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A Call for Action—Empowering Medical Students to Facilitate Change

Madeleine J. Cox,¹ Purva C. Shah,² Leah Komer,³ Muhammad Romail Manan,⁴ L V Simhachalam Kutikuppala,⁵ Benjamin Liu.⁶

The only constant in our lives is change. However, daring to make a change is another matter. There is a degree of apprehension regarding inconstancy in our general population and even more so in the medical community. The International Journal of Medical Students (IJMS) calls for overcoming this inertia and is leading the way for improved global healthcare.¹⁻⁷

This issue brings to light how, across the world, we are seeing examples of change and how this is improving our understanding of the human body and the world. We explore first-hand experiences of mitigating COVID-19 while also keeping in touch with other areas of clinical medicine and scientific research. We also take a look at concerns surrounding environmental healthcare and simultaneously, urge all readers to engage in the cause with us. Core to the IJMS in leading as a changemaker is through initiating empowerment, building a strategy, and utilizing our resources and the skills of all medical students across the globe to facilitate change into a reality.

The IJMS is honored to host a platform for medical students to contribute towards the growing medical literature. We would also like to express our appreciation to the flourishing community of medical student researchers for their motivation to offer meaningful and impactful pieces of literature to the field of medicine during these challenging times.

The COVID-19 pandemic has revolutionized the world, forcing a change in all the aspects of our lives. Of note, as a society we have adapted ourselves to wearing a face mask, hand hygiene practices and lockdowns. Social distancing measures have been implemented, despite its incompatibility with our instinctive nature as humans to feel connected and socialize. In this issue, we are exposed to student perceptions from the United States on social distancing practices,⁸ and Nigeria on their online medical education.⁹ From a more personal level, COVID-19 has also challenged our value systems and priorities. Through an experience report, we are introduced to brave medical students who describe their voluntary participation on the front-line during a deadly wave of the virus in Vietnam.¹⁰ All of the adjustments we have made to the current COVID-19 pandemic are based on our continual developing understanding of the SARS-CoV-2 virus. As healthcare workers and researchers we are learning about the virus's pathophysiology, clinical manifestations, treatment options and complications. Here we are introduced to two new case reports related to life-threatening COVID-19 complications including a non-traumatic splenic rupture,¹¹ and a late onset spontaneous pneumothorax.¹²

Sustainability in modern medicine is ensured through continuous evolution in all of its domains ranging from the eleven organ systems in humans to soft skills needed for improving doctor-patient relationships. Advancements and sizeable changes in medicine are

difficult to achieve due to the broad scope of the field. The IJMS strives to achieve this through observation and analysis of research in its various domains.

In this issue we are reminded that aggressive and atypical presentations of classical diseases should prompt a search for underlying immunosuppression. This is highlighted in a case report of a 42-year-old man with acute myelitis and meningitis secondary to varicella zoster reactivation who was found to have acquired immunodeficiency syndrome.¹³ Additionally, a case of accidental ingestion of dilute benzalkonium chloride with severe upper gastrointestinal injury and chemical pneumonitis highlights caution and the need for specialist intervention in all cases of poisoning irrespective of the toxin.¹⁴ Furthermore, an original article by Garcia-Espinosa et al. shows that diabetes mellitus, hypertension and a prior intracranial hemorrhage, can assist in the clinical suspicion and prognosis for an arteriovenous malformation.¹⁵ Another such article delves into how racial and insurance-based health disparities influence length of stay and total cost of a cholecystectomy.¹⁶ Additionally, we are also reminded of the importance of clinical rotations during medical school to engage students in real-life patient care situations. Be it in cardiology where the students' preference has reduced to a mere 17% according to a Canadian survey,¹⁷ or a rotation in Pediatrics during which the author developed an awareness for physician interference and the honest doctor-patient communication.¹⁸

Similarly, it is expected that in the world of scientific medical research we find a pattern of constant change, as it fosters an environment of learning, discovery and growth for the development of the medical field. Raj et al. discusses the unique skill set medical students offer in large studies due to their open-minded, refreshing and innovative approach to challenges.¹⁹ Additionally, we are called to consider a collaborative solution to global healthcare inequality through student exchange research programs aimed at training a new generation of healthcare professionals from low-income nations.²⁰

Finally, and most importantly, as a healthcare journal we call for immediate actionable change on the greatest threat to global public health – environmental destruction. We report on how rising temperatures and the elimination of the natural world will see ubiquitous devastating effects, primarily worsening rates of morbidity and mortality. It is our responsibility to appreciably contribute individual and collective actions. As a journal we aim to advocate for environmental sustainability through our attendance at multiple United Nations facilitated conferences.²¹ Advances in medicine must be simultaneously substantial yet sustainable for the environment and for the betterment of the entire human race. Only through policy changes and rigorous ground level work, can we hope to reverse the

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deteriorating climatic conditions. Our health is closely intertwined with the planet's health; if one of these collapses, so will the other.

In this issue, you will catch a glimpse of the ongoing transformation in various fields of medicine, some of which resulted because of the

COVID-19 pandemic, while others emerged in spite of it. Medicine is changing like never before, and it is our responsibility and duty as healthcare professionals from all around the world to support that change.

References

1. Bonilla-Escobar FJ. Leadership and Health: The Scientific Journal's Mission of Spreading Science in Times of Pandemic. *Int J Med Students*. 2020 Jan-Apr;8(1):9-10.
2. Găman MA, Ryan PM, Bonilla-Escobar FJ. To Stay at Port or to go to Sea: Are Clinical Clerkships a Double-Edged Sword during the COVID-19 Pandemic? Where do we go From Here?. *Int J Med Students*. 2020 May-Aug;8(2):92-5.
3. Bonilla-Escobar FJ, Kumar AA, Farrugia-Bonnici G, Ryan PM, Găman MA. A Grain of Sand in the Ocean: Training New Generations of Editors, Reviewers, and Medical Scientists. *Int J Med Students*. 2020 Sep-Dec;8(3):213-6.
4. MacArthur KR, Cox MJ, Egan C, Komer L. Pre-Existing Social Conditions: A Call to Prevent the Perpetuation of Gender Inequalities in Research Production during COVID-19. *Int J Med Students*. 2020 Sep-Dec;8(3):217-9.
5. Cox MJ, Komer L, Egan C, Shah PC, Tellios N, Kumar AA. Back to the Future: Medicine Beyond the COVID-19 Pandemic. *Int J Med Students*. 2021 Jan-Apr;9(1):9-10.
6. Ryan PM. More than a Manuscript: The International Journal of Medical Students as an Educational Institution. *Int J Med Students*. 2021 May-Jun;9(2):108-9.
7. Pustake M, Egan C, Kumar AA. Unmasking the Healthcare Issues Slipping through the Cracks during the Pandemic. *Int J Med Students*. 2021 May-Jun;9(2):110-1.
8. Barrett DL, Rainer KW, Zhang C, Blalock TW. Healthcare Students' Perception of Social Distancing during the 2019 Coronavirus Pandemic: A Cross-Sectional Survey. *Int J Med Students*. 2021 Jul-Sep;9(3):192-6.
9. Fasiku AV, Abdulsamad I, Adegoke JK, Afolabi AS, Adedayo SO, Olanipekun A, et al. Perception of Medical Students on the Effect of Covid-19 on Medical Education in Nigeria. 2021 Jul-Sep;9(3):197-201.
10. Lan TT, Khanh VT, Minh Duc NT. COVID-19 Volunteering Experience In Vietnam. *Int J Med Students*. 2021 Jul-Sep;9(3):235-6.
11. Crowley AC, Magadia RR, Lanpher AB. Splenic Rupture in a COVID-19 Patient – A Case Report. *Int J Med Students*. 2021 Jul-Sep;9(3):219-22.
12. Wortman II KO, Wortman KO. Pneumatocele Induced Pneumothorax in a patient with Post-COVID-19 Pneumonitis. *Int J Med Students*. 2021 Jul-Sep;9(3):223-6.
13. Novelo-Hernández VA, Cárdenas M, Torres-González C, García-Espinosa P, Ramírez R, Díaz-Torres M, et al. A Case Report of Acute Severe Myelitis and Meningitis Secondary to Varicella Zoster Virus Reactivation in a Patient with Acquired Immunodeficiency Syndrome. *Int J Med Students*. 2021 Jul-Sep;9(3):227-30.
14. Kumar A, Chetiwat R, Rastogi P, Tanwar S, Gupta S, Patnaik R, et al. Severe Esophagitis and Chemical Pneumonitis as a Consequence of Dilute Benzalkonium Chloride Ingestion: A Case Report. *Int J Med Students*. 2021 Jul-Sep;9(3):231-4.
15. Garcia-Espinosa P, Botello-Hernandez E, Torres-Hernandez G, Guerrero-Cavazos C, Villareal-Garza E, Flores-Rodríguez A. Predictors of Cerebral Arteriovenous Malformation Mortality: A Single-center, Five-year Retrospective Study. *Int J Med Students*. 2021 Jul-Sep;9(3):213-8.
16. Darbandi A, Chopra C. Trends and Factors Impacting Healthcare Charges and Length of Stay for Cholecystectomies: A New York State Population-based Analysis. *Int J Med Students*. 2021 Jul-Sep;9(3):202-6.
17. Huo B, MacNevin W, Dow T, Rajda M. The Impact of Previous Cardiology Electives on Canadian Medical Student Interest and Understanding of Cardiology. *Int J Med Students*. 2021 Jul-Sep;9(3):207-12.
18. Debnath B. Opportunistic Conversations about Eating Disorders: An Encounter from my Pediatrics Elective. *Int J Med Students*. 2021 Jul-Sep;9(3):240-1.
19. Raj R, Dominic C, Gandhi S, Taylor EH, Politis M, Hussain SNF, et al. Lessons Learnt from Operationalizing an International Collaborative Multi-Centre Study. *Int J Med Students*. 2021 Jul-Sep;9(3):242-4.
20. Campo LN, Santos Rocha SW. Student Mobility and Research Capacity: A Global Health Experience. *Int J Med Students*. 2021 Jul-Sep;9(3):237-9.
21. Atwoli L, Baqui AH, Benfield T, Bosurgi R, Godlee F, Hancocks S, et al. Call for emergency action to limit global temperature increases, restore biodiversity, and protect health. *Int J Med Students*. 2021 Jul-Sep;9(3):189-91.

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Call for Emergency Action to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health

Wealthy Nations Must Do Much More, Much Faster

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The UN General Assembly in September 2021 will bring countries together at a critical time for marshalling collective action to tackle the global environmental crisis. They will meet again at the biodiversity summit in Kunming, China, and the climate conference (COP26) in Glasgow, UK. Ahead of these pivotal meetings, we—the editors of health journals worldwide—call for urgent action to keep average global temperature increases below 1.5°C, halt the destruction of nature, and protect health.

Health is already being harmed by global temperature increases and the destruction of the natural world, a state of affairs health professionals have been bringing attention to for decades.¹ The science is unequivocal; a global increase of 1.5°C above the pre-industrial average and the continued loss of biodiversity risk catastrophic harm to health that will be impossible to reverse.^{2,3} Despite the world's necessary preoccupation with COVID-19, we cannot wait for the pandemic to pass to rapidly reduce emissions.

