive workstation simulator.[18,25] These workstations comprised a desktop computer in the reading room preloaded with anonymized cases and vignettes deemed appropriate for students by faculty. In both studies, medical students were encouraged to use the workstation when faculty and residents were busy dictating. The responses from both groups of students were positive, with one surveyed group reporting that 91% of the medical students believed the station had at least a "moderate" (Likert scale 4/5) positive impact on

their experience, and 35% saying the station was the best experience of the entire elective.[18] For the other group, of the 25 students surveyed, over half described the workstation as the best experience they encountered in radiology education, though the researchers noted that the initial process of exporting anonymized imaging studies for the workstation was time intensive (however, they predict maintenance time requirements to be substantially less), and there were also some hardware troubles.[25]

In addition, one prospective cohort study by an institution found that employing active learning methods leads to improved student feedback scores and time benefits for faculty.[14] The group created an integrated radiology clerkship, substituting hours of traditional didactics taught by faculty for self-directed simulation sessions where students could interpret cases on image-viewing software. Students (n=91) were assigned to either the traditional clerkship (n=42) or the integrated clerkship (n=49). Researchers found that not only was there a statistically significant improvement in student agreement scores from the integrated clerkship compared to the traditional one as seen with positive statements like "I have a better understanding of the role of the radiologist" (mean Likert score 4.6 vs. 4.3, P=0.031) or "my perception of radiology has been improved," (mean Likert score 4.7 vs. 4, P < 0.001), a secondary effect they noticed was that the integrated format freed up 7 hours of radiologist time over the week compared to relying on their traditional clerkship.[14] Other methods of interactive learning employed that were ultimately well received by students were the use of the novel open-source ICARUS module,[19,26] an interactive web-based platform like a game where students are presented with a clinical scenario, and can then simulate ordering studies, interpreting images, and making diagnostic decisions, or incorporating the use of audience response systems on students' smart phones to encourage anonymous interaction during traditional didactics.[4]

Two separate studies investigated developing a new website to help remedy the issue of certain radiology electives being disorganized. One of the research groups claims that students of the technology-driven younger generation prefer self-directed learning and want autonomy. A well-developed website could help accommodate these needs.[27] The other researchers built the website, hoping it would help consolidate resources, organize schedules, and improve communication between students and their faculty during the clerkship.[17] In both studies, surveyed students responded overall positively, with the results from one group showing that 82.5% found the website to be either "extremely informative" or "very informative" when asked to rate the website.[27] In the other group, survey results showed that 80% of students accessed the website at least once a day, 17% a few times a week, and 90% agreed that having easy access to the schedule positively impacted their experience.[17] Researchers were able to identify pearls and pitfalls that were similar across both studies. Both found that the website helped to promote more autonomy and learner control by easing access to the material.[17,27] One group found that this increase in autonomy even helped to relieve radiology faculty of time constraints that would otherwise be encountered during traditional teaching.[27] Potential pitfalls identified were technical failures,[27] and that a poorly designed website would have no benefits to improving student perceptions.[17]

Compared to the traditional didactic approach, the flipped classroom method encourages independent self-paced learning, where students often study or perform assignments on their own outside the classroom and return to discuss what they learned and collaborate with faculty. Two studies employed this, with one group having students interpret and dictate an image independently before returning to faculty and helping to generate the final report,[28] and the other group completing an interactive workshop where faculty presented a clinical scenario and focused on facilitating discussion and engagement from students as opposed to lecturing.[16] Both studies compared student feedback for the flipped classroom versus the didactic method. However, one prospective cohort study assigned students solely to flipped classroom versus didactic method,[16] while the other students would alternate between both methods.[28] Results for both were similar in that students responded significantly more positively to the flipped classroom method, with one group of students stating that they experienced more task value, had less boredom and greater enjoyment,[16] and the other group stating that they felt more engaged and had perceived more educational value.[28]

Lastly, medical students seem to highly value regular teaching and feedback from residents or faculty. In their review, Visscher and Faden report that medical students interested in radiology highly value longitudinal mentorship and small-group teaching. They often do not perceive a significant difference in teaching quality between residents and attendings.[29] One study developed a new "resident liaison for medical student education" role, where the selected resident would focus primarily on actively teaching medical students, recruiting other residents for teaching roles, and serving as course director for their 2-week radiology elective.[5] Following the program implementation, feedback from the teaching residents and students was excellent, with the 8 medical students surveyed giving an average rating of 9.6 out of 10 and stating that the teaching was excellent. They felt like the resident was invested in their learning. In a separate study, researchers implemented new resident-led rounds where students would be given the chance to take and interpret cases and be given prompt feedback.[10] When surveyed, medical students rated the resident-led rounds very well (Likert score mean 4.9 $\pm$ 0.35 out of 5), the highest of all the changes implemented (other changes including a case bank and a more detailed schedule). These findings may suggest that not only are students receptive towards resident teaching, but these residents may also be extremely effective teachers and possibly help alleviate some of the time constraints of teaching from attending radiologists.

Limitations

This article is primarily flawed in that most of the primary literature in this review are case studies and thus did not incorporate control groups for comparison. As a result, there is no specific way to identify if specific interventions were the actual

cause of any improved student feedback and perceptions. In addition, many of the studies included small sample sizes, so the results may not be generalizable across US medical schools. The majority of the studies also relied heavily on the Likert scale to assess students' attitudes, an inherently arbitrary metric that may not always properly represent how students felt.

In addition, this article was written with the purpose of creating an informative narrative literature review. Therefore, it did not follow the stringent guidelines of a true systematic review that followed PRISMA guidelines. This article focused on incorporating a collective of reviews, opinions, and recommendations as opposed to strict data extractions, structured appraisals, and meta-analyses expected of a systematic review. As a result, the article does not specifically examine each primary article to assess whether survey questions were validated, whether a statistician was involved, the response rates for each study, whether surveys were pilot-tested, or whether sample sizes were calculated.

Conclusions

With the current growth of reliance on imaging and projected manpower requirements to meet these demands, it is imperative that teaching institutions across the country look closely at how the specialty is perceived amongst medical students and that radiology electives be revamped to showcase the realities of the specialty and make it attractive. The aim should be to attract bright and motivated students to take up this specialty while also providing a rewarding environment to learn imaging skills for those students who will eventually pursue other fields. Investigators addressed some of the problems of the traditional radiology elective, as well as some of the newly implemented strategies that have been well received by medical students for improving perceived radiology elective quality. The majority of the traditional elective's flaws stem from students' passive observer role in the reading room and unclear expectations as to what medical students should do. Radiology clerkship directors may experience challenges such as time constraints for teaching and not having tasks suitable for the skill level of medical students. Certain novel teaching methods have been implemented, which have been well-received by students and could offer an approach to help alleviate some of these challenges. New active learning methods, such as case banks, interactive simulators, and websites, might help alleviate some of the teaching time constraints experienced by faculty while also keeping students actively engaged. Also, increased resident teaching roles and responsibilities, as well as flipped classroom teaching, can be viewed favorably by medical students while helping to decrease some of the teaching burden from faculty. While this is certainly not a fully comprehensive list of the various novel teaching methods used across clerkships, the positive feedback given by students suggests they may be a step in the right direction towards making radiology clerkships more engaging and valuable for students while also being logistically feasible for faculty.

Summary – Accelerating Translation

Title: A Narrative Literature Review on Quality Improvements for Radiology Clerkships from Medical Student Perspectives

Main problem to solve: Radiology clerkships have the potential to provide medical students with a better appreciation of the responsibilities of radiologists towards patient care while also raising interest and improving student confidence in diagnostic imaging skills. Unfortunately, many radiology clerkships across the US have developed a reputation for being unorganized and unengaging.

Aim of study: This review is focused on summarizing some of the clerkship practices performed across the US that have been well received by students, as well as some weaknesses with the traditional clerkship format from the student perspective, to highlight effective approaches to revamping electives to showcase the realities of the specialty while also attracting bright and motivated students.

Methodology: The investigators performed a literature search on the PubMed and CINAHL databases using specific search terms deemed relevant to the topic of this review. From the results of the initial research, investigators proceeded by individually selecting articles to be reviewed more in depth and for final analysis based on specific inclusion and exclusion criteria listed in the review. The result was 28 studies that gathered survey responses from medical students that completed radiology clerkships to determine their perceptions towards the clerkship.

Results: Major findings discussed included weaknesses with the traditional format related to passive learning through observing, and unclear expectations for medical students, as well as certain challenges that clerkship directors may face while attempting to implement changes to their clerkship. This review also discussed specific well-received practices involving more active learning, including interactive workstations, simulators, flipped classrooms, case banks, and online learning modules.

Conclusions: With the growing demands towards diagnostic imaging, it is imperative that teaching institutions across the country look closely at how the specialty is perceived amongst medical students and that radiology electives be revamped to showcase the realities of the specialty and make it attractive to bright and motivated students to take up this specialty. Investigators addressed some of the problems of the traditional radiology elective, as well as some of the newly implemented strategies that have been well received by medical students for improving perceived radiology elective quality. The majority of the traditional elective's flaws stem from students' passive observer role in the reading room and unclear expectations for what medical students should do. Radiology clerkship directors may experience challenges with time constraints for faculty to teach and not having tasks suitable for the skill level of medical students. Certain novel teaching methods have been implemented, which have been well-received by students and could offer an approach to help alleviate some of these challenges. New active learning methods, such as case banks, interactive simulators, and websites, might help alleviate some of the teaching time constraints experienced by faculty while also keeping students actively engaged. In addition, increased resident teaching roles and responsibilities and flipped classroom teaching can also be viewed favorably by medical students while helping to decrease some of the teaching burden from faculty. While this is certainly not a fully comprehensive list of the various novel teaching methods used across clerkships, the positive feedback given by students suggests they may be a step in the right direction towards making radiology clerkships more engaging and valuable for students while also being logistically feasible for faculty.

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Case Report

Pulmonary Thromboembolism in Multidrug-Resistant Tuberculosis: A Case Series Highlighting the Importance of Early Diagnosis and Management

Vikas Marwah,[1] Gaurav Bhati,[2] Robin Choudhary,[3] Anmol Sharma.[4]

Abstract

Background: Pulmonary tuberculosis (PTB) is an established cause of arterial and venous thrombosis. With the rising incidence of multidrug-resistant tuberculosis (MDR TB), which has a prolonged treatment course, pulmonary thromboembolism in such cases further complicates the treatment outcome in terms of mortality and morbidity. TB causes systemic hypercoagulability, which may lead to both arterial and venous thrombosis. Therefore, it is important for treating physicians to be aware of the entity and have a sharp watch for the development of Pulmonary thromboembolism in cases of MDR TB. **The Case:** We present the association of pulmonary thromboembolism (PTE) with MDR TB in three young males who developed pulmonary thromboembolism during the treatment of MDR TB, along with their management using anticoagulant agents. **Conclusion:** PTE in cases of TB is rare but fatal. High suspicion of PTE in patients with MDR TB will help in diagnosing the dreaded condition early and aid in reducing preventable mortality with PTE. Early recognition, prompt diagnosis, and management is the key to saving the lives of those with this fatal complication.

Introduction

More than 25% of the global burden of tuberculosis (TB) is seen in low and middle income countries like India with an estimated 27 lakh patients as per Global TB Report 2020.[1] The incidence of multidrug-resistant tuberculosis/rifampicin-resistant tuberculosis (MDR-TB/RR) is 11 per lakh of the Indian population and will keep on increasing in the future.