Reflecting the severity of the moment, this editorial appears in health journals across the world. We are united in recognising that only fundamental and equitable changes to societies will reverse our current trajectory.

The risks to health of increases above 1.5°C are now well established.² Indeed, no temperature rise is “safe.” In the past 20 years, heat related mortality among people aged over 65 has increased by more than 50%.⁴ Higher temperatures have brought increased dehydration and renal function loss, dermatological malignancies, tropical infections, adverse mental health outcomes, pregnancy complications, allergies, and cardiovascular and pulmonary morbidity and mortality.^{5,6} Harms disproportionately affect the most vulnerable, including among children, older populations, ethnic minorities, poorer communities, and those with underlying health problems.^{2,4}

Global heating is also contributing to the decline in global yield potential for major crops, falling by 1.8–5.6% since 1981; this, together with the effects of extreme weather and soil depletion, is hampering efforts to reduce undernutrition.⁴ Thriving ecosystems are essential to human health, and the widespread destruction of nature, including habitats and species, is eroding water and food security and increasing the chance of pandemics.^{3,7,8}

The consequences of the environmental crisis fall disproportionately on those countries and communities that have contributed least to the problem and are least able to mitigate the harms. Yet no country, no matter how wealthy, can shield itself from these impacts. Allowing the consequences to fall disproportionately on the most vulnerable will breed more conflict, food insecurity, forced displacement, and zoonotic disease—with severe implications for all countries and communities. As with the COVID-19 pandemic, we are globally as strong as our weakest member.

Rises above 1.5°C increase the chance of reaching tipping points in natural systems that could lock the world into an acutely unstable state. This would critically impair our ability to mitigate harms and to prevent catastrophic, runaway environmental change.^{9,10}

Global targets are not enough

Encouragingly, many governments, financial institutions, and businesses are setting targets to reach net-zero emissions, including targets for 2030. The cost of renewable energy is dropping rapidly. Many countries are aiming to protect at least 30% of the world's land and oceans by 2030.¹¹

These promises are not enough. Targets are easy to set and hard to achieve. They are yet to be matched with credible short- and longer-term plans to accelerate cleaner technologies and transform societies. Emissions reduction plans do not adequately incorporate health considerations.¹² Concern is growing that temperature rises above 1.5°C are beginning to be seen as inevitable, or even acceptable, to powerful members of the global community.¹³ Relatedly, current strategies for reducing emissions to net zero by the middle of the century implausibly assume that the world will acquire great capabilities to remove greenhouse gases from the atmosphere.^{14,15}

This insufficient action means that temperature increases are likely to be well in excess of 2°C,¹⁶ a catastrophic outcome for health and environmental stability. Critically, the destruction of nature does not have parity of esteem with the climate element of the crisis, and every single global target to restore biodiversity loss by 2020 was missed.¹⁷ This is an overall environmental crisis.¹⁸

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Health professionals are united with environmental scientists, businesses, and many others in rejecting that this outcome is inevitable. More can and must be done now—in Glasgow and Kunming—and in the immediate years that follow. We join health professionals worldwide who have already supported calls for rapid action.^{1,19}

Equity must be at the centre of the global response. Contributing a fair share to the global effort means that reduction commitments must account for the cumulative, historical contribution each country has made to emissions, as well as its current emissions and capacity to respond. Wealthier countries will have to cut emissions more quickly, making reductions by 2030 beyond those currently proposed^{20,21} and reaching net-zero emissions before 2050. Similar targets and emergency action are needed for biodiversity loss and the wider destruction of the natural world.

To achieve these targets, governments must make fundamental changes to how our societies and economies are organised and how we live. The current strategy of encouraging markets to swap dirty for cleaner technologies is not enough. Governments must intervene to support the redesign of transport systems, cities, production and distribution of food, markets for financial investments, health systems, and much more. Global coordination is needed to ensure that the rush for cleaner technologies does not come at the cost of more environmental destruction and human exploitation.

Many governments met the threat of the COVID-19 pandemic with unprecedented funding. The environmental crisis demands a similar emergency response. Huge investment will be needed, beyond what is being considered or delivered anywhere in the world. But such investments will produce huge positive health and economic outcomes. These include high quality jobs, reduced air pollution, increased physical activity, and improved housing and diet. Better air quality alone would realise health benefits that easily offset the global costs of emissions reductions.²²

These measures will also improve the social and economic determinants of health, the poor state of which may have made populations more vulnerable to the COVID-19 pandemic.²³ But the

changes cannot be achieved through a return to damaging austerity policies or the continuation of the large inequalities of wealth and power within and between countries.

Cooperation hinges on wealthy nations doing more

In particular, countries that have disproportionately created the environmental crisis must do more to support low- and middle-income countries to build cleaner, healthier, and more resilient societies. High income countries must meet and go beyond their outstanding commitment to provide \$100bn a year, making up for any shortfall in 2020 and increasing contributions to and beyond 2025. Funding must be equally split between mitigation and adaptation, including improving the resilience of health systems.

Financing should be through grants rather than loans, building local capabilities and truly empowering communities, and should come alongside forgiving large debts, which constrain the agency of so many low-income countries. Additional funding must be marshalled to compensate for inevitable loss and damage caused by the consequences of the environmental crisis.

As health professionals, we must do all we can to aid the transition to a sustainable, fairer, resilient, and healthier world. Alongside acting to reduce the harm from the environmental crisis, we should proactively contribute to global prevention of further damage and action on the root causes of the crisis. We must hold global leaders to account and continue to educate others about the health risks of the crisis. We must join in the work to achieve environmentally sustainable health systems before 2040, recognising that this will mean changing clinical practice. Health institutions have already divested more than \$42bn of assets from fossil fuels; others should join them.⁴

The greatest threat to global public health is the continued failure of world leaders to keep the global temperature rise below 1.5°C and to restore nature. Urgent, society-wide changes must be made and will lead to a fairer and healthier world. We, as editors of health journals, call for governments and other leaders to act, marking 2021 as the year that the world finally changes course.

References

1. Healthy Recovery. In Support of a Healthy Recovery. Available from: <https://healthyrecovery.net/>. Last updated May 26, 2020; cited August 24, 2020.
2. Intergovernmental Panel on Climate Change. Special Report Global Warming of 1.5°C Summary for Policymakers. Available from: <https://www.ipcc.ch/sr15/>. Last updated 2018; cited August 24, 2020.
3. S. Díaz, J. Settele, E. S. Brondizio E.S., H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.) IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. 2019. IPBES secretariat, Bonn, Germany. Available from: <http://www.ipbes.net>
4. Watts N, Amann M, Arnell N, et al. The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises. *Lancet*. 2021 Jan 9;397(10269):129-170.
5. Rocque RJ, Beaudoin C, Ndjaboue R, et al. Health effects of climate change: an overview of systematic reviews. *BMJ Open*. 2021 Jun 9;11(6):e046333.
6. Haines A, Ebi K. The imperative for climate action to protect health. *N Engl J Med* 2019;380:263-73.
7. United Nations Environment Programme and International Livestock Research Institute (2020). Preventing the Next Pandemic: Zoonotic diseases and how to break the chain of transmission. Nairobi, Kenya. 2020. Available from: https://72d37324-5089-459c-8f70-271d19427cf2.filesusr.com/ugd/056cf4_b5b2f067f094dd3b2250cda15c47acd.pdf
8. Intergovernmental Panel on Climate Change. Special Report Climate Change and Land Summary for Policymakers. Available from <https://www.ipcc.ch/srccl/>. Last updated January 2020; cited August 24, 2020.
9. Lenton TM, Rockström J, Gaffney O, Rahmstorf S, Richardson K, Steffen W, Schellnhuber HJ. Climate tipping points - too risky to bet against. *Nature*. 2019 Nov;575(7784):592-595.
10. Wunderling N, Donges JF, Kurths J, Winkelmann R. Interacting tipping elements increase risk of climate domino effects under global warming. *Earth System Dynamics*. 2021. 12, 601-619.
11. High Ambition Coalition (HAC) for Nature and People. Available from: <https://www.hacfornatureandpeople.org>. Cited August 24, 2020.
12. The Global Climate and Health Alliance. Are national climate commitments enough to protect our health? Available from: <https://climateandhealthalliance.org/initiatives/healthy-ndcs/ndc-scorecards/>. Last updated July 16, 2021; cited August 24, 2021.
13. Carbon Brief. Climate strikers: Open letter to EU leaders on why their new climate law is 'surrender.' Available from: <https://www.carbonbrief.org/climate-strikers->

- [open-letter-to-eu-leaders-on-why-their-new-climate-law-is-surrender](#). Last updated March 3, 2020; cited August 24, 2021.
14. Fajardy M, Köberle A, MacDowell N, Fantuzzi A. BECCS deployment: a reality check. Grantham Institute Briefing paper No 28, January 2019.
 15. Anderson K, Peters G. Climate Change The trouble with negative emissions. *Science* 2016;354:182-3.
 16. Climate Action Tracker. Available from: <https://climateactiontracker.org>. Last updated August 2021; cited August 24, 2021.
 17. Secretariat of the Convention on Biological Diversity. Global Biodiversity Outlook 5. Available from: <https://www.cbd.int/gbo5>. Last updated 2020; cited August 24, 2021.
 18. Steffen W, Richardson K, Rockström J, et al. Planetary boundaries: Guiding human development on a changing planet. *Science* 2015;347:1259-1265.
 19. UK Health Alliance on Climate Change. Our calls for action. Available from: <http://www.ukhealthalliance.org/cop26>. Cited August 24, 2021.
 20. Climate Action Tracker. Warming Projections Global Update: May 2021. Available from: https://climateactiontracker.org/documents/853/CAT_2021-05-04_Briefing_Global-Update_Climate-Summit-Momentum.pdf. Last updated May 2021; cited August 24, 2021.
 21. United Nations Environment Programme. Emissions Gap Report 2020. Available from: <https://www.unep.org/emissions-gap-report-2020>. Last Updated December 9, 2020; cited August 24, 2021.
 22. Markandya A, Sampedro J, Smith SJ, et al. Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study. *Lancet Planetary Health*. March 2018;2:e126-33.
 23. Paremoer L, Nandi S, Serag H, Baum F. Covid-19 pandemic and the social determinants of health. *BMJ* Jan 2021;372:n129.

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Healthcare Students' Perception of Social Distancing During the 2019 Coronavirus Pandemic: A Cross-Sectional Survey

Devon L Barrett,¹ Katharine W Rainer,¹ Chao Zhang,² Travis W Blalock.^{1,3}

Abstract

Background: Since the implementation of social distancing practices during the global Coronavirus Disease 2019 (COVID-19) pandemic there have been a myriad of definitions for 'social distancing.' The objective of this study was to determine students' awareness of the various definitions of social distancing, how strictly they adhered to social distancing guidelines, and how they perceived the importance of various social distancing practices. **Methods:** This cross-sectional survey was distributed via email to students at Emory-affiliated graduate schools, including the Medical, Nursing, and Public Health Schools. **Results:** Of the 2,453 recipients of the survey, 415 students responded (16.9% response rate). The majority of respondents were medical students (n=225, 55.6%). Of the respondents, 357 noted that they "frequently" or "always" abided by social distancing. The most common definition of social distancing with which respondents were familiar was that of the Centers for Disease Control and Prevention (CDC) (n=276 of 369 responses, 74.8%). There were significant differences across groups when grouping students by the definition of social distancing that they were aware of, the social distancing guideline they most closely followed, and their school of attendance regarding the importance of specific social distancing examples (p<0.05 for each). **Conclusion:** A survey of healthcare students identified differences in the importance of social distancing practices based on the definition of social distancing that they were aware of. The results of this study underscore the importance of having unified definitions of public health messaging, which ultimately may impact disease spread.

Key Words: Coronavirus, SARS-CoV-2; COVID-19; Social Distancing; Public Health; Students; Medical (Source: MeSH-NLM).

Introduction

On March 11, 2020, the SARS-CoV-2 virus (COVID-19) was declared a pandemic by the World Health Organization (WHO).¹ The virus, with striking transmissibility through large respiratory particles, has caused substantial morbidity and mortality across the world. The exponential growth dynamics of the virus² and failed efforts to control the spread burden not only healthcare resources and services, but also economies, education, and the psychological wellbeing of the general population, particularly students.³ With limited knowledge of how to treat and contain the virus throughout the first half of 2020, organizations like the Centers for Disease Control (CDC) in the United States, the WHO, and the White House in Washington, DC published guidelines for behavior, including 'social distancing'.⁴

While various media and health organizations have encouraged the practice of social distancing, there appears not to be one unified definition for what social distancing entails.^{5,7} The CDC defined social distancing as, "remaining out of congregate settings, avoiding mass gatherings, and maintaining distance (approximately six feet or two meters) from others,"⁷ the WHO instructed that people should maintain, "at least one meter (three feet) distance between yourself and anyone who is coughing or sneezing,"⁶ while the White House made no mention of physical distancing, instead encouraging working from home and avoiding social gatherings in groups larger than ten people.⁵ The myriad of definitions of social distancing can impact the way in which individuals apply these practices daily, which has further implications on the potential spread of SARS-CoV-2.

In the United States, there are a variety of advanced educational programs for students who have an interest in the healthcare field. These programs include Doctor of Medicine (MD), Registered Nurse, Physician Assistant, Physical Therapist, and Master and Doctor of Public Health. Students in these fields undergo two to four years of education related to public health, science, physiology, biology and/or infectious diseases. Given their graduate level education on these topics, these students have an above average understanding of human diseases as well as advanced training in healthcare, which supposedly helps them to better understand and appreciate the nuances of the COVID-19 pandemic. As such, they are an important subgroup of interest to evaluate how the lack of a unified response to the pandemic has influenced behavior, as they hypothetically understand the risks of the disease more so than the general public. The objective of this study was to determine students in the healthcare field's awareness of the various definitions of social distancing, their adherence to social distancing guidelines, and their understanding of the importance of various social distancing activities.

Methods

Setting and Participants

An anonymous, internet-based survey was administered from April 17, 2020, to May 3, 2020, to 2,453 students in healthcare programs at Emory University, specifically students enrolled in on-campus education at one of the three following schools: The Emory University School of Medicine (n=833), the Woodruff School of Nursing (n=794), and the Rollins School of Public Health (n=776). All schools are located on Emory

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University's main campus in Atlanta, Georgia, USA. Within the School of Medicine, students from the medical doctorate, physician assistant, and physical therapy programs were invited to respond; the programs within the Schools of Medicine were selected by convenience sampling. All students in the nursing school and public health school were invited to respond. The study was exempted from review by the Emory University Institutional Review Board (STUDY00000394). Informed consent was obtained from all survey participants; research conformed to the principles embodied in the Declaration of Helsinki.⁸

Survey

The fifteen-question survey was created on SurveyMonkey™ through author collaboration and then distributed via email. The survey contained demographic questions as well as questions that assessed (1) students' awareness of multiple organization's definitions of social distancing, (2) which social distancing guidelines students followed most closely, (3) the frequency at which students were abiding by these guidelines, (4) the relative importance of recommendations and examples of social distancing practices, (5) whether the students experienced symptoms of COVID-19, and (6) whether students believed others were abiding by social distancing guidelines. The definitions of social distancing were from the Centers for Disease Control and Prevention (CDC) and the WHO; guidelines for social distancing practices were from the CDC, WHO, and President Trump's Coronavirus Guidelines for America.⁵⁻⁷ Survey questions were multiple-choice questions, with the exception of one question that asked students to elaborate on whether they believed others were abiding by social distancing guidelines in a free text format. All multiple-choice questions offered a selection option of "prefer not to say."

All multiple-choice questions allowed for only one answer except for the question instructing respondents to mark which of the definitions of "social distancing" they were familiar with. This question allowed for multiple answer choices, including the CDC's definition, the WHO's definition, uncertain, none of the above, and prefer not to say. The survey question relating to the frequency of which students practiced social distancing was assessed on a Likert scale with options including always (100% of the time), frequently (75%-99% of the time), occasionally (50-74% of the time), rarely (25-49% of the time), very rarely (1-24% of the time), or never (0% of the time). The survey questions assessing the importance of 19 different actions or practices as they pertain to social distancing had participants rank each action or practice on a 5-point Likert scale: very important (5), important (4), moderately important (3), slightly important (2), and not important (1).

Analysis

Statistical analysis was conducted using SAS Version 9.4. Descriptive statistics for each variable were reported. For results in Table 1, frequencies and their percentages were shown for categorical variables; Chi-square test or Fisher's exact test was employed if appropriate. For numerical covariates displayed in Table 2, the mean and standard deviation were calculated and presented; one-way ANOVA tests were performed if appropriate. In order to evaluate if students' identification of one definition of social distancing was responsible for a significant difference in results, Tukey's test for post-hoc analysis was conducted. Paired sample t-test was used for comparing "six" and "three" feet for those who said that they followed WHO guidelines. The significance level was set at 0.05. Free responses were independently coded by two medical students (D.L.B. and K.W.R.); discrepancies in qualitative coding were resolved by consensus. Themes and representative quotes were presented. Missing data were excluded from calculations.

Results

Of the 2,453 recipients of the survey, 415 students responded (16.9% response rate). The majority of respondents were female (n=304, 75.1%). The medical doctorate program was the program with the most respondents (n=225, 55.6%, **Table 1**). Students most commonly noted that they "frequently" or "always" practiced social distancing, defined

as practicing social distancing 75-100% of the time (n=357, 96.7%, **Table 1**). Respondents were most familiar with the CDC's definition of social distancing (n=276, 74.8%, **Table 1**). 96 respondents (26.0%) were uncertain or not familiar with either the CDC's or the WHO's definition of social distancing.

There were statistically significant differences in students' assessment of importance of three examples of social distancing when grouping students by the social distancing definition (either WHO, CDC, Both, Neither, or Uncertain) that they were aware of. These three examples included "increasing physical space between workers at worksite[s]," "stay[ing] at least six feet" and "at least three feet away from other

Table 1. Study Respondent Demographic Information and Social Distancing Practices (n=415).

Demographic Characteristics	n (%)
Age: 25-29 years of age group (n=405)	232 (57.3)
Gender	
Male	100 (24.7)
Female	304 (75.1)
Non-Binary	1 (0.2)
Other/Missing	10
Race	
White or Caucasian	283 (69.9)
Black or African American	41 (10.1)
Asian or Asian American	47 (11.6)
Two or More Races	22 (5.4)
Other	8 (2.0)
Prefer not to say	4 (1.0)
Missing	10
Ethnicity	
Hispanic	26 (6.4)
Non-Hispanic	375 (92.6)
Prefer not to say	4 (1.0)
Missing	10
Degree Program Enrollment	
Medical School – Medical Doctorate Program	225 (55.6)
Medical School – Physician Assistant Program	43 (10.6)
Medical School – Physical Therapy Program	15 (3.7)
Nursing School	45 (11.1)
Public Health School	43 (10.6)
Other / Prefer not to say	28 (6.9)
Not currently enrolled in degree program	6 (1.5)
Missing	10
Which of the following organization's definitions of "social distancing" are you familiar with? ^{a,b} (n=369)	
World Health Organization	152 (41.2)
Center for Disease Control	276 (74.8)
Uncertain	83 (22.5)
None of the above	13 (3.5)
Which of the following guidelines for "social distancing" do you most closely follow? ^b (n=369)	
World Health Organization	27 (7.3)
Centers for Disease Control and Prevention	215 (58.3)
President Trump's Coronavirus Guidelines for America	4 (1.1)
My own understanding of 'social distancing'	94 (25.5)
Uncertain	27 (7.3)
None of the above	2 (0.5)
Since March 1, 2020, how often have you practiced 'social distancing'? ^b (n=369)	
Always	96 (26.0)
Frequently	261 (70.7)
Occasionally	10 (2.7)
Rarely	1 (0.3)
Very Rarely	1 (0.3)
Never	0
In general, do you believe that people other than yourself are abiding by 'social distancing' practices? ^b (n=369)	
Yes	257 (69.7)
No	110 (29.8)
Prefer not to say	2 (0.5)

Legend: ^a Multiple selections allowed. ^b The n = 369 as 46 individuals did not respond to these questions.

Table 2. Respondents' Ranking of Importance of Examples of Social Distancing as Provided on the Study Survey when Grouping Respondent's by Social Distancing (1) Definitions, (2) Guidelines they follow, and (3) Students' Program Enrollment.