TB is known to affect the coagulation parameters of the body.[2] Identifying the patients who are at high risk of developing venous thromboembolism and meticulous planning of their chemotherapy consisting of anti-tuberculous medications and anticoagulants becomes of paramount importance to avoid adverse outcomes. Patients with acute infections are 2-10 times more prone to develop venous thromboembolism (VTE) as compared to the normal population[3]. VTE is also known to complicate chronic infections like tuberculosis, affecting around 3-4 % of these patients and the estimated percentage can be higher since most cases are subclinical and are never diagnosed.[4]

The study aimed to highlight the likely and often missed complication of pulmonary thromboembolism in cases of tuberculosis and to increase awareness among the treating physicians as a differential of pulmonary thromboembolism while managing a case of TB. We report three cases of MDR pulmonary tuberculosis manifesting with massive and sub-massive pulmonary thromboembolism (PTE) with no prior apparent risk factors before illness. This study is important for physicians managing MDR TB to be aware of PTE as a complication and take prompt action toward early diagnosis and treatment of this potentially fatal clinical entity.

Highlights:

- Tuberculosis itself poses as a hypercoagulable state and poses a risk for deep vein thrombosis and venous pulmonary thromboembolism.
- Physicians treating tuberculosis must be aware and alert regarding this uncommon yet fatal complication of tuberculosis and have a keep clinical eye to diagnose thrombosis at earliest.
- Early diagnosis and management with anticoagulation and fibrinolysis when required is the key to limit the mortality and morbidity associated with this disease.

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The Case

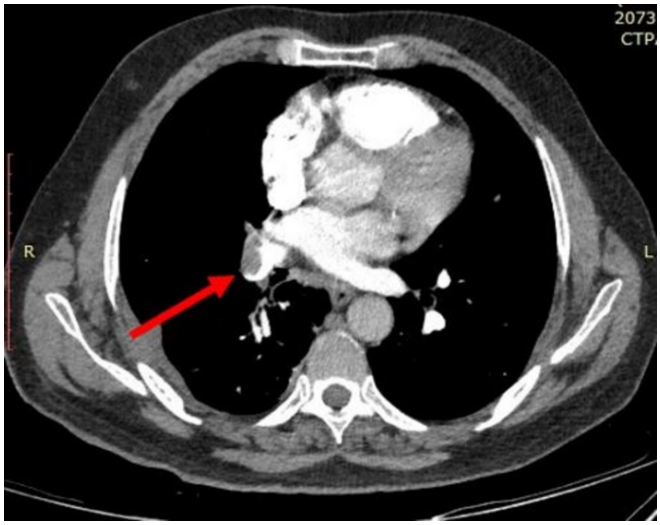
Case 1

A 21-year-old male, a nonsmoker reported complaints of breathlessness, fever, cough, right-sided pleuritic chest pain, and loss of appetite of 10 days duration. His chest radiograph showed right-sided upper lobe consolidation and pleural effusion, diagnostic pleurocentesis of which revealed exudative, lymphocyte-predominant fluid with high adenosine deaminase (ADA). The patient was found to be sputum smear positive for acid-fast bacilli (AFB) and cartridge-based nucleic acid amplification test (CBNAAT) was suggestive of rifampicin resistance. He was started on anti-tubercular drugs, however, he started to have breathlessness on exertion. He underwent computed tomography pulmonary angiography which revealed thrombo-embolism in the right pulmonary trunk as shown in *Figure 1*. The patient was started on low molecular weight heparin at 60 mcg twice a day and later switched to tab dabigatran 150 mg BD after 5 days along with second-line antituberculous therapy (ATT) to which he showed a favorable response and gradually improved. Dabigatran was stopped after 6 months, and a thrombophilia workup was done which was negative.

Case 2

A 35-year-old healthy male presented with complaints of fever, dry cough, and progressive breathlessness (MMRC II to III) along with a weight loss of two kilograms over two months. On evaluation, chest radiograph and contrast-enhanced computed tomography of the chest were suggestive of right-sided pleural effusion as shown in *Figure 2*. Pleural fluid analysis revealed lymphocyte-predominant, exudative effusion with ADA of 58 IU/ml. The patient was diagnosed with tuberculous pleural effusion and was started on first-line anti-tubercular therapy (ATT) comprising Tab isoniazid 300mg, rifampicin 600 mg, pyrazinamide 1500 mg , and ethambutol 1200 mg OD (once a day).

Figure 1. CT Pulmonary Angiogram Showing Thrombo-Embolism in he Right Pulmonary Trunk.

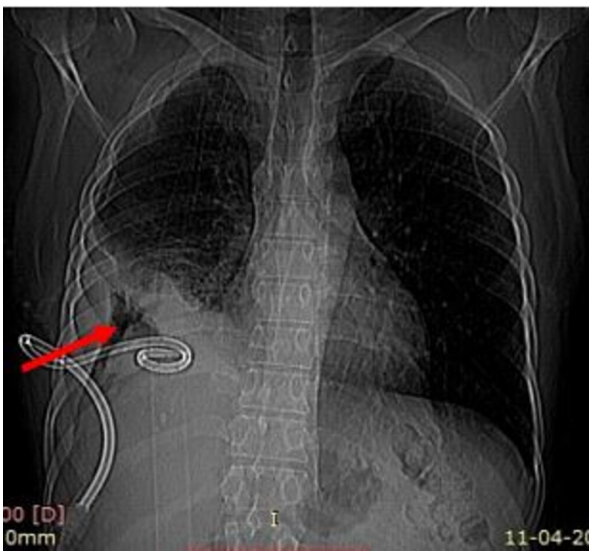


The patient had completed two months of anti-tubercular therapy when he suddenly had acute onset breathlessness of one-day duration with hemodynamic collapse. The patient had sudden cardiac arrest and cardiopulmonary resuscitation (CPR) was started immediately. The patient was thrombolysed with 50 mg of recombinant tissue plasminogen activator (r-TPA) and was intubated and placed on mechanical ventilation. He improved clinically but developed acute kidney injury, hematuria, and upper gastrointestinal hemorrhage, which was managed with pantoprazole infusion (80 mg stat followed by 8 mg/h infusion) along with hemodialysis, with which the kidney function recovered. He was continued on Injection heparin 5000 U BD. Subsequently patient was diagnosed to have loculated effusion on the right side of the chest and diagnostic pleurocentesis which revealed exudative fluid with positive pleural fluid mycobacterium tuberculosis (MTB) culture. A line probe assay done on culture specimens showed resistance to rifampicin and isoniazid. Patient was diagnosed as multidrug-resistant tuberculous pleural effusion and was treated with an MDR TB regimen (Tab bedaquiline 400 mg QD for 2 weeks followed by 200 mg thrice weekly, Tab levofloxacin 750 mg OD, Tab linezolid 600 mg OD, Tab Ccofazamine 100 mg OD, Tab cycloserine 750 mg OD) and tab apixaban 5 mg BD with which he gradually improved. Thrombophilia work-up done after three months was negative.

Case 3

A 27-year-old male presented with complaints of cough, pleuritic chest pain, weight loss of four to five kilograms over six months along with intermittent fever with evening fever of one-week duration. On evaluation, the patient had bilateral pleural effusion on the chest radiograph. Computed tomography pulmonary angiography revealed thromboembolism in the right main pulmonary trunk along with a few centrilobular nodules in the right upper lobe and right lower lobe, bilateral pleural effusion, and a cold abscess over the right third rib as shown in *Figure 3*.

Figure 2. CXR PA View Showing Right-Sided Pleural Effusion with a Pigtail in Situ.



The patient was diagnosed to have disseminated tuberculosis (pleuro-pulmonary and bone involvement), CBNAAT of pus aspirate from cold abscess revealed MTB along with rifampicin resistance. The patient was started on an MDR regimen along with oral Rivaroxaban 2.5 mg BD. Gradually patient improved and was subsequently treated with rivaroxaban for six months and anti-tuberculous therapy was continued for 18 months. Thrombophilia workup was done after rivaroxaban was stopped and it came back negative. We also did a color doppler of the lower limb of all three patients which was normal.

Discussion

Venous thrombosis is frequently associated with recurrent thromboembolism which can also be fatal.[5] Tuberculosis can result in a transient hypercoagulable state with thrombocytosis, increased fibrinogen, factor VIII, plasminogen activator inhibitor 1 plasma levels; a decline in antithrombin III and protein C and S levels leading to activation of coagulation cascade and suppression of fibrinolytic pathway.[6,8.] Mycobacterium tuberculosis bacillus also promotes direct endothelial damage which aggravates the development of thrombus.[7] Production of pro-inflammatory cytokines (interleukin 1, interleukin,[6] tumor necrosis factor α) in response to mycobacterial products also results in a hypercoagulable state.[9,10] Lymphadenopathy seen frequently in these patients can also cause mechanical compression of adjacent blood vessels leading to stasis and finally thrombosis.[11] Rifampin also has been implicated in the development of venous thrombosis and because of its enzyme-inducing effect, a higher dose of oral anticoagulants is frequently needed to achieve therapeutic INR levels.[12]

On review of Indian literature, we could identify various case reports of pulmonary TB along with documented deep venous thrombosis. whereas the association of TB along with PTE has been reported in fewer cases.[13-17] Mohan B, et al reported the largest case series from India with 5 cases of pulmonary embolism, in which all the five cases were males and with age less than 47 years. In our study, all the cases were young males out of which two cases had primary pleuro-pulmonary MDR tuberculosis while one had primary pulmonary MDR tuberculosis. Thrombolysis was warranted in only one of our patients as he developed hypoxia, hypotension, and cardiac arrest requiring mechanical ventilation while the other two cases were diagnosed based on out-of-proportion tachycardia and breathlessness on exertion and were managed with low molecular weight heparin initially and oral anticoagulants later. In our study, two patients had breathlessness as the main presenting symptom with a relatively short duration of illness before reporting at a medical facility and their dyspnea was disproportionate to the pulmonary lesions seen on the chest radiograph, along with a short history which raised the suspicion for pulmonary thromboembolism. These patients were all healthy young individuals with no prior risk factors for pulmonary thromboembolism apart from MDR tuberculosis.[14]

Figure 3. Computed Tomography Pulmonary Angiography Revealed Thromboembolism in the Right Main Pulmonary Trunk Along with a Few Centrilobular Nodules in the Right Upper Lobe and Right Lower Lobe and Bilateral Pleural Effusion.

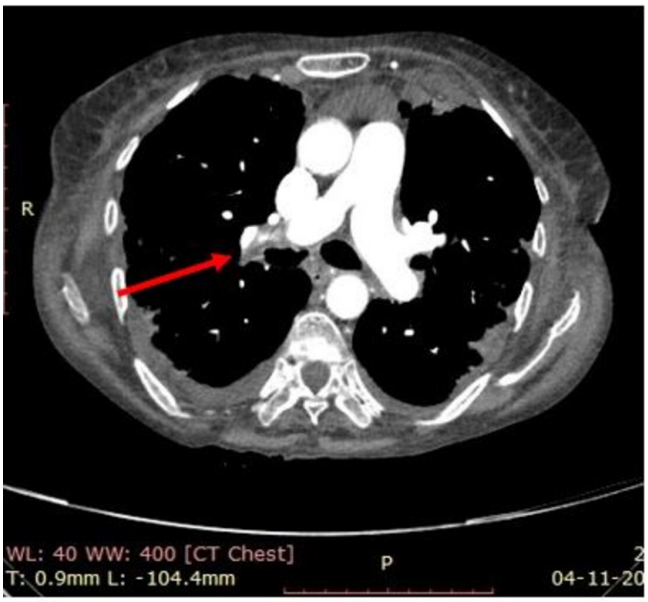


Table 1. Indian Case Series and Case Reports of Deep Vein Thrombosis Associated with Tuberculosis.