Examples of 'Social Distancing'	Students' Awareness of Social Distancing Definition(s), Mean (SD)				P-value
	CDC Only (n=125)	WHO Only (n=5)	Both (n=43)	Uncertain (n=75)	
Work or engage in schooling from home whenever possible	4.8 (0.45)	4.8 (0.42)	4.8 (0.58)	4.7 (0.62)	0.69
Avoid social gatherings in groups of more than ten people	4.6 (0.55)	4.9 (0.45)	4.9 (0.40)	4.8 (0.55)	0.48
Avoid eating or drinking at bars, restaurants, and food courts	4.8 (0.45)	4.8 (0.53)	4.8 (0.45)	4.8 (0.79)	0.93
Avoid non-essential shopping trips	4.8 (0.45)	4.7 (0.50)	4.6 (0.64)	4.5 (0.84)	0.13
Avoid visiting nursing homes and retirement communities	4.8 (0.45)	4.9 (0.46)	4.9 (0.35)	4.9 (0.43)	0.90
Avoid touching your face	4.4 (0.55)	4.4 (0.84)	4.5 (0.73)	4.2 (1.1)	0.14
Increase physical space between workers at worksite	4.2 (0.84)	4.7 (0.46)	4.6 (0.54)	4.4 (0.87)	<0.010
Staggering work schedules	3.4 (1.82)	4.1 (0.97)	3.9 (1.0)	3.9 (1.0)	0.17
Limit in-person work related meetings	4.4 (0.55)	4.8 (0.50)	4.8 (0.49)	4.6 (0.84)	0.13
Avoid international travel	4.6 (0.55)	4.8 (0.64)	4.8 (0.59)	4.8 (0.54)	0.86
Avoid domestic travel	4.4 (0.89)	4.4 (0.80)	4.4 (0.76)	4.2 (1.1)	0.37
Wear a face mask in public	3.4 (1.5)	3.9 (0.93)	3.8 (0.92)	3.5 (1.1)	0.059
Avoid outdoor exercise	1.8 (1.3)	1.7 (0.83)	1.7 (0.91)	1.8 (1.0)	0.89
Stay at least six feet away from other people	4.6 (0.55)	4.7 (0.54)	4.7 (0.58)	4.4 (0.93)	<0.010
Stay at least three feet away from other people	3.2 (1.8)	4.5 (0.88)	4.4 (0.86)	4.1 (1.2)	<0.010
Avoiding sharing things like towels and utensils	3.8 (1.6)	4.0 (1.1)	4.1 (1.0)	4.0 (1.2)	0.69
Stay at home	4.4 (0.89)	4.6 (0.55)	4.6 (0.71)	4.5 (0.79)	0.62
Avoid having visitors to your home	4.4 (0.55)	4.6 (0.59)	4.5 (0.65)	4.5 (0.83)	0.46
Limit social circle	3.6 (1.7)	4.3 (1.3)	4.3 (1.1)	4.0 (1.4)	0.33
Examples of 'Social Distancing'	Social Distancing Guidelines Students' Abide By, Mean (SD)				P-value
	CDC (n=215)	WHO (n=27)	Own Understanding (n=94)	Other (n=33)	
Work or engage in schooling from home whenever possible	4.8 (0.45)	4.9 (0.32)	4.7 (0.53)	4.4 (0.90)	<0.010
Avoid social gatherings in groups of more than ten people	4.9 (0.33)	4.9 (0.36)	4.9 (0.52)	4.7 (0.82)	0.047
Avoid eating or drinking at bars, restaurants, and food courts	4.8 (0.51)	4.8 (0.40)	4.9 (0.35)	4.4 (1.1)	<0.010
Avoid non-essential shopping trips	4.7 (0.57)	4.6 (0.69)	4.6 (0.67)	4.2 (1.0)	<0.010
Avoid visiting nursing homes and retirement communities	4.9 (0.37)	4.9 (0.27)	5.0 (0.27)	4.6 (0.79)	<0.010
Avoid touching your face	4.5 (0.74)	4.5 (0.64)	4.2 (1.0)	4.2 (1.2)	0.051
Increase physical space between workers at worksite	4.7 (0.49)	4.7 (0.53)	4.5 (0.74)	4.3 (0.95)	<0.010
Staggering work schedules	4.1 (1.0)	3.9 (1.03)	4.1 (1.0)	3.6 (0.97)	0.027
Limit in-person work related meetings	4.8 (0.47)	4.7 (0.51)	4.7 (0.63)	4.3 (0.98)	<0.010
Avoid international travel	4.8 (0.56)	4.7 (0.53)	4.8 (0.58)	4.6 (0.83)	0.23
Avoid domestic travel	4.4 (0.80)	4.4 (0.84)	4.3 (0.92)	4.0 (1.1)	0.18
Wear a face mask in public	3.9 (0.86)	4.0 (0.92)	3.5 (1.2)	3.3 (1.2)	<0.010
Avoid outdoor exercise	1.7 (0.83)	1.8 (0.89)	1.7 (1.1)	1.8 (1.1)	0.89
Stay at least six feet away from other people	4.7 (0.57)	4.8 (0.43)	4.5 (0.77)	4.4 (0.93)	<0.010
Stay at least three feet away from other people	4.5 (0.82)	4.5 (1.0)	4.0 (1.2)	4.2 (1.1)	<0.010
Avoiding sharing things like towels and utensils	4.0 (1.1)	4.2 (1.1)	4.1 (1.2)	3.8 (1.3)	0.44
Stay at home	4.6 (0.61)	4.8 (0.48)	4.6 (0.66)	4.2 (1.0)	<0.010
Avoid having visitors to your home	4.6 (0.58)	4.6 (0.51)	4.5 (0.84)	4.4 (0.93)	0.31
Limit social circle	4.4 (1.1)	4.2 (1.4)	4.0 (1.4)	3.9 (1.5)	0.075
Examples of 'Social Distancing'	Students' Program Enrollment, Mean (SD)				P-value*
	Medical School (n=225)	Nursing School (n=45)	PT/PA School (n=58)	Public Health School (n=43)	
Work or engage in schooling from home whenever possible	4.8 (0.44)	4.7 (0.80)	4.7 (0.70)	4.6 (0.44)	0.39
Avoid social gatherings in groups of more than ten people	5.0 (0.21)	4.7 (0.73)	4.6 (0.71)	4.9 (0.30)	<0.010
Avoid eating or drinking at bars, restaurants, and food courts	4.9 (0.42)	4.7 (0.77)	4.5 (0.82)	4.8 (0.50)	<0.010
Avoid non-essential shopping trips	4.7 (0.58)	4.4 (0.95)	4.4 (0.82)	4.8 (0.42)	<0.010
Avoid visiting nursing homes and retirement communities	4.9 (0.37)	4.9 (0.29)	4.9 (0.45)	4.9 (0.30)	1.0
Avoid touching your face	4.3 (0.85)	4.7 (0.6)	4.4 (0.95)	4.3 (1.0)	0.068
Increase physical space between workers at worksite	4.6 (0.60)	4.5 (0.7)	4.5 (0.82)	4.8 (0.41)	0.11
Staggering work schedules	4.1 (0.92)	3.6 (1.2)	3.9 (1.1)	4.2 (0.79)	0.024
Limit in-person work related meetings	4.7 (0.55)	4.8 (0.53)	4.6 (0.82)	4.7 (0.56)	0.23
Avoid international travel	4.8 (0.56)	4.7 (0.74)	4.7 (0.67)	5.0 (0.22)	0.13
Avoid domestic travel	4.4 (0.82)	4.2 (1.1)	4.0 (0.95)	4.6 (0.54)	<0.010
Wear a face mask in public	3.8 (0.98)	3.8 (1.1)	3.4 (1.2)	4.0 (0.85)	0.082
Avoid outdoor exercise	1.8 (0.91)	2.1 (1.2)	1.4 (0.63)	1.7 (0.78)	<0.010
Stay at least six feet away from other people	4.6 (0.63)	4.6 (0.82)	4.6 (0.80)	4.8 (0.39)	0.18
Stay at least three feet away from other people	4.3 (0.99)	4.3 (1.0)	4.2 (1.1)	4.6 (0.54)	0.15
Avoiding sharing things like towels and utensils	4.0 (1.2)	4.3 (0.98)	3.9 (1.3)	4.1 (0.99)	0.19
Stay at home	4.6 (0.58)	4.5 (0.79)	4.4 (0.91)	4.7 (0.51)	0.11
Avoid having visitors to your home	4.6 (0.64)	4.5 (0.76)	4.3 (0.84)	4.6 (0.59)	0.011
Limit social circle	4.3 (1.3)	4.2 (1.2)	4.2 (1.3)	4.0 (1.2)	0.84

Legends: PT: Physical Therapy; PA: Physician's Assistant; CDC: Centers for Disease Control and Prevention; WHO: World Health Organization. * p-value calculated by ANOVA

people" (**Table 2**, $P < 0.05$ for each). Specifically, the "uncertain" group was significantly different from the CDC only group. Similarly, when grouping students by the social distancing definition that they most closely followed, there were significant differences in the assigned importance of 12 of 19 social distancing examples (**Table 2**). Finally, when grouping students based on the school that they attend there were significant differences in mean ranked importance in seven of 19 examples of social distancing practices (**Table 2**). There was no association between respondents' awareness of social distancing definitions and the guidelines that they said they followed. Students who identified as following WHO guidelines felt it was more important

to remain six feet from other people as opposed to three feet (mean (SD): 4.8 (0.40), 4.3 (1.0), respectively; $p = 0.017$).

The majority of respondents (69.7%) felt that people other than themselves were abiding by social distancing practices, though many expressed doubts of adherence ($n = 257$, 69.7%, **Table 1**). **Table 3** shows the key themes of respondents' views on the social distancing practices of others. Notably, 13 respondents felt that those who were not abiding by social distancing practices were acting as a result of misinformation (**Table 3**).

Table 3. Key Themes of Survey Respondents' Views on Social Distancing Practices of Others with Representative Quotes of these themes from Respondents on the Study Survey.

Themes	Number of Responses; Representative quotes
The respondent states agreement that they and/or others do practice social distancing	142; "I believe that the vast majority of people are doing the best they can as they see it to socially distance."
Group gatherings as seen in person, on the news, or social media	71; "I have also seen other people blatantly breaking social distancing recommendations on social media."
Mention of maintaining physical distance between individuals as an example of social distancing	58; "When I go to the grocery store, many people are less concerned about maintaining a buffer of space between them and other people."
Acknowledgement of people ignoring or not abiding by social distancing recommendations (non-specific)	51; "I don't have the impression that the broader public is abiding by the practices I am following."
Use of masks and personal protective equipment	27; "In the grocery stores, only 30% [of people] or so wear masks."
Changes in essential trip frequency	23; "I watch others be intentional about not going out into the community more than necessary."
Social distancing practices influenced by policies on business and venue closures / opening	18; "Most non-essential businesses are closed; people don't have much of a choice."
Changes in road congestion	16; "Everything outside is empty and there is no traffic."
Mention of changes to work and school related practices due to social distancing policy	16; "People in my neighborhood are mostly working from home."
Lack of access to credible information or misinformation influencing social distancing practices	13; "I also see the rampant spread of misinformation and just pure blind ignorance prevalent in society today, so I wonder if the number of people following the guidelines is as high as I hope."
Social Distancing practices vary based on geographic location	10; "My family is in California so there is a shelter in place there right now."
Social Distancing practices are a violation of freedom and human rights	9; "There are many who believe that the measures being imposed are in some way violating their freedom and therefore are against it."
Emotions and fears dictating social distancing practices	6; "Others may not see COVID-19 as a threat to them so they choose to not make any changes to protect themselves."

Discussion

The results of this study demonstrate that different social distancing definitions influenced the importance with which respondents ranked specific social distancing practices. There were significant differences between how important "Increasing physical space between workers at worksite" was depending on which definition of social distancing the student was aware of (CDC, WHO, White House, own definition). This study also highlights the impact of misinformation and uncertainty on social distancing practices: 25.5% of students' felt that they practiced their own understanding of social distancing and an additional 7.3% were uncertain of which guidelines they were following. Regardless of which guidelines the respondents followed, 96.7% of respondents felt that they practiced some form of social distancing 75-100% of the time. This is a slightly higher percentage than previously reported data, which suggested that Americans' "always" or "very often" complied with social distancing guidelines 93% of the time.⁹

As demonstrated in this study, the varied and changing definitions of the term 'social distancing' and social distancing guidelines can create confusion amongst individuals regarding proper practices to abide by, even across students in professional healthcare programs. Further exemplifying this confusion is that students abiding by WHO guidelines felt it more important to remain six feet away from other people as opposed to three feet, the key difference between the two guidelines.