Author	Type of Study	Year	No of cases	Modality used for diagnosis	Treatment	Diagnosis VTE/PTE
Gogna A[11]	Case report	1999	2	Venous doppler, CECT abdomen	LMWH	VTE
Naithani R et al [13]	Case report	2007	1	Venous Doppler	LMWH+ Warfarin	DVT
Sharma *et al.*[14]	Case report	2007	1	Venous Doppler USG	Unfractionated heparin + warfarin	DVT
Kumar *et al.* [12]	Case report	2011	1	Venous Doppler	Unfractionated heparin + warfarin	DVT
Shah *et al.* [15]	Case report	2011	1	Venous Doppler	Enoxaparin + warfarin	DVT
Mohan B et al.[16]	Case report	2011	5	Venous Doppler and CT	Streptokinase + urokinase +heparin	PTE
Muley *et al.*[18]	Case report	2014	2	Venous Doppler USG	Unfractionated Heparin + warfarin	DVT
Sangani *et al.*[17]	Case report	2015	1	Venous Doppler USG	Enoxaparin + warfarin	DVT

Our study is the index case series from India of MDR TB cases complicated by PTE. It is also reiterated that our patients developed PTE despite there being no clinical or radiological evidence of DVT. In two of our cases, MDR TB was diagnosed on CBNAAT at presentation Thus, it is important to identify that MDR TB can be a risk factor for developing PTE and if there is a clinical suspicion of the same then these patients should be actively evaluated, and they should be started on therapeutic anticoagulation till the diagnosis has been ruled out. PTE can be life-threatening so the index of suspicion should be high in these patients to prevent unnecessary mortality. The review of Indian literature of case reports and case series documenting PE with tuberculosis has been shown in ***Table 1***. Case reports of pulmonary tuberculosis along with venous thromboembolism have been reported from India, among these very few had pulmonary thromboembolism.

The association of pulmonary thromboembolism (PTE) with MDR TB has not been reported in India. We report three cases of this under-recognized association where timely diagnosis was life-saving. High suspicion of PTE in patients with MDR TB will help in diagnosing the dreaded condition early and aid in reducing preventable mortality.

Summary – Accelerating Translation

Title- Pulmonary Thromboembolism in Multidrug-Resistant Tuberculosis: A Case Series Highlighting the Importance of Early Diagnosis and Management.

Main Problem to solve- Pulmonary Tuberculosis is a common disease worldwide and the cases of Multidrug resistance are on the increasing trend. These patients are at a higher risk of developing pulmonary thromboembolism which increases the mortality and morbidity in them. The methodology aim of this retrospective observational study was to highlight this important entity for all the clinicians treating such cases. In our study, these three cases of young males who were diagnosed with Multidrug resistance Tuberculosis developed Pulmonary thromboembolism.

Results and conclusion were treated with MDR TB drugs and anticoagulation. Patients with MDR Tuberculosis are predisposed to Pulmonary thromboembolism and its diagnosis requires a high index of suspicion and should be promptly treated to reduce mortality.

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Case Report

A Case-Based Discussion Supporting Ethics Education in Medical Schools

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Abstract

Background: Ethics education in medical schools lacks uniformity, yielding uncertainty when providers are faced with ethically complex patients. Without streamlined ethics training, providers are less confident in their ability to provide ethically appropriate care for all patients, particularly for those most ethically vulnerable. This case report seeks to elucidate ethical concerns when treating an ethically complex patient. Subsequently, the need for early ethics education is substantiated. **The Case**: A 58-year-old unhoused patient with no known medical history presented to the emergency department (ED) for evaluation of an infected foot wound. Imaging confirmed acute gas gangrene osteomyelitis. The patient refused the recommended below-the-knee amputation (BKA) but was amenable to intravenous antibiotic therapy. He was subsequently determined by psychiatry to lack decisional capacity and met the DSM-5 criteria for schizoaffective psychosis. Subsequently, the patient's brother deferred decision-making to the patient, who he believed should make his own medical decisions. Following an ethics consultation, the brother's decision, and by proxy the patient's, was respected. **Conclusion**: In this case, the patient's autonomy was prioritized, despite his high level of ethical vulnerability. Ethically conscious treatment was provided despite the implicit stigmatization of homelessness and psychiatric illness. However, an ethics consultation was necessary for this to occur. Ultimately, this paper should serve as a call to action for standardization and prioritization of ethics education during and beyond medical training.

Introduction

The 1990 Patient Self-Determination Act, which incorporates patient preference into medical decision-making, has incited a paradigm shift in healthcare from paternalistic to patient-centered. Through this act, patients are empowered to play a role in decisions about their own healthcare, for example by making advance directives while capacitated or deciding how much, if any, treatment they desire. By definition, a capacitated patient can understand their illness and treatment options sufficiently to make decisions that are aligned with their personal values. Today patients often do make their own health decisions, however, their legal next of kin can be called on in the event of incapacitation (e.g. traumatic brain injury, stroke, psychosis) without an advance directive.[1]

The concept of self-determination empowers patients to make their own health decisions yet often falls short for unrepresented, incapacitated patients. Unrepresented patients, which include elderly, homeless, incarcerated, or mentally disabled patients, both lack advance directives and, "available friends or family to make medical decisions as 'default' surrogates".[2] These patients are a highly vulnerable population, necessitating a high level of ethical awareness from their healthcare providers.

Highlights:

- Self-determination falls short for incapacitated, unrepresented patients.
- Homelessness yields vulnerability in a hospital setting.
- Stigmatization of psychiatric illness may impair the autonomy of affected patients.
- Early and streamlined ethics education may mitigate autonomy-limiting treatment.

This ethical literacy can, and should, be implemented early in medical education. As described by clinical ethicists, the "necessity for the teaching of clinical ethics rests in the immutable fact that any serious medical decision involves two components—a technical decision requiring the application of knowledge of basic and clinical sciences to the patient's present problems, and a moral component demanding that the technically correct decision is also morally defensible".[3] When ethics and medicine collide, healthcare providers should be well-equipped to provide optimal care through robust medical and ethical knowledge.

This case-based discussion will highlight the need for improved ethics education in medical schools to mitigate provider uncertainty, as reflected in the care of an incapacitated,

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unrepresented patient. We will first discuss how providing autonomy for this patient requires an ethical understanding of medical decisional capacity and stigmatization of both homelessness and psychiatric diagnoses. We will subsequently address how early and streamlined ethics education can empower providers to advocate for patient autonomy. The subsequent case describes the treatment of a homeless, incapacitated, unrepresented patient who presented to our institution refusing treatment for a possible life-threatening illness.

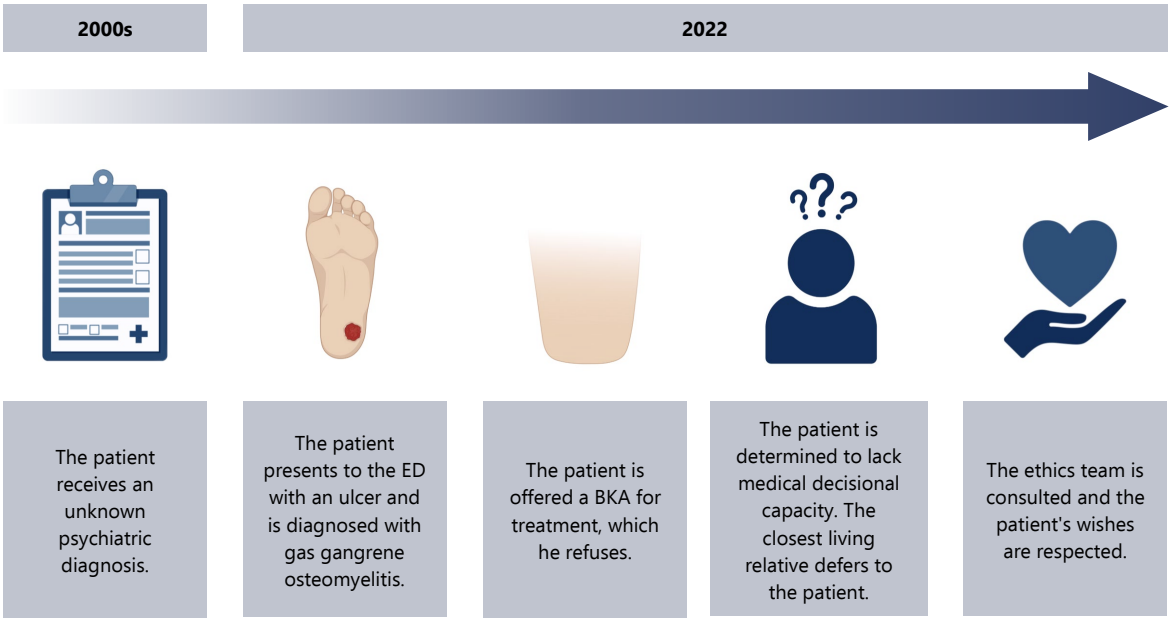
The Case

A 58-year-old homeless patient presented to the ED for evaluation of an infected foot wound (*Figure 1*). The patient's brother endorsed a prior hospitalization, during which the patient received a psychiatric diagnosis that he did not disclose to his family. There was no other known medical history. Imaging demonstrated a heel ulcer associated with bone destruction, indicative of acute gas gangrene osteomyelitis. A psychiatric evaluation determined that this patient lacked decisional capacity and met the DSM-5 criteria for schizoaffective psychosis. The patient adamantly refused the recommended BKA but was amenable to intravenous antibiotic therapy. He stated that he knew people who had bad experiences with amputations in the past and believed that his antibiotics would cure him. The patient's closest living relative, a brother, deferred decision-making to the patient, whom he believed should make his own medical decisions. The ethics consultation team was contacted, and the brother's wishes were respected.

Discussion

In this case, an unrepresented, incapacitated patient was given autonomy in his care in lieu of beneficence, as he inevitably did not receive the most highly recommended medical care, the BKA (*Figure 1*). The ethical framework underlying this decision will be described, followed by a discussion of the need for streamlined ethics education in medical schools. We will begin with discussing ethical aspects of this patients care (decisional capacity, vulnerability of homelessness, stigmatization of psychiatric illnesses) which will substantiate a subsequent discussion of improved ethics education in medical schools.

Figure 1. Timeline Representing the Patient's Clinical and Ethical Course Prior to and During the Described Hospitalization. Pertinent Details Include the Prior Psychiatric Diagnosis, Presenting Clinical Signs, and Subsequent Ethics Committee Consultation.



Decisional capacity

The patient described was limited in his decisional capacity, yet consistently stated that he did not want the BKA and insisted on continuing with antibiotic therapy. As with the assumption of innocence in law, medicine deems patients capacitated until proven otherwise, and the responsibility to recognize incapacity falls on any licensed physician. Yet, most physicians fail to recognize incapacity due to a lack of training on the matter or limited knowledge of local guidelines. To determine capacity, a provider should adhere to their institution's legal and ethical standards, while evaluating the patient's ability to do the following.[4]

1. Comprehend the rationale for the proposed intervention.
2. Appreciate their current medical status.
3. Rationally come to a decision.
4. Communicate said decision appropriately.