Within the field of healthcare, unclear definitions can make it challenging to understand disease prevalence and trends,¹⁰ can lead to biases in assessments of conditions,¹¹ and can present challenges in assessing the effectiveness of policy outcomes.^{12,13} Leaving policy criteria subject to interpretation, or having conflicting criteria, is ultimately detrimental to the success of a policy.¹³ Given that local and state governments utilize federal guidance to inform their social distancing planning efforts,¹⁴ unclear social distancing definitions and guidelines can be particularly problematic. This is most clearly seen by past attempts at social distancing during prior viral outbreaks, where there was varied implementation of social distancing practices due to variation between and within international, federal, and state policies.^{15,16} Furthermore, inconsistent and unclear messaging in the COVID-19 public health response has led to notable differences in self-reported knowledge, attitudes, and behavior related to COVID-19.¹⁷

Studies have shown that relaxing social distancing guidelines without instituting compensatory practices, like case-detection, isolation, and contact-tracing, may result in a resurgence of COVID-19 disease activity.¹⁸ Other studies call for prolonged and intermittent social distancing into 2022 as resurgences could result in potentially more deadly waves of disease.¹⁹ With the potential of disease resurgence, the importance of a clear definition of social distancing and promoting a unified set of guidelines for physical distancing is paramount.

Limitations of this study included convenience sampling, response bias, and a small sample size in this single-center study. Respondents were mostly from the medical school, despite the majority of survey recipients being enrolled at either the Public Health School or the Nursing School; however, the survey was conducted in the midst of the COVID-19 pandemic, with each school implementing different educational restrictions. Emory University's proximity and association with the CDC could have impacted respondents' awareness of national guidelines. Finally, the survey was not validated. Future research should include conducting follow-up surveys across different timepoints to improve understanding of changes in perception of social distancing practices. In addition, broadening the distribution of the survey to non-healthcare students across a diverse geographic location

could improve the study's generalizability and highlight geographic variability in social distancing practices.

Conclusion

A survey of healthcare students identified significant differences in the mean importance of various social distancing practices based on the definition of social distancing that they were aware of. The results of this study can help inform the larger public health community in understanding what social distancing means to a group of students receiving professional level education in the healthcare sector and underscores the importance of having a uniformed definition and guidelines for practicing social distancing during the COVID-19 pandemic.

References

- World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19, 11 March 2020. Available from: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19--11-march-2020>. Last updated March 11, 2020; cited February 18, 2021.
- Shim E, Tariq A, Choi W, Lee Y, Chowell G. Transmission potential and severity of COVID-19 in South Korea. *Int J Infect Dis*. 2020 Mar 22;93:339-44.
- Cao W, Fang Z, Hou G, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res*. 2020 Apr 2;287:112934.
- Mahase E. Covid-19: UK starts social distancing after new model points to 260 000 potential deaths. *BMJ*. 2020 Mar 19;368:m1089.
- Ritschl PV, Nevermann N, Wiering L, et al. Solid organ transplantation programs facing lack of empiric evidence in the COVID-19 pandemic: A By-proxy Society Recommendation Consensus approach. *Am J Transplant*. 2020 Apr 24;20(7):1826-36.
- World Health Organization. Coronavirus disease (COVID-19) advice for the public. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>. Last updated February 16, 2021. Cited February 18, 2021.
- Centers for Disease Control and Prevention. Interim US Guidance for Risk Assessment and Public Health Management of Persons with Potential Coronavirus Disease 2019 (COVID-19) Exposures: Geographic Risk and Contacts of Laboratory-confirmed Cases. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/php/risk-assessment.html>. Last updated February 2, 2021. Cited February 18, 2021.
- General Assembly of the World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *J Am Coll Dent*. 2014 May 9;81(3):14-18.
- Gallup. Americans Still Social Distancing, but Less Vigilant. Available from: <https://news.gallup.com/poll/309611/americans-social-distancing-less-vigilant.aspx>. Last updated April 30, 2020. Cited May 22, 2020.
- Fruhbeck G. Childhood obesity: time for action, not complacency. Definitions are unclear, but effective interventions exist. *BMJ*. 2000 Feb 5;320(7231):328-329.
- Nord E. Disability weights in the Global Burden of Disease 2010: unclear meaning and overstatement of international agreement. *Health Policy*. 2013 Apr 24;111(1):99-104.
- Rodziewicz TL, Houseman B, Hipskind JE. Medical Error Prevention. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020.
- Pollack Porter KM, Rutkow L, McGinty EE. The Importance of Policy Change for Addressing Public Health Problems. *Public Health Rep*. 2018 Nov 15;133(1_suppl):9S-14S.
- Uscher-Pines L, Schwartz HL, Ahmed F, et al. School practices to promote social distancing in K-12 schools: review of influenza pandemic policies and practices. *BMC Public Health*. 2018 Mar 29;18(1):406.
- Katz R, Vaught A, Simmens SJ. Local Decision Making for Implementing Social Distancing in Response to Outbreaks. *Public Health Rep*. 2019 Jan 19;134(2):150-154.
- Kraemer JD, Siedner MJ, Stoto MA. Analyzing Variability in Ebola-Related Controls Applied to Returned Travelers in the United States. *Health Secur*. 2015 Sep 9;13(5):295-306.
- Wolf MS, Serper M, Opsasnick L, O'Connor RM, Curtis L, Benavente JY, et al. Awareness, Attitudes, and Actions Related to COVID-19 Among Adults With Chronic Conditions at the Onset of the U.S. Outbreak: A Cross-sectional Survey. *Ann Intern Med*. 2020 Jul 21;173(2):100-109.
- Tuite AR, Greer AL, De Keninck S, Fisman DN. Risk for COVID-19 Resurgence Related to Duration and Effectiveness of Physical Distancing in Ontario, Canada. *Ann Intern Med*. 2020 May 28;173(8):675-8.
- Kissler SM, Tedijanto C, Goldstein E, Grad YH, Lipsitch M. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science*. 2020 May 22;368(6493):860-868.

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Conflict of Interest Statement & Funding

The Authors declare that there is no conflict of interest.

Author Contributions

Conceptualization: DLB, KWR, TWB; Data Curation, Investigation, Project Administration, Resources & Writing – Original Draft Preparation: DLB, KWR; Formal Analysis: DLB, CZ; Methodology: DLB, CZ; Software: DLB, CZ; Supervision: TWB; Validation: CZ; Writing – Review & Editing: DL, KWR, TWB.

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Perception of Medical Students on the Effect of COVID-19 on Medical Education in Nigeria

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Abstract

Background: The lockdown due to the COVID-19 pandemic disrupted normal activities including undergraduate medical education in Nigeria, similar to the rest of the world. Nigeria as a low- and middle-income country had peculiar challenges in adjusting to the new norm. This study aimed to assess Nigerian medical student's perception of the effect of COVID-19 on their learning. **Methods:** A semi-structured, pre-tested online questionnaire was administered to consenting medical students from thirty-three medical schools in Nigeria. Questions assessed the effect of COVID-19 on study and wellbeing, as well as the perception of interventions from institutions and student organizations to reduce the lockdown consequence on learning. Data was analyzed using (SPSS) version 25. **Results:** A total of 623 students from 33 institutions participated. All private institutions and 25% of public institutions had commenced online lectures/tutorials, 92% of students in private institutions and 21% in public institutions had attended online lectures/tutorials. Of those who did not attend institution-organized classes, 30.5% were opposed to online lectures, the main reasons stated being internet cost/availability and inefficiency. About 65% of the participants were aware of student-organized online tutorials/seminars. Eighty percent did not feel motivated to study and perceived their personal study to be less effective. **Conclusion:** Nigerian medical student's perception of the effect of COVID-19 on their medical education was largely negative. Private institutions fared better in coping with the challenges of the pandemic. Proper planning will be needed to curb the effect of COVID-19 on students' health and wellbeing.

Key Words: Medical Education; Medical Student; Coronavirus; COVID-19; Nigeria (Source: MeSH-NLM).

Introduction

On the 11th of March 2020, World Health Organization (WHO) declared Coronavirus Disease 19 (COVID-19) a pandemic.¹ Every level of education was challenged, including undergraduate medical education. Many countries resorted to the use of technology to ensure continuity in learning, as online education seemed to be the only logical alternative during this lockdown.²⁻⁵ Studies have also shown that online education holds some merit over traditional methods of learning.⁶ However, with online education, peculiarities in undergraduate medical training such as the need for clinical and laboratory activities, which play a pivotal role in learning, cannot be carried out. These have been replaced with clinical scenarios and alternatives to practical experiences.

The experiences of medical students in these times have varied depending on individual and location-based situations. While some final year students received an accelerated graduation,⁷ others were asked to stay home until further notice with lectures and training moved online⁸, and alternatively, some were allowed to participate in relief efforts during the pandemic.⁹ Many students experienced increased psychological pressure from uncertainties regarding future practice and how the pandemic might disrupt it.¹⁰ In addition, some students were not favorably disposed to the online learning environment.⁵ An Italian medical student described his online experience as "troubled",¹¹ and an Indian medical student described his experience of transitioning to online learning as "rough", citing poor

internet connection and poor video quality as some of the reasons that influenced his experience.¹² A pharmacy student in Nigeria stated in his experience that the education of many of his colleagues had been put to a halt and that the transition to online learning was affected by the lack of infrastructure, with only a few institutions commencing online learning.¹³

In Nigeria, medical undergraduate education (MBBS or MBChB) is a six-year program with a one-year compulsory internship. Like all other countries, medical colleges in Nigeria were closed due to the pandemic and one could assume that learning would have moved from the traditional method of face-to-face lecture to an online platform. However, being a low- and middle-income country, many Nigerians lack stable electricity supply, reliable network, and internet coverage. Many students also may not be able to afford the extra costs and equipment needed to utilize online learning to its full potential, if used at all. All of the aforementioned factors may impair the learning of undergraduate medical students during this pandemic.

This study, therefore, assessed Nigerian medical student's perception of the effect of COVID-19 on their medical education. It is expected that findings from this study may inform interventions aimed at improving medical students learning during the pandemic, especially as the country experiences the second wave of the COVID-19 outbreak.

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Methods

Study Design & Participants

A descriptive cross-sectional study was conducted using Google Forms. A semi-structured questionnaire comprising of 47 questions was created by the authors. The survey was validated by pre-testing it with 10% of the study sample size for content and structure, and the internal consistency of scales used was done using Cronbach's alpha with a score of 0.689. A sample size of 661 was determined using Fisher's formula for estimating sample size of a single proportion with prevalence assumed to be 50%, degree of accuracy desired set at 4%, and non-response rate of 10%. Students from all six years of undergraduate medical education in 33 medical institutions across the country, 7 private and 26 public, were included in the study. Non-proportionate stratified random sampling was used to select each participant.

Questionnaire

A semi-structured pre-tested questionnaire was administered among consenting medical students in the English language. Links to the online Google Forms (Google LLC, CA, U.S.A.) Questionnaire were shared via the official class/Medical Student Association WhatsApp (WhatsApp Inc, CA, U.S.A.) groups and via text messages. The questionnaire was available online for 50 days. A limit on the number of survey responses from a single email prevented duplicate responses, and all respondents were informed about the study's goals and risks. The questionnaire consisted of four sections; Section one captured information about population demographics; Section two measured participants awareness of online activities organized by institutions and student bodies in response to COVID-19, as an indirect measure of the response of these organizations in ensuring continued education during the pandemic; Section three measured the impact of COVID-19 on personal studying and learning, based on participants' perspective; and Section four measured participants perceived effect of the pandemic on their general day-to-day life and their educational progress. The questionnaire was expected to take an average of 15 minutes to complete.