Two established models of decisional capacity exist, called "four skills" and "sliding scale", but emphasis in recent years has shifted

towards values-based models which question the concordance of a patient's current and longstanding values.[5] In this shifting ethical environment, medical students may lack comprehension of the nuances of capacity assessment.[6]

Vulnerability of homelessness

This patient presented to the hospital without a home or local family and was accordingly predisposed to experience vulnerability and bias. A 2020 study by Gilmer et al demonstrated that homeless patients report a negative perception of healthcare due to worse health outcomes, less preventative care (43-56% have a primary care provider), and high hospital readmission rates.[7] These unfortunate experiences may, in part, be modulated by provider bias against this socially and medically complex patient population. When a provider is aware that a patient is homeless, the patient is more likely to report poor-quality treatment, particularly for mental illness, addiction, and chronic pain.[8] This sub-optimal treatment coupled with high readmission rates implies that homeless patients simply do not receive appropriate care or resources to stay out of the hospital. Whether due to provider negligence in creating a feasible discharge plan or patient failure to cooperate in the therapeutic relationship (e.g. via limitations to accessing insurance, prescription medications, transportation, or primary care services), homeless patients are more at risk for neglect of chronic conditions that may land them in the ED soon again for a preventable outcome. This was the case for our patient, who through years of neglected treatment for his diabetes and psychoses, found himself highly ill and vulnerable in the ED yet again. Neglect of this vulnerable population violates beneficence, the principle to do good on behalf of every patient. It is never too early in one's medical training to seek awareness of the vulnerability associated with homelessness.

Stigmatization of psychiatric illness

Another factor increasing this patient's risk for vulnerability is the health system- and physician-level bias associated with psychiatric diagnoses. Notably, patients with ischemic heart disease are less likely to receive guideline-consistent treatment (e.g. coronary artery bypass grafting, beta-blockers) if they also have schizophrenia or a related psychosis.[8] Due to associated communication barriers, patients with psychosis may experience a sense of implicit coercion, or the sense that they are being involuntarily compelled to make certain decisions. For example, a patient with dangerous psychoses may be coerced to remain in the hospital against their will. Although for their own safety, the unwilling admission of a psychiatric patient is not without harm. Implicit coercion by definition undermines patient autonomy and denigrates the therapeutic patient-provider relationship, leading to provider moral distress as well as patient dissatisfaction.[9] Implicitly coercive and autonomy-limiting treatment of patients with psychoses may illicit failure to cooperate in a therapeutic relationship and worsen their outcomes in the long run.[9] If the patient described in this case experienced implicit coercion in a healthcare setting, his perceived lack of autonomy may have encouraged failure to cooperate with prior medical recommendations, increasing his risk for disease progression to this current hospitalization. Patients with psychosis are a highly vulnerable population at risk for implicit coercion, limited autonomy, and subsequent rehospitalization, and awareness of this social stigmatization should be built into medical education.

Inconsistencies in ethical curricula across medical schools

Successful treatment of patients in socially marginalized groups (e.g. without a home, or with a psychiatric diagnosis) requires a commitment to the ethical principle of patient autonomy. Moreover, inadequate ethics education may inhibit providers from responding quickly and appropriately to ethical dilemmas in patient care. However, strong ethical awareness is not without strong ethics education. Thus, the authors propose standardized and hands-on ethics training among healthcare providers to provide optimal care for similarly incapacitated, unrepresented patients. To achieve this goal, the current state of ethics education requires restructuring.

A 1985 article "Basic Curricular Goals in Medical Ethics," argued that medical ethics should be a required component of the medical school curriculum, and this notion was added to the Liaison Committee on Medical Education standards the same year.[10] Subsequently, medical educators began to incorporate human ethics into their courses, yet the early implementation of ethics education was fraught with inconsistency. Two decades later, in 2002, among syllabi at the 58 responding medical schools, there were ten course objectives, eight teaching methods, 39 content areas, and six assessment methods.[11] This non-standardized, lecture-based education model may insufficiently or inconsistently prepare students to develop medical ethics literacy before they enter the clinic.

Proposed ethics curriculum for medical schools

An optimal ethics curriculum would empower students to step outside of the textbook and think critically. Through a hands-on curriculum that introduces real-world clinical experiences of providers and patients, students can challenge each other and discuss their uncertainty in a non-clinical setting. Subsequently, these students may be more comfortable questioning ethical decision-making as clinicians. More hands-on models have been successfully implemented in several medical schools. For example, the Students' Medical Ethics Rounds (SMER) model of ethics education, where students role-played, had discussions, and conversed with experts, improved confidence in tackling ethical problems in 89.8% of participating students.[12] This model provides students with early exposure to ethically complex topics, which will increase their capacity to address ethical uncertainty and ultimately improve patient care. A standardized, clinically applicable ethical training model would equip students to challenge ethical dilemmas as they arise, ultimately improving patient care.

In summary, in this case-based discussion, we outline ethical aspects of treating an incapacitated, unrepresented patient including decisional capacity, the vulnerability of homelessness, and the stigmatization of psychiatric illness. We subsequently address the need for standardized ethics education to appreciate these dilemmas. Without providers committed to a critical awareness of capacity and vulnerability, the patient described may have been subject to an undesired amputation. When highly

vulnerable patients require medical care, a strong ethics foundation can improve their provider's understanding of the way forward. By challenging healthcare students early in their careers to be critical of autonomy-limiting decisions, we can better care for a common yet unjustly treated population: the unrepresented, incapacitated patient.

Summary – Accelerating Translation

Title: A Case-Based Call to Action for the Standardization of Medical School Ethics Education

Main Problem to Solve: Healthcare providers are inconsistently trained to care for ethically complex patients, for whom there is uncertainty in determining who will or how to make appropriate medical decisions. In ethics curricula at 58 medical schools, there were ten course objectives, eight teaching methods, 39 content areas, and six assessment methods (11).

Aim of Study: To propose a revision of ethics education in medical schools, through analysis of an ethically complex patient's story.

Methodology: A patient's hospital experience is first described, then specific ethical aspects are addressed, followed by a discussion of current and proposed medical school ethics education models.

Results: The patient described does not have the ability to consent for himself, however, he requests a treatment that is not medically recommended. This poses an ethical dilemma for his healthcare team, who decide to respect his wishes after consultation with an ethics committee. Were it not for consultation with the ethics committee, it is unlikely that each provider could address this dilemma with certainty.

Conclusion: Ethics education lacks uniformity. Thus, earlier, more clinically applicable ethics education models are necessary for the early stages of medical training. Moreover, increased provider comfort in addressing ethical uncertainty will promote patient-centered medical care.

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Interview

The Life of an Editor: Dr. Russell Van Gelder, MD, Ph.D., Editor in Chief of Ophthalmology, the Journal of the American Academy of Ophthalmology

Malina-Maria Cernatescu,[1] Juan C. Puyana,[2] Francisco J. Bonilla-Escobar.[3]

Abstract

In this insightful interview article, we delve into the life and role of Dr. Russell Van Gelder, MD, Ph.D., Chair of the Ophthalmology Department at the University of Washington and Editor in Chief of Ophthalmology, the Journal of the American Academy of Ophthalmology. Driven by a profound passion for literature, he emphasizes the enduring impact of scientific publications as fundamental to knowledge. He views curating this literature as a privileged responsibility, ensuring its enduring quality. Dr. Van Gelder acknowledges the complexities of predictive editing and the challenges of identifying impactful papers. He let us dig into the editorial process at Ophthalmology as we learn about its rigor, involving meticulous screening, comprehensive reviews, and constructive feedback. For aspiring editors, he underscores the importance of a genuine love for literature and the value of constructive criticism. Dr. Van Gelder addresses common misconceptions about the editor's role, highlights the ethical aspects of publishing, and advocates for a focus on content quality, especially in a world marked by predatory practices. He shares a memorable encounter with the work of Clyde Keeler, a scientist from the early 20th century, underlining the timeless nature of literature as a repository of knowledge that transcends generations. In essence, Russ, as affectionately referred to by colleagues, offers a deep understanding of the life of an editor dedicated to preserving the integrity and excellence of scientific publications in the field of ophthalmology. His perspective is distinctively important for medical students and early careers physicians, underscoring the crucial role that editors play in the advancement of scientific knowledge.

Introduction

Editors of peer-reviewed clinical journals, often coming from clinical backgrounds rather than having formal editorial expertise [1], are in a position where their competence could greatly benefit from proper editorial training.[2] Surprisingly, since 1998, it has been observed that many journals do not typically provide training for their editors.[3] Despite the understanding that "one always stands on the shoulders of those who came before,"[4] there has been a gradual increase in the need for standardized training opportunities, in addition to learning from others. However, a significant deficiency in the quality and effectiveness of these training initiatives still exists.[5]

It is crucial to ensure that the publications overseen by editors of medical journals maintain the highest standards of quality and integrity. Only the most credible and valuable research should be shared with the medical community and, ultimately, the patients who rely on it for their well-being. This is of utmost importance as biased and incomplete reporting of research findings can have severe consequences, including patient harm and misjudgments regarding treatment.[5] In the context of clinical trials, it is crucial to recognize that the incidence of fraud is not negligible.[6] Additionally, research coordinators frequently encounter instances of misconduct, with only approximately half of these cases being reported.[6,7] This makes the role of an editor akin to that of a detective and a goalkeeper, with one striving to uncover issues or suspicious clues and the other endeavoring to prevent biased research from being published.

Editors also play a vital role in adapting to the ever-changing landscape of medical publishing. In the digital age, they are increasingly responsible for ensuring the integrity of data, particularly given that issues like image manipulation can be inconspicuous in today's technology-driven world.[8]

The role of an editor is central in managing this intricate process, as authors may have vested interests in their research outcomes, and reviewers may bring their own perspectives to the table. Editors must maintain a delicate balance and ensure that the

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ultimate focus remains on the journal's readers, who seek accurate, reliable, and clinically relevant information.

Methods

In this illuminating interview article, we delve into the life and role of Dr. Russell Van Gelder, MD, Ph.D., a prominent figure in ophthalmology, serving as the chair of the Ophthalmology Department at the University of Washington and as the Editor in Chief of Ophthalmology, the Journal of the American Academy of Ophthalmology (AAO). Through a series of questions asked during a conversation with Dr. Russell Van Gelder, MD, Ph.D., he shared his insights and experience with medical students worldwide. The conversation aimed to delve into the editorial process at Ophthalmology. We sought to understand its rigorous nature, dispel common misconceptions about the editor's role, emphasize the ethical aspects of publishing, and advocate for a heightened focus on content quality. This is particularly crucial in a world marked by predatory practices. Furthermore, guidance was offered for aspiring medical students keen on integrating the editorial role into their careers.

The Interview

Please tell us about yourself and the positions you currently hold

I'm Russell Van Gelder, from University of Washington, chair of the department of ophthalmology. I've been here for 16 years. I grew up in the New York area. I went to college, medical school and graduate school at Stanford in California. I did my internship there, then went to Washington University in Saint Louis for ophthalmology residency. I stayed there for a uveitis and medical retina fellowship and then stayed on faculty for another eight years at Washington University before coming here in 2008. I've been the Editor in Chief of Ophthalmology for about a year and a half. I took the helmet in February of 2022 and prior to that, I had been an editorial board member at that journal since 2013. I think I was on the editorial board of American Journal of ophthalmology for about 10 years before that. I was an associate editor at Investigative Ophthalmology and Visual Sciences for at least 10 years. I was also an associate editor at Translational Vision Science and Technology (TVST). I wrote a column and was an associate editor for many years at the journal of Ocular Immunology and Infection. So, I had a fair amount of editorial experience before I came into the editor in chief position. I've only been in academia, and all my editorial experiences are in vision science and ophthalmology, so that's what I do.

What motivated you to become an editor?

My motivation to become an editor stem from my upbringing in an academic family, where my father worked as a wildlife biologist. Surrounded by writers and editors, I was encouraged to write from a young age and had the freedom to explore a wide range of literature. However, my deep love for literature goes beyond familial influences. I am driven by the understanding that, 50 years from now, the enduring legacy of our present-day efforts lies in the papers we produce. Unlike lab notebooks, which may be lost or forgotten, literature persists as the foundation of our collective knowledge. The pivotal point in the journey from discovery to practical application is the scientific publication of this knowledge. It is a privilege to serve as a curator of this invaluable literature, ensuring that the material preserved for future generations is of the highest quality and significance.

Since you mentioned "curate," we have observed situations where a prestigious journal rejects a paper, only for that very research to later receive a Nobel Prize. What role does an editor play in these circumstances?

Well, you're not going to get them all right as the curator and it is much more of a curatorial job than an editorial job. You know people think of editing as rewriting and sharpening. My brother was editor and is now publisher of the magazine Fantasy and Science Fiction and when he edits, he curates first, he does choose his papers, but then he works with the authors very intensely to try to sharpen their writing and improve it, and a book editor really spends a great deal of time doing that. We don't spend as much time doing that and so most of the job is really curation and selecting which papers will have the broadest impact. I don't think you ever have a crystal ball to say "this is going to be the most important thing". So, you do the best you can at the time and say "this will be a broad interest to our readership", "will our readers want to read this paper?", "will it change how they practice medicine for us?" and that's really the criteria that we use. So, if I ever pass on a Nobel Prize winning paper at some point, I don't think I'll have any regrets.

There's a lot of great work that's never going to get a Nobel Prize and then there a few things that have gotten Nobel Prizes that maybe weren't necessarily the greatest scientific papers. It's too hard to predict.

Figure 1. Dr. Russell Van Gelder, MD, Ph.D., Editor in Chief of Ophthalmology, the Journal of the American Academy of Ophthalmology.

Can you briefly describe the primary roles and responsibilities of an Editor and how do you arrive to an editorial position?

The primary roles and responsibilities of an editor typically involve assessing submitted papers for interest and quality, assigning papers to editorial board members, and managing the publication process. To become an editorial board member, one is usually invited by the Editor in Chief based on their performance as a reviewer and their expertise in the field. Reviewers play a crucial role in the editorial process by evaluating manuscripts and providing feedback. Those who consistently excel as reviewers are often considered for editorial board positions.

At Ophthalmology and all of our family journals, the editor in chief still reserves the decision prerogative to make the final decision on a manuscript. But, in some journals the associate editors have that power, and they will make the accept or reject decision without the editor in chief being involved.

Reviewer and Editor positions can serve as training for becoming an Editor in Chief, with additional responsibilities such as assembling journal issues, shaping the journal's direction, making policy decisions, and ensuring the timely publication of high-quality content. The Editor in Chief oversees the entire editorial process and holds the final decision-making authority regarding manuscript acceptance or rejection.

What about the editing projects that you are particularly proud of?

We have done a few things in the journal that are, I think, relatively innovative. We launched a journal club this year online, where we feature one paper and have an expert really dissect the paper for our readership. That's been quite popular: it's drawn hundreds of people to view these, and I think it's a value add. We've also done very well with our social media presence. That's a new area, obviously, in the publishing world, relatively speaking. I just saw the numbers. We have a podcast that we do around our literature in ophthalmology and we're at 220,000 downloads on our podcasts at this point. So, that's really getting the literature to a very broad community which is what we want to see – people are actually engaged in the papers that we're publishing.

We have a social media editor, who's an associate editor, Lorraine Provencher, and then we have four social media editors, and their responsibilities include hosting the podcasts and also curating our social media feeds (our Twitter and Instagram feeds). So, they'll pull things from the papers and highlight them and put them on X or Instagram and basically just keep people's interest in the literature.

What can you tell us about the Associate Editors of Ophthalmology?

We currently have six Associate Editors, each with varying responsibilities based on the workload of their respective areas. For instance, our Associate Editor for the retina section, Andy Schachat, is currently handling 25 active manuscripts. Andy Schachat is a notable figure, having previously served as the Editor in Chief of Ophthalmology. It's worth mentioning that we have term limits for the editorship, with a maximum tenure of 10 years, including the possibility of renewal. Andy served a full 10-year term as the Editor in Chief and still enjoys his role, so when his board term was ending, he expressed his willingness to continue as an associate editor.

Additionally, we have an impressive lineup of former and current editors in chief from other renowned journals serving as associate editors. This includes the former editor of JAMA Ophthalmology and the former editor of the British Journal of Ophthalmology, among others. The expertise and experience of these individuals significantly contribute to the efficiency of our editorial team.

Furthermore, we have a dedicated editorial team of five members who collectively oversee our family of four journals: Ophthalmology (our flagship journal), Ophthalmology Retina, Ophthalmology Glaucoma, and Ophthalmology Science. These journals operate cohesively as a family, allowing us to transfer manuscripts between them when it's deemed appropriate and with the consent of the authors. Our success is measured collectively as a family of journals, and our goal is to consistently publish outstanding scientific literature.

At IJMS we have a team of editors that mostly comes from the batch of student editors but they handle around 3 articles at a time. What is your opinion about this?

Where you (students) are at, is a different stage. There's a learning curve on this. Usually, you start out doing a lot of reviews for journals that may not be as impactful as some of the journals that you end up working for, and that that's part of the process, that's natural. I think I was an associate editor of Molecular Vision for many years. It's not an enormously impactful journal but I learned a lot doing the work for that journal.

Could you walk us through your typical editing process?

The process begins with the submission of a paper to our journals, which are published by Elsevier but owned by the American Academy of Ophthalmology. The papers are uploaded to the Editorial Manager system. Our editorial staff conducts an initial check for plagiarism, formatting compliance, and adherence to author instructions. If the paper passes this stage, I review the abstract, figures, and tables. If it doesn't align with our readership's interests or our typical publishing scope, I may reject it. After this initial screening, promising papers are sent to associate editors for further evaluation. I sometimes ask the associate editors for their opinion on whether the paper is novel or pertinent to our field.

Since our readership consists of ophthalmologists from all around the world, I must think about them when accepting a paper. If a subject is too narrow, if it does not look like an area of research that we typically publish, then I reject it immediately, so that the authors can quickly move to another journal.

I should mention our journal is a member benefit for the American Academy of Ophthalmology. The 17,000 US members of the Academy all get the journal in print form every month, and then it's available online for all our 26 thousand members worldwide. It's a big subscription base for the size of the field. And I must be very mindful that when they get that blue journal the mail and open it up, "a new technique for peripheral retina Retinopexy" is going to be of interest to a very small fraction of our readership, and that's a reason for ophthalmology journal to pass on it. But there's also ophthalmology retina and that is read by the 3000 retina specialist in the US and they might open it up and say "wow that's interesting", so we try to get the paper to where it will have the best readership.

When I come across an intriguing article but I'm uncertain about its potential broad appeal, I forward it to one of my associate editors., often with a note attached to it saying, "this paper looks interesting, is this novel?". I don't know everything in the field, and I can't tell sometimes if "something's been done before or not", "what's the incremental knowledge here" and if "this is the right design".

The papers may be rejected if they're too similar to recent work or if there are design issues. Authors may be offered the option to transfer their work to another journal within our portfolio. We always aim to direct papers to the journals where they will find the most relevant readership.

Following the initial submission, papers undergo a review process. At this stage, our Associate Editors and members of the editorial board provide their initial recommendations, which can range from acceptance to revisions. I may offer overarching guidance on necessary revisions when the situation calls for it.

After the article returns from review, typically the Associate Editor or an Editorial Board member will furnish an initial recommendation. It's exceedingly rare for a paper to be accepted outright; I can't recall ever accepting a paper without suggesting potential improvements since there is usually room for enhancement. These improvements are typically informed by the combined feedback from the 2-3 reviewers and the editorial board member.

Occasionally, I may also contribute a higher-level recommendation. While I seldom delve into minute details like specific line edits (such as removing a comma from line 41), I might provide more general feedback. For example, I could suggest that the core message of the paper is somewhat limited, despite its importance, and recommend condensing it into a report for further consideration. In some cases, I may advise authors that their submission essentially comprises two separate papers, each addressing distinct questions. Given the constraints of our printed journal, where page space is limited, I may suggest shortening the paper, a recommendation authors usually follow. This approach is necessary to ensure we can effectively manage the publication of approximately 10 papers and 2 reports each month while balancing page space constraints.

One of the nice things we have is that we are considered the most impactful journal in the field. So, our impact factor is sitting up around 13.7, which is healthy for a specialty journal, that's the same territory as Proceedings and National Academy of Science or Cancer Research or some of the bigger journals out there. We're about five points above the next general ophthalmology journal, so I think people want to have their work in our journal, because their visibility is higher, so when we ask for people to modify their papers, they're usually happy to do that in order to get it published in Ophthalmology.

Have you continued to develop as an editor like training or something you can mention for future generations?

We've actually gone the other way and we are setting up our own editorial mentoring program within Ophthalmology (not just our journal but the 7 major Journals in Ophthalmology, Optometry and Visual science) entered into a consortium, where we are training the next generation of editors, through a selection process, paired mentoring to really create people who are very thoughtful about the literature. We're just launching it this year. Our first session is going to be at ARVO 2024 which will be here in Seattle. I anticipate I am going to learn as much as the trainees, especially the first run or two through this, from my colleagues. At the editor in chief level, you don't have any mentors except previous editors in chief. And I have learnt a great deal from the last editors of our journal. But the opportunity to interact with the other editors in chief from the journals in our field I think is how I will get the most of my learning.

How have you adjusted to evolving landscapes, particularly in terms of technological advancements?

The realm of technology is constantly evolving, and it's crucial to surround yourself with individuals who possess a deep understanding of these technological developments and their practical applications. I belong to a generation that didn't grow up with innate familiarity with social media. That's why I value the presence of our five social media editors, all of whom are younger than 40. They play a pivotal role in keeping me informed about the nuances of various social media platforms such as Instagram, X, and TikTok, along with their respective strengths and weaknesses.

To stay ahead of technological changes, it's imperative to have a team that comprehends the ever-shifting tech landscape. However, there's also a timeless quality to the scientific literature. I've ventured into the archives at the Health Sciences Library to retrieve papers dating back to the 1920s. When you delve into those historical papers, it feels like stepping into a time machine. The process of scientific discovery remains remarkably consistent. It's worth noting that someone a century from now, perhaps in 2123, will be able to visit a library, locate one of the papers I edited, and appreciate that a hundred years ago, this

foundational knowledge was established. Preserving this timeless essence of literature is of paramount importance because it means we are effectively preserving knowledge at a particular point in time for the benefit of future generations.

What do you know about Artificial Intelligence (AI) and how it's going to affect our work?

We've addressed this issue in a recent editorial, and our stance, is that AI, such as chatGPT, cannot serve as a co-author [9]. Co-authors must understand and take responsibility for the paper's content, which AI cannot do. AI's capacity for hallucinations and other inaccuracies further reinforces our reluctance to have authors vouch for AI-generated content. However, there's a range within artificial intelligence, and we permit the use of AI tools like spell checkers or readability-enhancing apps. These can be helpful for clarity. AI is a tool, not a substitute, and while it can assist in improving writing clarity, someone must ultimately take responsibility for the final output. We don't want incorrect information cited in our journal due to AI errors.

What about the other way so you're mentioning the author side, what about the editor side with chat GPT?

The use of any AI system in a trial process inevitably requires a training process. For example, I could potentially establish an AI to assess every abstract and determine whether it merits a review. However, this approach would essentially institutionalize my existing biases. I'm cautious about entrusting editorial authority to an AI because it needs to be trained, and my implicit biases differ from those of others. These biases are not related to race but rather to scientific preferences. I might, for instance, tend to dismiss papers like small surgical series outcomes that lack a control group or comprehensive patient selection. Such papers must meet a very high bar for me to consider them novel surgical techniques worth publishing. If I trained an AI to mimic my decision-making and reject abstracts, it would likely lead to the rejection of valuable papers, even the rare one in 100 that genuinely merits publication. Consequently, I currently see limited utility for AI in our editorial process.