Data Collection & Analysis

The data for the study was collected anonymously using a pre-tested, semi-structured, and self-administered questionnaire. Data was exported from Google Forms to Excel (Microsoft Corp, WA, U.S.A.) and coded and analyzed using SPSS version 25 (Statistical Package for the Social Sciences, SPSS Inc, U.S.A.). Categorical variables were summarized using frequencies and percentages while quantitative variables were summarized using means and standard deviation. Chi-square was used for the measure of association between categorical variables. All results are presented using tables and charts.

Ethical Consideration

Formal approval for the study was obtained from the Health Research and Ethics Committee of the Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria (HREC No: IPHOAU/12/1588). All students were invited to participate after providing informed consent. Confidentiality was maintained as no identifying information was collected during the survey.

Results

Demographics

A total of 623 responses were analyzed with a response rate of 94%, from 33 Medical Institutions in Nigeria spanning the six geo-political zones of the country, with the highest response from the South-West at 45.4% and the lowest from the South-East at 7.2%. A total of 55.7% were males and 44.3% were females. The majority of responders (64.2%) were in their clinical years. 88.4% of participants were from public universities (60.2% Federal, 28.3% State) and 11.6% from private universities. Other socio-demographic characteristics can be seen in **Table 1** (n=623 for all percentages).

Integrative Learning Responses of Medical Institutions and Student Bodies to COVID-19 Disruption of Medical Education.

At the time of the questionnaire, most institutions had yet to switch to online teaching. Of the 33 institutions included in this study, only 25% of public institutions had commenced online lectures as reported by their students, and all private institutions had commenced online lectures ($P<0.001$) (**Figure 1A**). 92% of the participants in private institutions participated in online classes organized by their institution, however, participation was only 21% for those in public institutions ($P<0.001$) (**Figure 1B**). Similar awareness levels were seen among participants in both public and private institutions when it came to awareness of student-led initiatives towards online learning and seminar organization at institution level (63% for public institution and 76% for private institutions); ($P=0.059$) (**Figure 1C**); and regional/national level (58% for public institution and 66% for private institutions); ($P=0.455$) (**Figure 1D**). Among the students who are currently not attending any online lectures organized by their institution, 44.6% wanted their institution to commence online teaching, while 30.5% were opposed ($n=623$ for the above percentages), citing reasons such as internet cost and availability (32%), lack of effectiveness (23%), and unstable electricity supply (15%) as to the main factors that influenced their decision ($n=191$).

Figure 1. Response of Participants to Questions about (A) Commencement of Online Lectures in Institutions, (B) Participation in Online Lectures, and (C) Awareness of Online Programs Organized by Student Body at Institution Level and (D) National Level. (For A, n=33; B-D, n=623)

Fig 1A Commencement of Online Lectures in Institutions (n=33; Private=7 Public=26)

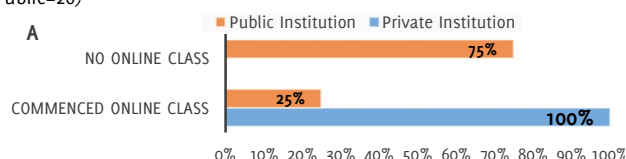


Fig 1B Participation in Online Lectures (n=623; Private=72 Public=551)

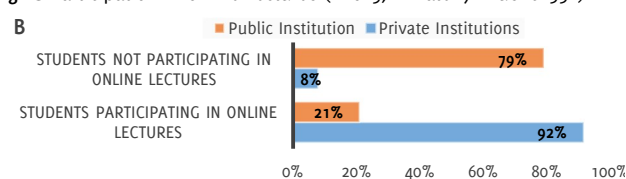


Fig 1C Awareness of Online Programs Organized by Student Body at Institution Level (n=623; Private=72 Public=551)

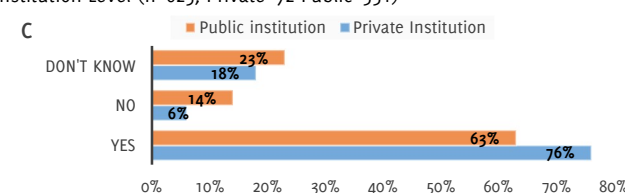


Fig 1D Awareness of Online Programs Organized by Student Body at National Level (n=623; Private=72 Public=551)

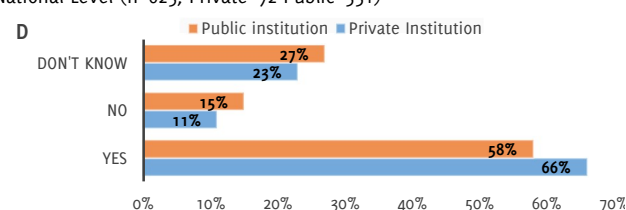


Table 1: Demographic Characteristics of Sample Population (n= 623)

Characteristics	Frequency (%)
Mean age(years)	
Total	22.2 ± 3.3
≤ 20	19.1 ± 1.1
21-25	22.8 ± 1.4
26-30	27.3 ± 1.4
>30	36.0 ± 5.4
Male	23.1 ± 3.7
Female	20.9 ± 2.4
Gender	
Male	347(55.7%)
Female	276(44.3%)
Marital Status	
Single	607(97.4%)
Married	12(1.9%)
Would rather not say	4(0.6%)
Educational Year	
1 st	26(4.2%)
2 nd	97(15.6%)
3 rd	100(16.1%)
4 th	184(29.5%)
5 th	144(23.1%)
6 th	72(11.6%)
Geopolitical Zone of Institution	
North-Central	48(7.7%)
North-East	71(11.4%)
North-West	113(18.1%)
South-East	45(7.2%)
South-South	63(10.1%)
South-West	283(45.4%)
Institution	
Private	72(11.6%)
Public	551(88.4%)
Access to stable electricity	248(39.8%)
Possession of internet-capable device	623(100.0%)
Ready access to the internet	424(68.1%)

Impact of COVID-19 on Students' Self-Learning (Table 2)

Students were asked about their self-study during the pandemic. The majority of the respondents (82%) said they still engaged in self-study, and 45% engaged in group learning/discussion (females were more likely to have participated in group learning/discussion; (P=0.006)). However only 19.9% felt motivated to study, 82.4% perceived their study and learning was less effective when compared to the pre-pandemic period, and 68.9% would rather their institution resume despite the ongoing pandemic. There was essentially no statistical difference between responses based on gender (n= 623 for the above percentages).

Impact of COVID-19 on Students' Environment and Wellbeing (Table 3)

When asked about their perception of the impact of COVID-19 on their environment and general wellbeing – physical, social and mental health – the majority of the respondents indicated that the effect has been largely negative. Many of the students (56.3%, n=623) would rather have served as medical assistants under supervision instead of staying at home. Only 13% (n=623) indicated that the effect of the pandemic will spur improvement in medical education in the country.

Discussion

The COVID-19 pandemic has significantly affected medical education in Nigeria like in the rest of the world. Before the pandemic, the medical education system in Nigeria had faced with many unresolved challenges such as inadequate funding and poor infrastructure.¹⁴ Therefore, this pandemic provided unique problems that were difficult to handle for these institutions. This was revealed in the fact only 25% of the 26 included public institutions had commenced some form of online classes as organized by the institution management, with only 21% of their students participating in these online lectures. This is different from a study done in Saudi Arabia, in which all medical institutions switched to online learning.¹⁵

The reason for this poor response and adjustment may be because most publicly owned medical institutions, which constitute nearly 80% of total medical institutions in Nigeria, have been poorly funded in the past by the government and as such, lacked the necessary resources and management drive to properly handle the change brought about by the pandemic.¹⁶ Notwithstanding the historical lack of funding, additionally the revised national budget also included a reduction in

Table 2: Participants' Perceived Effect of Covid-19 on Self-Learning (n= 623).

Characteristics	Total, n(%)	Male, n(%)	Female, n(%)	p-value
Engagement in self-study during this pandemic	511 (82.0)	286 (45.9)	225 (36.1)	0.426
Participation in group discussion/learning with colleagues	280 (45.0)	140 (22.5)	140 (22.5)	0.006
I have been motivated to study	124 (19.9)	77 (12.4)	47 (7.5)	0.066
There was more time available for me to study during this pandemic	181 (29.0)	95 (15.2)	86 (13.8)	0.173
My study was more effective when compared to pre-pandemic period	87 (14.0)	53 (8.5)	34 (5.5)	0.230
I was engaged in extracurricular activities during the pandemic to support myself	500 (80.2)	275 (44.1)	225 (36.1)	0.273

Table 3: Participants' Perception on the Effect of Covid-19 on Health and Wellbeing (n=623).

Question	SA, n (%)	A, n (%)	N, n (%)	D, n (%)	SD, n (%)
COVID-19 has negatively influenced the following					
Physical health	89 (14.3)	180 (28.9)	141 (22.6)	143 (23.0)	70 (11.2)
Mental health	139 (22.3)	201 (32.3)	115 (18.5)	112 (18.0)	56 (9.0)
Social health	133 (21.3)	219 (35.2)	148 (23.8)	85 (13.6)	38 (6.1)
The lockdown and restrictions have affected my welfare negatively	178 (28.6)	164 (26.3)	137 (22.0)	86 (13.8)	58 (9.3)
My cost of living has increased	177 (28.4)	167 (26.8)	132 (21.2)	92 (14.8)	55 (8.8)
I have had minimal social interactions with others	180 (28.9)	223 (35.8)	106 (17.0)	75 (12.0)	39 (6.3)
I have been having difficulties studying	297 (47.7)	195 (31.3)	69 (11.1)	43 (6.9)	19 (3.0)
My focus is less compared to when the disease wasn't yet in the country	262 (42.1)	183 (29.4)	68 (10.9)	79 (12.7)	31 (5.0)
I've been having constant anxiety about the possibility of I or my family contracting the virus	116 (18.6)	153 (24.6)	131 (21.0)	137 (22.0)	86 (13.8)

Legend: Where SA= Strongly Agree, A= Agree, N= Neutral, D= Disagree, SD= Strongly Disagree.

the budgetary allocation to the health and education sector. This in turn may translate to a possible reduction in salaries for medical educators and also further limit funding towards infrastructure needed to improve learning both now and in the near future.¹⁷ All of these have contributed to the lack of proper response by most public institutions who rely on the government for funding. Ossai (2020) in his publication on the readiness of Nigeria to tackle the impact of COVID-19 on medical education also shared similar sentiments, stating further that the lack of funding and infrastructure not only made Nigeria ill-equipped to handle the challenges that arose for undergraduate medical education, but also for postgraduate medical education including residency training.¹⁷

Many students attending these public institutions also felt that a quick transition from traditional lectures to online learning would prove difficult and ineffective as many claimed that lack of regular electricity supply and cost of internet subscription would hinder many students from attending online classes, the same reasons given in a publication by Oladipo et al. (2020) addressing the challenges of medical education in the pandemic era.¹⁸ Similar challenges were also stated in a study done in India⁵ and a write up from Brazil¹⁹ concerning the implementation of online learning in public institutions in the respective countries, which are both middle income countries like Nigeria. However, this was not the case for higher income countries such as the United States,² China,³ and others²⁰, who already had the infrastructure and systems for online learning and thus easily adapted even to the peculiar challenges of medical education. Private institutions, which constituted only 15% of the institutions included in this study, fared better in transiting to online lectures (100%), most likely due to the availability of more resources and proper planning. In addition, the majority of students in private institutions come from relatively wealthy families who have the means to provide the funds and resources to adjust seamlessly to this change.