What advice would you give to early career editors?

First and foremost, it's crucial to distinguish between an editing career and editorial service. Full-time editor positions in biomedical literature are exceedingly rare, with the New England Journal possibly being one of the few exceptions. To make this a significant part of your career, consider the following advice.

1. Passion for Literature: Only pursue this path if you have a genuine love for literature. If the idea of spending your free time in a library is appealing, this might be the right job for you.
2. Not for Recognition: Don't do it for the prestige or recognition. Editorial roles often involve making tough decisions that may not sit well with everyone, so thick skin is essential.
3. Say Yes to Opportunities: Embrace every opportunity to engage in the editorial process. If asked to review a paper, accept the task. When you do review a paper, seek feedback from the editorial board on the quality of your review and how it could be enhanced. Avoid excessive detail; focus on summarizing why you find a paper worthwhile or not. Explain what questions or concerns arise when reading the paper and how it could be improved.
4. Constructive Criticism: Instead of merely stating a paper is not good, provide specific insights. Ask yourself, "If I were an author on this paper, what would I have done differently?" This is the type of feedback that authors find valuable. For instance, if you would never submit a paper based on a small sample size, make that clear in your review. If a figure is unclear, suggest how it could be improved.

Remember that being an effective editor requires a deep passion for literature, a willingness to accept criticism, and the ability to provide constructive feedback that helps authors enhance their work.

What are some common misconceptions about the editor's role?

It's somewhat challenging to gauge because people's perceptions of the editor's role may vary. As an Editor in Chief, there might be an impression that you possess more authority than you typically exert. In reality, I rarely override the decisions of my associate editors or editorial board members. I can count on one hand the instances where I've overturned their recommendations, whether they suggested rejection and I opted for acceptance, or vice versa. I seek their opinions for a reason, and I highly value their expertise.

Authors sometimes receive rejection and then approach me, suggesting that the reviews weren't excessively critical and asking for reconsideration after making revisions. What I'd like to convey to them is that they're appealing to the wrong party. The reviewers and editorial board members were the ones who determined that the paper wasn't suitable for publication, and my decision aligns with their judgment. Unless there's a significant flaw in the process, such as a conflict of interest issue, I'm generally in agreement with their assessments.

For example, we maintain a rigorous system to ensure our editorial board's integrity. We require them to disclose any perceived conflicts of interest, updating this information annually. Other journals may not be as diligent in this regard. If a paper on a certain drug goes to an editorial board member who has a financial connection to a competitor of that drug, and the paper is rejected, authors may question the fairness and impartiality of the decision. In such cases, I acknowledge the issue and agree that it was not handled correctly. However, we seldom encounter such situations, as we make efforts to be aware of potential conflicts among our editors.

Can you give advice to early career researchers to enhance the quality of the work?

Unfortunately, we're in this "publish or perish" world, where people feel compelled to publish everything they do and to show that their time was well spent by publishing. That is an error, a lot of work should not be published. If you don't have a clear answer to something, don't just dump the data out there, it's not useful. Concentrate on the work itself. If you do good work, you will be published in good places. Be extremely rigorous. Be your own worst critic by far. You never want someone to come back with a review that finds things that you didn't see. If someone says in a review "this paper is flawed in the following way" and you're like "Oh my God it is", that should never happen. You should have anticipated everything that is not right and you should fix it before you do the work. So, doing a flawed experiment and saying "well it's flawed but I'm going to publish it" really doesn't do any favors to anybody. In this day and age, I think that publishing work anywhere will get recognized. In the old days you had to publish in journals that had subscriptions and that libraries picked up. Now with Open Access anyone could find your work anywhere, which is great. Don't get hung up on the percentage of the journals that you're publishing in. You can publish great stuff in low impact factor journals and that's fine, people will recognize good work when they see it. Pick your questions carefully and answer them and design your experiments as well as you can. I do tell my students that you can pick your question, you can design your experiments, you can execute your experiments and you can interpret your experiments, the only thing you can't pick is your results. So, keep that in mind: your work is really just to plan and to execute and that the results will be the results.

Can you share a memory or impactful experience from your career?

It's somewhat challenging to pinpoint uniquely impactful papers, as I recall some of the papers we turned down more vividly than those we accepted. We encountered a few substantial clinical trials that came our way, and despite the significant effort and resources invested, we identified fundamental flaws that led us to decline their publication. For instance, in a well-designed clinical trial, endpoints are pre-specified, and the analysis plan, such as intent-to-treat, is defined. If a study initially commits to an intent-to-treat approach but then switches to presenting data based on actual treatment outcomes due to dropouts, it raises questions about why individuals dropped out and how this might skew the results. We made the decision not to publish such papers, even if they later found their way to more impactful journals. This is something I take pride in, as we prioritize quality over chasing impact factors.

In the publishing landscape, some journals are profit-driven, relying on advertising or charging high fees for open access publishing. They may use their impact factor to justify these costs to authors and advertisers. However, as a not-for-profit organization, we focus on delivering content that serves our members' interests rather than chasing a high impact factor. We place greater value on maintaining our integrity and ethical publishing practices over maximizing profits.

Is having sponsors in a journal a concern?

It's a matter of caution. Advertising is acceptable to sustain operations, as someone needs to cover the costs. From my perspective, literature should not be a profit-driven endeavor, and that's a fundamental belief. I hold the view that hospitals and literature shouldn't be driven by profit motives. While our journal operates on a not-for-profit basis, our publisher, Elsevier, is profit-oriented, generating substantial revenue. Many publishers thrive on the contributions of volunteer reviewers and authors who pay to share their work. I understand the open-source movement, and pre-print servers, which offer valuable services to the scientific community. However, they lack curation and editing. In fields like physics, there's a culture of sharing preprints, but it's still evolving, and some preprint servers contain unsorted content.

The NIH, as a primary research funder in the US, has only recently caught up to 2004 funding levels in real terms after two decades with minimal increases. Despite this, the volume of published research has doubled since 2004. This suggests that increased efficiency isn't the sole reason; it's often because academic institutions equate publication numbers with productivity. They assess factors like the number of papers, where they're published, an author's h-index, and journal impact factors. Some institutions even use formulas that multiply paper count by impact factor. This system can be manipulated, leading to questionable publications. For instance, a paper titled "What's the Deal with Birds" was published in the "Scientific Journal of Research and Reviews" with peculiar tables and graphs [10]. It's an extreme example, but it illustrates the issue. The key advice is to focus on producing high-quality work, and the rest will follow naturally.

Is any there any particular piece of work that left a lasting impact on you?

When I was a young faculty member entering the field, an older colleague advised me to explore the work of Clyde Keeler, who had a long history in the area. Clyde Keeler, born in 1900, published from 1928 to 1992, amassing 72 years of publications. He made notable contributions, including the discovery of the retinal degenerate mouse in 1920 [11]. I delved into his papers, which I found in the library, and was amazed by its brilliance. This experience, around the year 2000, revealed that Keeler had tackled the same issues I was contemplating 80 years earlier, using the technology available at the time. He examined pupillary light responses with a metronome and a ruler to graph time because computers and advanced tools were unavailable. It taught me that literature is a frozen repository of knowledge and intelligence, allowing communication across generations and time, which left a lasting impact.

Summary – Accelerating Translation

In summary, the interview with Dr. Russell Van Gelder, Editor in Chief of Ophthalmology, provides a comprehensive view of academic publishing and editorial responsibilities. Dr. Van Gelder's dedication to curating scientific literature, commitment to quality over quantity in research and publishing, and emphasis on staying updated with evolving technologies underscore the key principles for success in this field. His insights into the role of an editor, the evolving publishing landscape, and the importance of maintaining ethical standards in an era of profit-driven models offer valuable guidance to early career researchers and aspiring editors, ultimately highlighting the enduring pursuit of knowledge and integrity in academic publishing.

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IJMS INTERNATIONAL JOURNAL of MEDICAL STUDENTS

Experience

From Symptoms to Diagnosis: A Medical Student's Experience in Solving Her Own Mystery

Madeline Franke.[1]

Introduction

As a medical student, you are thrown into a field that requires astute pattern recognition and memorization of any disease or condition that could disrupt the human body. Your priority is to acquire as much knowledge as possible regarding the signs, symptoms, and presentations of common and rare afflictions alike. Oftentimes, this knowledge holds the power to eventually recognize minute details of an individual and identify what has shaken their body from their baseline health. However, what happens when a medical student feels an ache in their body similar to the one they have been learning about? What might go through their head when their own symptoms line up with cases from their textbooks? While it is true that medical students often mistakenly identify themselves with symptoms they do not possess, the set of skills they acquire through years of schooling may sometimes help provide the answers they are searching for.

I remember beginning my third year of medical school with an unwavering enthusiasm for what I was about to encounter. That was the year we started clinical rotations, which was when we finally got to put years of book learning and simulations into practice with real patients. A few months into my clinical training, I became aware of an overwhelming fatigue that I confronted every day, despite increasing the number of cups of coffee. I quickly dismissed how I felt and attributed it to the endless cycle of early mornings, long days, and late-night study sessions. However, I realized that no amount of sleep gave me relief and my evening naps became longer and longer. This fatigue lasted months and I could not seem to shake it. At this time, I began to further investigate my body and its symptoms. I noticed that I became cold very easily and my eyes were paler than usual. Finally, I saw my doctor who told me after some basic blood work that my tiredness was most likely due to an iron-deficiency anemia because that was common in young women my age.

As luck would have it, I started my internal medicine clinical rotation on the benign hematology subspecialty. It had been months since my doctor had diagnosed me with iron deficiency anemia, but no amount of iron pills or diet change had relieved my fatigue. I still felt as though something was not right. After weeks of working closely with the best hematologists at my hospital, I heard an offer I could not pass up, "Would you like to look at your own blood under the microscope at my clinic?"

For some reason, I felt the weight behind that statement. Through my schooling and clinical experience thus far, I had all the skills to look at a peripheral blood smear and understand a patient's diagnosis. I could glance at blood cells and know immediately what the patient was probably experiencing, how they might be feeling, and how to best treat them. I had never had the chance to look closely at my own blood, but I felt like this was the chance to see clearly what was going on with me from the inside. I made a blood slide and slowly adjusted the powerful microscope to view the smallest parts of me. Instantly, I knew. I knew what was causing my fatigue and saw what I had only ever seen in textbooks. Clear as day, I saw that my red blood cells were small, pale, and misshapen. Lectures on microcytic anemia flooded my mind as I examined the slide filled with characteristic "target" cells. Only two things cause microcytic anemia – iron deficiency and thalassemia – and only one of them causes target cells. I saw thalassemia, a genetic mutation affecting an important protein involved in creating healthy red blood cells. The reason for months of exhaustion was no longer intangible, it was as lucid and real to me as a broken arm or stubbed toe (*Figure 1*).

After further testing I received the diagnosis of "β-thalassemia," which is a genetic condition of varying severity that affects 1.5% of the population worldwide.[1] β-thalassemia is an inherited hemoglobinopathy, which means that it causes defects in the synthesis of normal hemoglobin that can lead to small, ineffective red blood cells.[1] Specifically, I had a mild form of β-thalassemia, called β-thalassemia minor, which is clinically asymptomatic unless certain stressors are present.[2] It is important to note that I could not have determined the exact subtype of thalassemia on my own without seeking further care from my doctor. Self-diagnosis is not the end, but the beginning; the purpose of having an awareness of your health is to recognize the need for further evaluation, and not to stop at a preliminary diagnosis.

Although it will not cause major health problems in my life, the importance of establishing this diagnosis was quickly discovered. Upon learning that I had this "thalassemia trait," I found out that

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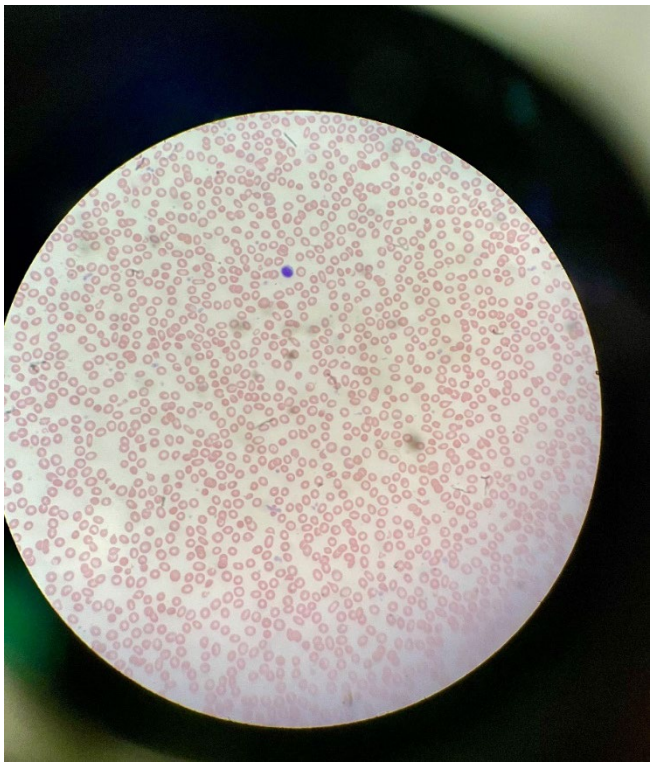
my mother also has a mild form of β-thalassemia, which opened a conversation about her genetic and ethnic background. I also had to make sure that my partner did not have a similar genetic mutation, or there could be potential effects in our future children. Furthermore, I had to stop taking iron supplements because thalassemia can lead to a state of iron overload, which could be dangerous. Though there is no way to "treat" my fatigue, I now knew the cause of my symptoms and learn ways to better work around them.

Figure 1. A Window to The Body. The Image Depicts My Peripheral Blood Smear that I saw Through the Lens of a Powerful Microscope.



Medical students may be tempted to diagnose themselves with everything they are studying, even if they are experiencing no symptoms.[3] Colloquially called "medical student syndrome," it is a common experience that unites all well-studied new learners. However, my story serves as a reminder to not immediately dismiss the small voice that questions the status of your health. While we, as students, should stay away from anxiously diagnosing our own bodies with potentially irrational conditions, it is important to recognize that we are actively being taught to constantly recognize and synthesize a plethora of medical information. Careful consideration of this information and an educated awareness of the situation are critical to distinguish between a case of medical school syndrome and an actual disease. Although it is important to recognize that true abnormalities may not be present in our own bodies, I think that our unique medical training supplies us with the knowledge to identify variations from our baseline and find patterns that we would not have otherwise seen.

Summary – Accelerating Translation

Title: From Symptoms to Diagnosis: A Medical Student's Experience in Solving Her Own Mystery.

This experience highlights a third-year medical student's journey in using her new knowledge and clinical skills to identify whether or not the symptoms she began to notice in herself were only pieces of a larger picture. Her main problem to solve was the cause of her ongoing fatigue. This experience documents her moment of realization of her actual diagnosis. The aim of this story is to discuss the common feeling of "medical school syndrome," and bring awareness to the reality that a medical student's perception of their own body might be more credible than they think.

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Experience

My Experience Building a Water System in a Small Rural Community in the Dominican Republic

Rosemary Wright.[1]

The Experience

Clean water is vital for physical, social, and mental health. However, water insecurity is a public health threat for many countries. Water insecurity is defined as the inability to access adequate, reliable, and safe water needed for a healthy life.[1] Studies have shown that lack of clean water is associated with food insecurity, diarrheal disease, heightened blood pressure, poor mental health, and poor perceived health.[2-6] It is therefore essential to improve water-related intervention efforts.

Sabana Larga is a rural community of approximately 230 families located in the province of Dajabon on the Northwest region of the Dominican Republic. The community relies heavily on rivers and streams for domestic water use including bathing, washing, cleaning, and cooking. However, these sources are unreliable because of the irregularity and insufficiency of rainwater. All families in the community worry about the water conditions. Building a new water system has been a priority for the community for many years but has been delayed due to lack of funds and assistance in planning and building such a system. In 2016, as a Peace Corps volunteer living in the community, I asked the Saint Cloud Rotary club for financial support to build a new water system.

Objective

To share my experience during my Peace Corps service of building a water system in a rural community in the Dominican Republic with the support and participation of the Saint Cloud Rotary Club, the Dajabon Rotary Club, local engineers, and the local community. This information can help other medical students, who may have been or become actively engaged in their communities,[7-8] build similar water systems and related infrastructure in the Dominican Republic or other Caribbean countries to provide adequate amounts of clean water to these communities.

The Water Project

The water project was divided into three stages. The first stage was the installation of solar panels in a large field in Sabana Larga to retrieve solar energy to capture solar energy for generation of electricity (*Figure 1A*). This electricity was used to pump water from an already existing well 140 feet below ground. The water from the well was pumped to a newly built water tank described below. The solar panels were purchased in the nearby city of Dajabon and were transported and assembled by local community members.

The second stage was the placement of a 25,000-gallon water tank to provide sufficient water for the growing population of Sabana Larga (*Figure 1B*). The tank was equipped with valves and piping to each home. All the materials were purchased in one hardware store located in the city of Dajabon. All the items aligned with the local culture and technology available. The water tank was designed by local engineers and was constructed by community members. The Saint Cloud Rotary Club came to Sabana Larga in June 2017 for one week to help with the construction under the supervision of the engineers.

The third stage was the distribution of the water filtration systems to each household, the primary school, and the clinic (*Figure 1C*). Bio Arena, a Dominican company located in Dajabon, installed 125 water filters in 123 households, the primary school, and the local clinic. Prior to the distribution of water filters, most homes purchased water in plastic jugs or "botellon" from large trucks that pass by every other day. Each botellon holds five gallons and costs 150 pesos (~2.70 USD) for a new bottle or 40 pesos (~0.72 USD) for a refill. Each household used at least one botellon a day and the cost of such purchases represented a financial burden for many families. Households that were not able to afford the botellon instead used river water for drinking, introducing associated health risks.

The construction of the water system was successfully implemented between April 2017 and June 2017. The main aim of the water project was to increase access to clean water and reduce water insecurity for the community.

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Discussion

Several lessons were learned during the water project implementation. First, it was recognized that community involvement at every step of the project was imperative. As a Peace Corps volunteer, I arranged several community meetings to listen to the needs of the community (*Figure 1D*), understand future plans for building a new water system, and discuss the importance of the maintenance of such a system once established. The meetings also focused on local customs and traditions, leading to a stronger relationship between the community members and the other stakeholders, fostering a positive working relationship.

Second, a water committee was formed at the time of planning to oversee construction, performance, and maintenance of the water system. This was crucial because ultimately the community would take over the project. The committee consisted of ten members, each with a specific role. One concern for me was that only three women were included in the committee, and their roles were primarily administrative e.g., secretarial, with minimal decision-making responsibility. I recommend equal gender representation in all organizations and intervention programs in the future to empower women and girls.

Figure 1. Different Stages of Implementation of the Water Project in Sabana Larga, Dominican Republic.

Legend: **A:** Solar panels for electricity generation to pump water from the well. **B:** The 25,000-gallon water tank to store water for the community. **C:** Schematic of the Bioarena filters that was distributed to 123 households, the primary school, and the clinic. **D:** One of the many community meetings to discuss water-related needs.

Lastly, new skills were acquired during the process. Several community members gained construction skills; for maintenance and when repairs are needed, these community members will know how to fix the problem independently. If properly used with care, water systems last for decades. Financial management skills were also developed. The water committee was required to collect 50 pesos (~1 USD) from every family at the end of each month to maintain the water system. Ongoing financial responsibility will be required to ensure long term sustainability of the water system. I personally gained valuable communication and project management skills coordinating the diverse activities involved and communicating with multiple stakeholders during the process.

The new water system in Sabana Larga was successfully implemented with the help of several stakeholders including members of the local community and external partners. The new water system has improved access to clean and safe drinking water for the families, leading to a healthier community and better quality of life for everyone.

Summary – Accelerating Translation

Titulo: Mi experiencia de construir un sistema de agua en una pequeña comunidad rural en la República Dominicana

Sabana Larga es una comunidad rural con 230 familias ubicada en la provincia de Dajabón en el noroeste de la República Dominicana. Hay poca lluvia durante todo el año. La falta de agua impide que las familias se bañen, laven, limpien y cocinen. Todas las familias de la comunidad se preocupan por las condiciones del agua. La construcción de un nuevo sistema de agua ha sido una prioridad para la comunidad durante muchos años, pero la razón qué no hay un proyecto todavía es la falta de fondos y asistencia para construir este sistema de agua. Mi objetivo para este documento es compartir mi experiencia durante mi servicio en el Cuerpo de Paz de construir un sistema de agua en una comunidad rural en la República Dominicana con el Club Rotario de Saint Cloud, el Club Rotario de Dajabón, los ingenieros locales y la comunidad local. Esta información puede ayudar a otros voluntarios u organizaciones a construir sistemas de agua similares en la República Dominicana u otros países del Caribe para dar suficiente cantidad de agua limpia a las comunidades.

Entre abril de 2017 y junio de 2017 se implementó con éxito el nuevo sistema de agua en Sabana Larga. El sistema de agua mejoró el acceso a agua potable limpia y segura para todas las familias de la comunidad.

Se aprendieron muchas lecciones durante del proceso. Primero, era importante que la comunidad se involucrara en cada paso del proyecto. El voluntario del Cuerpo de Paz organizó varias reuniones comunitarias para escuchar las necesidades de la comunidad, considerar planes futuros para construir un nuevo sistema de agua y hablar sobre el mantenimiento del sistema de agua. En segundo lugar, se formó un Comité de Agua en el momento de la planificación para supervisar el correcto funcionamiento y mantenimiento del sistema de agua. Esto fue crucial porque la comunidad se haría cargo del proyecto en el futuro. Una cosa que observé fue que las mujeres en el comité de agua solo tenían roles simbólicos. Estos puestos dan poca o ninguna responsabilidad. Recomiendo la representación equitativa de género en todas las organizaciones y programas de intervención en el futuro para empoderar a mujeres y niñas. Por último, se adquirieron nuevas habilidades durante el proceso. Varios miembros de la comunidad consiguieron habilidades de construcción; si se necesitan reparaciones, estos miembros de la comunidad sabrían cómo solucionar el problema sin participación de extranjeros. Si se usan correctamente con cuidado, los sistemas de agua duran décadas. También se desarrollaron habilidades de gestión financiera. El Comité de Agua estaba obligado a recolectar 50 pesos de cada familia al final de cada mes para mantener el sistema de agua. Conseguí habilidades de comunicación y gestión de proyectos, ya que se esperaba que coordinara varias actividades y me comunicara con múltiples partes interesadas durante el proceso.

El nuevo sistema de agua mejoró el acceso a agua potable limpia y segura para las familias, lo que llevó a una comunidad más saludable y una mejor calidad de vida para todos.