Despite the lack of response and motivation from the management of most medical institutions in Nigeria, student-led initiatives have been the major route for organized seminars during this pandemic period. Almost three-fifths (59.4%) of the respondents claimed that their local student body has organized online learning programs during this time, also the majority of respondents affirmed that similar learning programs were also being carried out at regional or national levels. This shows the commitment of the medical students towards improving their learning; however, more can still be done to ensure that every student can participate and benefit.

Self-study has always been an important part of medical education, as it is difficult to teach everything in detail during lectures and this is reflected in our study, as a majority of the respondents (82%) still engaged in personal study despite the prolonged disruption of face-to-face learning activities. Nonetheless, lectures and clinical activities have always been a motivating factor for students towards learning and skill acquisition and this became clearly evident as a majority of the students (80.1%) indicated that they lacked the motivation to study and also affirmed that their study was less effective now than before the pandemic when schools were in session. The importance of lectures and clinical activities mattered to the respondent so much so that 68.9% of the respondents preferred that medical institutions resume despite the current pandemic still surging both globally and locally. This may be attributed to the fact that medical training cannot be easily learnt in isolation or relying on personal study alone; a large part of medical training requires learning from experts and adequate guidance to properly understand clinical concepts.

Every student needs to be in proper health both physically, mentally, and socially to be up to the task and this appears difficult to achieve in this period of uncertainty and fear, as described in a study by Brodeur et al. (2021), which also reported that the pandemic may have severely affected peoples mental health.²¹ A slight majority of the

respondents (54.9%) agreed that this pandemic has affected their welfare negatively, which is in line with the result of a study carried out by Knepple et al. (2021) which recorded higher level of stress and negative effect of the pandemic in the young.²² A similar number of respondents also claimed that there has been an increase in their cost of living, which may have led most of the respondents (80.3%) to engage in more extra-curricular activities outside of medicine than they normally would, such as work or other courses/training to help support their living expenses. This may further worsen the ability of the students to focus on learning and improving their skills even when the pandemic recedes.

Apart from the burden of the disease itself in terms of incidence, prevalence, and complications, there has been much concern about how the pandemic has affected various facets of life, especially as it pertains to education. Many students worry about their health, safety, education, and the well-being of their families,²³ and this may cause a lot of mental stress and its related mental health consequences. Concerning the effect of the pandemic on mental health, some students (43.6%) believed that they experienced constant anxiety and fear during this pandemic, which agrees with the finding by Brodeur et al. (2021) and Knepple et al. (2021). A study by Dawel et al. (2020) suggested that the negative effects themselves may be attributed to the social, professional, and financial disruptions induced by the pandemic rather than the stress of being exposed to the virus.^{21,22,24} All of these issues surrounding mental well-being will need to be addressed properly moving forward to ensure that students get back to a healthy state of mind before institutional activities resume in the near future.

Despite the challenges facing medical students in Nigeria today and their concerns about the Nigerian medical education system's response to COVID-19, they still have a desire to contribute to the fight against COVID-19 and to the health and wellbeing their community. Some medical students were involved in a campaign or activity to help curb the spread of the virus and many more are taking to social media to provide regular information about the outbreak.

Strengths

This study examined Nigerian medical student's perception of the effect of COVID-19 on their medical education and is perhaps one of the few studies conducted on this subject in Nigeria. In addition, the study used a nationally representative data with a considerable sample size from many medical schools in the country across public and private universities.

Limitation

First, the sample population was not evenly distributed across all geo-political zones and levels of training, which may introduce some bias. Secondly, the study was cross-sectional and did not measure the effect over time and how students adjusted accordingly. Thirdly, the effect of the pandemic on student's mental health was based purely on the participants own perception and not on objective questioning and analysis, therefore it may be difficult to validate if the effects were due to the pandemic alone, especially because medical education alone is mentally challenging.

Conclusion

COVID-19 has affected all areas of medical education and student wellbeing in Nigeria. The degree of effect was especially influenced by the type of institution attended. Student-led initiatives have been the major drive for continued student education during this pandemic, as many public institutions have failed to meet the learning challenges of the present time. Proper planning and adequate rehabilitation will be needed to curb and possibly reverse the effects of COVID-19 on students' health and wellbeing when things return to normal. Further studies may look in-depth at the effect in specific areas such as the effects on mental health.

References

1. Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Biomed.* 2020 Mar 19;91(1):157-160.
2. Ferdig RE, Baumgartner E, Hartshorne R, Kaplan-Rakowski R, Mouza C. Teaching, Technology, and Teacher Education During the COVID-19 Pandemic: Stories from the Field. eBook. Association for the Advancement of Computing in Education (AACE). Retrieved August 24, 2021 from <https://www.learntechlib.org/p/216903/>.
3. Chen T, Peng L, Yin X, Rong J, Yang J, Cong G. Analysis of User Satisfaction with Online Education Platforms in China during the COVID-19 Pandemic. *Healthcare (Basel).* 2020 Jul 7;8(3):200.
4. Basilaia G, Kvavadze D. Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. *Pedagog Res.* 2020 Apr;5(4):1-9.
5. Thomas A, Shenoy MT, Shenoy KT, Kumar SS, Sidheeque A, Khovidh C, et al. Survey Among Medical Students During COVID-19 Lockdown: The Online Class Dilemma. *Int J Med Stud.* 2020 May-Ago;8(2):102-6.
6. Joshi A, Kale S, Chandel S, Pal DK. Likert Scale: Explored and Explained. *Curr J Appl Sci Technol.* 2015 Feb 20;396-403.
7. Jumreornvong O, Yang E, Race J, Appel J. Telemedicine and Medical Education in the Age of COVID-19. *Acad Med.* 2020 Dec;95(12):1838-43.
8. George AP, Ewens EE. Two Student Perspectives on Clinical Medical Education During the COVID-19 Pandemic. *Int J Med Stud.* 2021 Jan-Apr;9(1):61-2.
9. Garman JC. COVID-19: Turning a Pandemic into a Learning Opportunity for Senior Medical Students. *Int J Med Stud.* 2020 Sep-Dec;8(3):307-8.
10. Komer L. COVID-19 amongst the Pandemic of Medical Student Mental Health. *Int J Med Stud.* 2020 Jan-Apr;8(1):56-7.
11. Biavardi NG. Being an Italian Medical Student During the COVID-19 Outbreak. *Int J Med Stud.* 2020 Jan-Apr;8(1):49-50.
12. Chatterjee S. The COVID-19 Pandemic Through the Lens of a Medical Student in India. *Int J Med Stud.* 2020 Jan-Apr;8(1):82-3.
13. Adebisi YA, Agboola P, Okereke M. COVID-19 Pandemic: Medical and Pharmacy Education in Nigeria. *Int J Med Stud.* 2020 May-Ago;8(2):162-4.
14. Professor, Ibrahim HM. Medical education in Nigeria. *Med Teach.* 2007 Jan 1;29(9-10):901-5.
15. Tanveer M, Bhaumik A, Hassan S. COVID-19 Pandemic, Outbreak Educational Sector and Students Online Learning in Saudi Arabia. *J Entrep Educ.* 2020;23(3).
16. Lawal O, Samy M. Perception of Stakeholders in Funding of Medical Education in Nigeria. *Int J Asian Soc Sci.* 2017;7(6):521-33.
17. Ossai EN. Impact of COVID-19 on medical education and the challenges: how prepared is Nigeria? *Pan Afr Med J.* 2020 Dec 14;37(Suppl 1):45.
18. Oladipo AT, Fashola OT, Agboola EI, Adisa OO, Oyekanmi OD, Akinsete AM. Challenges with medical education in Nigeria in the COVID-19 era. *Pan Afr Med J.* 2020 Nov 6;37:223.
19. Carvalho VO, Conceição LSR, Gois MB Jr. C. COVID-19 pandemic: Beyond medical education in Brazil. *J Card Surg.* 2020 Jun;35(6):1170-1171.
20. Tokuç B, Varol G. Medical Education in Turkey in Time of COVID-19. *Balk Med J.* 2020 Jun 1;37(4):180-1.
21. Brodeur A, Clark AE, Fleche S, Powdthavee N. COVID-19, lockdowns and well-being: Evidence from Google Trends. *J Public Econ.* 2021 Jan 1;193:104346.
22. Knepple Carney A, Graf AS, Hudson G, Wilson E. Age Moderates Perceived COVID-19 Disruption on Well-Being. *Gerontologist.* 2021 Jan 21;61(1):30-35.
23. Sahu P. Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. *Cureus.* 2020 Apr 4;12(4):e7541.
24. Dawel A, Shou Y, Smithson M, Cherbuin N, Banfield M, Calear AL, et al. The effect of COVID-19 on mental health and wellbeing in a representative sample of Australian adults. *Front Psychiatry.* 2020 Oct 6;11:579985.

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Author Contributions

Conceptualization & Investigation: IA, JKA, ASA, SOA & AO. Formal Analysis: AVF & ASA. Methodology: IA & ASA. Data Curation, Project Administration & Visualization: AVF. Supervision: AVF & TOO. Validation: TOO. Resources, Writing – Original Draft Preparation & Writing – Review & Editing: AVF, IA, JKA, ASA, SOA, AO & TOO.

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Trends and Factors Impacting Healthcare Charges and Length of Stay for Cholecystectomies: A New York State Population-based Analysis

Aria Darbandi,¹ Christina Chopra.²

Abstract

Background: Gallbladder disease confers a significant economic toll on the United States healthcare system. This study aims to characterize current trends and features of the cholecystectomy population and identify factors that influence the length of stay and total charges. **Methods:** Case information was extracted for laparoscopic and open cholecystectomies from 2013-2016 using the New York Statewide Planning and Research Cooperative System (SPARCS) database. Descriptive, comparative, and multivariable linear regression analysis was conducted on 58,141 cases assessing age group, race, gender, admission presentation, surgical technique, insurance status, year of operation and severity of illness by the length of stay and total charges. **Results:** Of all procedures, 91.6% were laparoscopic, and 79.4% were emergent on admission. Total procedures trended down, while laparoscopic and emergent cases steadily increased ($p < 0.0001$). Total charges increased during the study period, while the length of stay decreased ($p < 0.0001$). Open and emergent procedures were associated with a higher cost and longer inpatient stays ($p < 0.0001$). Open procedures were proportionally more common among elderly, male patients, and in elective cases ($p < 0.0001$). Emergent presentation was more common in females, non-whites, and younger patients ($p < 0.0001$). Regression model showed that male gender, open operation, Black race, and emergent presentation were independent predictors for a longer stay and greater total charges ($p < 0.0001$). Medicare insurance predicted lower total charges but longer length of stay ($p < 0.0001$). **Conclusion:** Race, insurance, procedure type, and patient presentation influence hospital charges and stays following cholecystectomy. Understanding these trends will allow policymakers and providers to limit the healthcare burden of cholecystectomy.