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Experience

Mitigating Physician Emigration in Nigeria by Improving the Internship Experience

Faithful Miebaka Daniel,[1] Emmanuel Aniekan Essien,[2] Monica Anurika Gbuchie,[3] Bonaventure Michael Ukoaka,[1] Victoria Ezinne Emeruwa.[4]

Introduction

Access to healthcare is a fundamental human right. However, Nigeria, among other under-resourced countries, continues to grapple with healthcare infrastructure and personnel challenges, making it difficult to achieve the Sustainable Development Goal (SDG) of universal health for all by 2030.[1] The low doctor-to-patient ratio in Nigeria is one of the factors contributing to inadequate access to healthcare, which affects 63% of Nigerians.[1] This situation is worsened by the decreased interest in specialist training among interns, leading to healthcare worker shortages.[2] Additionally, many interns choose not to pursue medicine after completing their internships and show a growing preference to emigrate to developed countries.[2,3]

Nigerian doctors have various career options, including clinical practice, academia, research, medical advisory, medical entrepreneurship, and nonclinical pursuits.[4] During the compulsory one-year internship after graduation, they serve as first-contact physicians under supervision and decide on their career trajectories.[2,4] Several studies have explored the factors influencing interns' specialty preferences to foster equitable distribution across clinical expertise.[2]

International studies have highlighted the impact of internship experiences on career aspirations and emigration decisions.[3] They highlight why addressing the brain drain requires a critical focus on internships, a period where future specialists are nurtured and pivotal career decisions are made.[2,3] A recent study by Akinwunmi et al. revealed that 79.5% of interns intended to pursue medical practice in foreign nations, and over 41% planned to migrate within two years.[5] This coincides with the duration required to conclude their internship training and Nigeria's one-year compulsory National Youth Service Scheme.[5] The Nigerian Medical Association reported that 727 medical doctors trained in Nigeria relocated to the UK within six months between December 2021 and May 2022, while 5600 doctors migrated over eight years. Unfortunately, this trend is projected to intensify in the coming years, as medical stakeholders and the Nigerian Medical Students Association (NiMSA) opposed a bill that would mandate Nigerian-trained medical and dental practitioners to practice in Nigeria for a minimum of five years before being granted a full license to migrate abroad.[6] The Students' body has advised lawmakers to create a conducive environment and improve remuneration rather than enforcing laws that infringe on fundamental human rights and discourage prospective medical students.[6]

Negative Experiences of Interns

Adverse experiences during internships can profoundly impact doctors' personal and professional lives, making emigration more attractive.[2,3] The negative experiences that favor emigration are classified as push factors and summarized in *Table 1*. Interns often experience excessive workload and burnout due to long hours, understaffing, limited resources, and being delegated to perform non-core duties.[3] These experiences can lead to physical and mental exhaustion, decreased quality of life, loss of empathy, and depersonalization.[3] Nigeria's economic challenges have also led to increased financial constraints for doctors, making basic needs and support unaffordable.[1,2]

Early career doctors in Nigeria cite a lack of professional development and growth opportunities, a challenging work environment, and limited access to necessary equipment and support systems as reasons for migrating.[2] This trend contributes to brain drain and negatively impacts Nigeria's healthcare system.[2] The mistreatment of younger doctors has been reported as having severe consequences on their emotional well-being, job satisfaction, and professional development.[7] These can include verbal abuse, humiliation, intimidation, and excessive criticism, impacting their self-esteem and confidence.[7] The influence might be more pronounced in interns due to their early career stage and

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lack of experience, leading to powerlessness and frustration. Mistreatment and bullying also increase the risk of workplace violence against doctors, as public humiliation devalues the physician before patients, caregivers, and allied health workers.[7] Unsurprisingly, such experiences, especially when severe, would naturally drive doctors to seek opportunities that offer a more respectful, supportive, and enabling environment, which is sought after in other countries.[1,4,7] These multifarious challenges discourage Nigerian doctors in the diaspora who are willing to return.

Justification for Targeting the Realities of Interns

The career choices of young interns significantly impact the healthcare system of Nigeria. This factor plays a crucial role in determining the distribution of specialized services and the replacement of retiring healthcare professionals.[4] Currently, nearly 50% of Nigerian-trained doctors practice abroad, resulting in a considerable forfeiture in medical education investment and the lost practice years having a multiplier effect.[1] Nigeria was among the nine countries that, as a group, lost two billion dollars between 2010 and 2017 due to brain drain.[1]

Table 1. Push and Pull Factors Influencing Physician Emigration and Recommendations from Selected Studies.

Paper	Push Factors	Pull Factors	Negative experiences during the internship	Recommendations
Ikhide E.[1]	-Poor salaries -Working conditions -Inadequate medical facilities -Poor infrastructure	-Better working conditions -Prospects of higher salaries -Prospects of higher quality of life	----------	-Legislative collaboration to fulfill 15% threshold of the National budget for health -Increased health expenditure -Proper implementation of extant regulations guiding terms of service of doctors under government scholarships/
Ezeike C.et al.[2]	-Better pay -Better working conditions -To acquire skills -Better living conditions -Dwindling economic prospects of the country -Declining standard of medical education	-Improvement in working experiences -Improvement in working conditions	----------	-Improvement in working conditions -Early career guidance -Balanced exposure to all specialties
Cronin et al.[3]	-Burnout(emotional exhaustion) -Depersonalization -Negative perception of training -Negative experience as an intern -Opportunities for better training abroad -Poor supervision of postgraduate training schemes -Preference for foreign-trained specialist -Lengthy specialty training -Unpredictable training pathways and duration -Better opportunities for work-life balance abroad.	-Positive perception of training -Choice/ desire to specialize -Age (Older interns) -Graduate entry doctors(those who did medicine as a second degree)	-Low staffing levels -High non-core task allocation -Poor mentoring supports during training -Poor level of supervision during internship -Poor level of preparedness on starting work as an intern -High levels of stress in the working environment -High level of bullying in the workplace	-Reduction of non-core task allocation -Improvement in staffing levels -Improvement of working conditions -Improvement in the reputation of the country's health system as a destination choice

Nigerian interns often migrate to Western countries, such as the United Kingdom, the United States of America, and Canada, in search of better job opportunities, remuneration, and working conditions.[5,8] Another reason is the promise of better job security and health insurance coverage.[9] However, recent studies have shown a growing interest among Nigerian medical doctors seeking job opportunities in Middle Eastern countries, such as Saudi Arabia, Qatar, and Oman.[10] Moreover, specialized surgical fields have become increasingly popular among Nigerian medical practitioners in these destination countries.[2] The countries where Nigerian medical doctors have shown interest have a defined doctor-to-patient ratio, significantly reducing the likelihood of physician burnout, which is an important reason for medical interns' migration, particularly after the internship year experience.[10] Furthermore, these countries share leadership that supports and regulates universal healthcare, backed by efficient government funding and a robust national health insurance scheme.[3] These countries also have cutting-edge research institutions, an efficient nationalized health information system, and a preventive medicine approach that has influenced this trend.[3] This combination of factors has made these countries an attractive destination for Nigerian medical professionals seeking better opportunities

Given the substantial impact of interns' career choices on the healthcare system of Nigeria, it is justifiable to implement talent retention strategies that focus on interns. This approach maximizes the return on investment in medical education, ensures workforce stability, and secures future healthcare needs.[1,3,4] Improving internship conditions would also attract foreign-trained doctors to return for their housemanship, boosting the local workforce and increasing the likelihood of their

retention.[1] Addressing their concerns and providing mentorships that support their growth would foster their commitment to the country's health system. Younger doctors are more adaptable to changing clinical landscapes, which is advantageous. Therefore, it is essential to address their concerns and provide mentorship that supports their growth to foster their commitment to the country's health system.

Impact of COVID-19 Pandemic on Interns

The COVID-19 pandemic has had a significant impact on the healthcare system of Nigeria, with essential health workers, particularly doctors, being among the most impacted. In the first week of the pandemic alone, approximately 20 doctors in Nigeria succumbed to COVID-19 complications, highlighting the devastating effect of the pandemic on the country's healthcare workforce.[11] The pandemic exacerbated existing fragility in Nigeria's healthcare system. While no specific data links the continuous surge in internal migration to the COVID-19 pandemic, we speculate that the shift could be attributed to the unfavorable experiences many healthcare workers endured, such as shortages of personal protective equipment, limited screening services, and poor hazard allowances.[11] The lack of commitment to protecting doctors encouraged intern migration due to inadequate hazard allowances below $14, which is insufficient to cover treatment for potential COVID-19 cases.[12] Furthermore, the pandemic led to a shortage of essential healthcare workers, thereby increasing the burden on the few available and contributing to the migration intentions of healthcare professionals within and outside the country.

Addressing the Challenges

To retain Nigerian doctors, healthcare systems and policymakers must prioritize creating a work environment that fosters job satisfaction, fair compensation, and professional growth.[2,3] *Table 1* summarizes recommendations to address this challenge.

To address physician emigration, it is crucial to consider implementing policies and pull factors similar to those of destination countries, as outlined in *Table 1*. Additionally, it is essential to identify and address any shortcomings in managing the COVID-19 pandemic to improve physician retention in the local healthcare system. To achieve this, the Nigerian Medical Association (NMA), Nigerian Association of Resident Doctors (NARD), Medical and Dental Council of Nigeria (MDCN), Federal Ministry of Health (FMoH), Federal and State Governments, and Postgraduate Medical Colleges must work together.

These stakeholders should prioritize improving remuneration to reflect current economic realities, overhauling the medical curricula, and increasing the number of research institutions and laboratories.[4] In addition, stakeholders can explore ways to align the postgraduate academic and fellowship routes to create a more seamless and effective transition for individuals pursuing higher education and professional development and to help increase career options for doctors.[4] A balanced rotation through all specialties has been suggested to help with the equitable distribution of specialties.[2]

Addressing mistreatment and bullying, implementing anti-bullying policies, and fostering a positive work environment can improve doctors' well-being and career satisfaction.[7] The MDCN must also enforce the Code of Medical Ethics (COME) to discipline errant medical seniors who abuse their status in the workplace.

It is worth noting that Nigeria has yet to dedicate at least 15% of the annual national budget to healthcare.[1] Most systemic challenges bedeviling healthcare can be solved through increased healthcare financing, enhanced healthcare insurance coverage, efficient distribution of resources, and elimination of bureaucratic bottlenecks and corruption. These measures will ensure that healthcare systems remain sustainable, doctors are retained, and patients receive the best care.[1,4]

Conclusion

To establish sustainable healthcare in Africa's most populous country, increasing the number and distribution of doctors, specialist providers, and clinical researchers is imperative. To achieve this, evaluating career preferences and their determinants, like internship experience, can be a significant step in addressing the issue of brain drain and physician shortages. This assessment would enable stakeholders in the Ministry of Health and healthcare administrators to influence the career choices of interns, which, in turn, would benefit the local population and reduce economic losses from brain drain, thereby contributing towards establishing a robust healthcare system.

Summary – Accelerating Translation

In this article titled "Mitigating Physician Emigration in Nigeria by Improving the Internship Experience," we argue for the significance of positively influencing interns' experiences to address the issue of physician emigration in Nigeria. The negative experiences faced by interns, including excessive workload, burnout, inadequate remuneration, lack of professional development opportunities, mistreatment, and bullying, contribute significantly to their desire to emigrate. Therefore, we propose implementing strategies to create a supportive work environment that offers fair compensation, opportunities for professional growth, and access to necessary resources, along with addressing mistreatment and bullying, improving salaries, overhauling medical curricula, and enforcing the Code of Medical Ethics. By prioritizing the needs of interns, stakeholders can influence their career choices and increase the likelihood of retaining them within the Nigerian healthcare system, reducing the brain drain and addressing physician shortages. Additionally, it is crucial to increase healthcare financing, improve health insurance coverage, and eliminate bureaucratic bottlenecks and corruption to improve the healthcare system and retain doctors in Nigeria.

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