Key Words: Cholecystectomy; Length of Stay; Gallbladder Diseases; Healthcare Costs (Source: MeSH-NLM).

Introduction

Gallbladder disease is very common in the United States and presents a significant burden to the country's healthcare system. In 2014, cholecystectomy was the 8th most frequent operating room procedure, accounting for 2.6% (372,600) of all operations.¹ Epidemiologists have thoroughly examined identifying and characterizing factors contributing to the high prevalence of gallbladder disease in the United States.²⁻⁵ Variables such as race, gender, and socio-economic class all contribute to the manifestation of this disease.^{4,5}

While data on reductions in mortality or morbidity have been conflicting, laparoscopy has been shown to reduce patient hospital stays and total costs.⁶⁻⁹ First performed in Germany in 1985, the less invasive laparoscopic cholecystectomy quickly became the gold standard approach in the 1990s, replacing the traditional open approach.¹⁰ Despite its now widespread use, healthcare institutions still resort to the traditional open approach under certain circumstances including limited resource settings, lack of qualified surgeons, and predisposing patient risk factors.¹¹ Whether a procedure is emergent or elective may also determine surgical approach, as some surgeons argue the necrosis and inflammation in acute settings makes laparoscopy unfavorable.¹²

The aim of this study was to identify current trends in cholecystectomy procedures, describe differences in patient characteristics based on surgical approach and admission presentation, and identify factors that predict the patient length of stay and hospital charges. We targeted the

New York State population, as characterization of cholecystectomy procedures in this specific area has not been recently reported.¹³

Methods

Patient Population

Patient records were taken from the New York State Department of Health Statewide Planning and Research Cooperative System (SPARCS), a publicly available prospective database that captures all admissions and discharge records from New York State hospitals. All New York State hospitals are required to submit admissions and discharge data, including patient characteristics, treatments, insurance status, and All Patient Refined Diagnosis-related Groups (APR DRG) and International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes. The SPARCS database has been used for a variety of clinical and epidemiological studies.^{14,15} Due to the open-source nature of the data used for this study, IRB clearance was deemed unnecessary by the research team's affiliated institutional review board.

Admissions and discharge data for 66,647 hospitalizations undergoing non-laparoscopic or laparoscopic cholecystectomies from 2013-2016 were identified using Clinical Classifications Software (CCS) codes for the principal diagnosis of biliary tract disease (149) and the principal procedure of cholecystectomy and common duct exploration (84) (**Table 1**). CCS codes are clustered ICD-9-CM codes that fit into more cohesive and uniform categories, allowing for more effective data analytics. These codes have been used in a variety of clinical studies.¹⁶⁻¹⁸ The data

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excluded admissions on non-biliary CCS diagnostic codes such as pancreatic disorder (152) and secondary malignancy (42). This focused our study population to patients with biliary tract disease, whose primary purpose for hospital admissions was a cholecystectomy. Patients under the age of 18 were also excluded. APR DRG codes were then used to create cohorts of patients undergoing laparoscopic (263) and non-laparoscopic (262) procedures.

Primary outcome variables were total hospital charges and length of stay (LOS). Total charges are defined as all hospital expenses accrued from admissions to discharge. LOS is defined as the number of days the patient spends as an inpatient from admission to discharge, rounded to the nearest day. Co-variables used in this study were gender, race, age, presentation, surgical technique, insurance, year of discharge, and APR DRG severity of illness (SOI) score. Patient age was divided into four groups: 18-29, 30-49, 50-69, and above 70. SOI subclasses ranks patients as either minor, moderate, major, or extreme based on the amount of physiologic or organ system function loss. This score was used in our multivariable analysis and considers the severity of secondary diagnosis and comorbidities, accounting for interactions with patient characteristics and requirements for additional resources for care.¹⁹ The insurance category "other" included self-pay, worker compensation, and unreported data. The racial category "other" encompassed multiracial and undisclosed race. Presentation referred to whether the patient was admitted to the emergency department upon admission.

Statistical Analysis

Univariable analysis was conducted to summarize total admissions, procedure type (laparoscopic or open), patient presentation (elective or emergency), year of discharge, age group, gender, race, and insurance status. Number of cases and procedure type were described by year of discharge, along with a separate chart outlining yearly changes in LOS and total charges. Comparative analysis was carried out to assess differences between procedure type and patient presentation. Two-sample t-tests were used to compare differences in LOS and total charges among differences in patient presentation and procedure type. Chi-squared tests and two-proportion z-tests were used to compare proportions of the categorical variables of gender, race, age group, insurance status, admissions presentation, and procedure type.

Multivariate linear regression models with selection were used to assess the predictability of outcome variables LOS and total charges. The model included age group, gender, presentation, procedure type, race, insurance status, year of discharge, and SOI score. These factors were chosen because they had significant associations in the bivariate analysis. A two-tailed p-value <0.05 was set for statistical significance for all analyses. All data analysis was conducted using IBM SPSS Statistics 26.0 (Armonk, New York).

Results

After this initial screening, 58,141 patient records were included in this study (Figure 1). The characteristics of the study cohort are outlined in Table 2. Admissions for cholecystectomies declined annually, with an overall decrease of 15.3% (15,691 cases in 2013 to 13,602 cases in 2016). The percentage of laparoscopic surgeries increased (91.0% to 92.5%, $p<0.0001$) (Figure 2). LOS decreased (3.94 to 3.74, $p<0.0001$) and total charges increased (\$34,260 to \$42,232, $p<0.0001$) over the course of the study (Figure 3).

Open procedures were more likely to be elective in nature (42.2% vs. 18.6%, $p<0.0001$) (Table 3). Open procedures were, on average, more expensive and resulted in longer hospital stays (6.88 vs. 3.58 days, \$56,415 vs. \$36,607, $p<0.0001$) (Table 4). The percentage of emergent presentations increased during the study (78.6% to 81.2%, $p<0.0001$). Emergent surgeries had longer hospital stays and greater total charges on average (3.97 vs. 3.4 days, \$39,324 vs. \$34,202, $p<0.0001$).

Table 1. Procedural and Diagnostic Codes Included in Study.

Code Type	Code	Description
APR DRG	262	Cholecystectomy except laparoscopic
	263	Laparoscopic cholecystectomy
CCS ICD-9-CM Procedural	84	Cholecystectomy and common duct exploration
CCS ICD-9-CM Diagnostic	149	Biliary tract disease

Legend: APR all patient refined diagnosis-related groups; CCS clinical classifications software

Figure 1. Patient Flow Chart

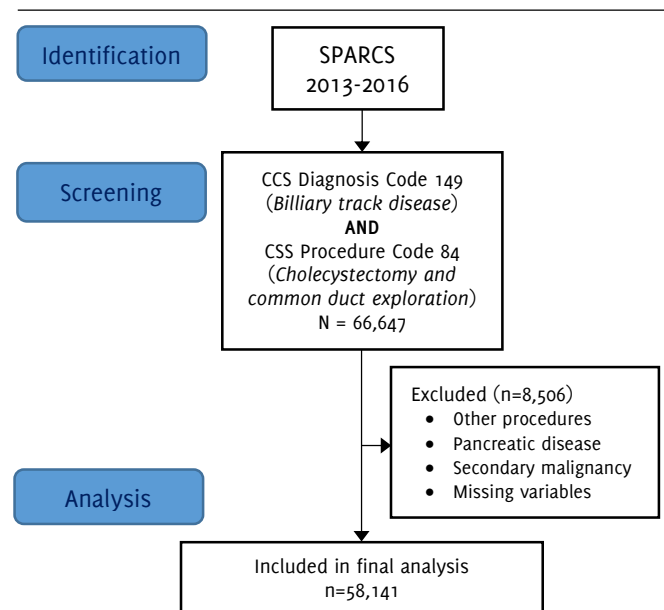


Figure 2. Trends in Laparoscopic and Emergent Cholecystectomies

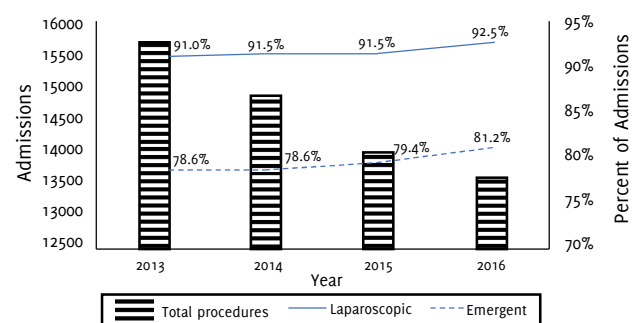


Figure 3. Trends in Total Charges and Length of Stay in Cholecystectomies

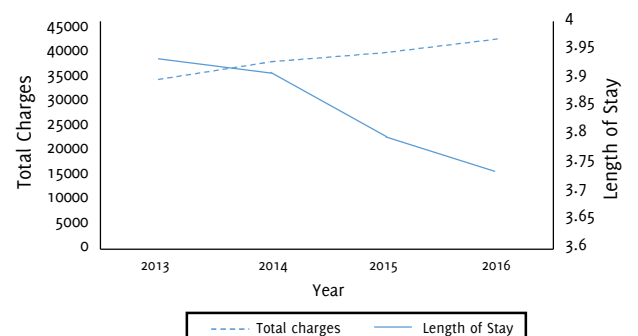


Table 2. Cholecystectomy Patient Demographic and Clinical Characteristics (2013-2016)

Variable	Value
Admissions	58,141 14,532/year
Gender	
Female	37,804 (65%)
Male	30,337 (35%)
Age Group	
18-29	8,333 (14.3%)
30-49	19,251 (33.1%)
50-69	19,731 (33.9%)
70+	10,826 (18.6%)
Race	
White	33,369 (57.4%)
Black	7,407 (12.7%)
Unknown	17,365 (29.9%)
Presentation	
Elective	11,897 (20.6%)
Emergency	46,154 (79.4%)
Operation	
Laparoscopic	53,266 (91.6%)
Open	4,875 (8.4%)
Insurance	
Medicaid	14,977 (25.8%)
Medicare	15,586 (26.8%)
Private	23,248 (40%)
Other	4,330 (7.4%)

Table 3. Cholecystectomy Patient Characteristics By Clinical Presentation (2013-2016)

Variable	Emergency	Elective	p value
Mean LOS	3.97± 3.97	3.4± 3.94	<0.0001
Mean Charges	\$39,324± \$33,621	\$34,202±\$38,503	<0.0001
Gender			
Female	30,291 (80.1%)	7,513 (19.9%)	<0.0001
Male	15,863 (78.0%)	4,474 (22.0%)	-
Operation			
Laparoscopic	43,338 (81.4%)	9,928 (18.6%)	<0.0001
Open	2,816 (57.8%)	2,059 (42.2%)	-
Age Group			<0.0001
18-29	7,175 (86.1%)	1,158 (13.9%)	<0.0001
30-49	15,943 (82.8%)	3,308 (17.2%)	<0.0001
50-69	15,092 (76.5%)	4,639 (23.5%)	<0.0001
70+	7,944 (73.4%)	2,882 (26.6%)	-
Race			<0.0001
White	26,209 (78.5%)	7,160 (21.5%)	-
Black	6,011 (81.2%)	1,396 (18.8%)	<0.0001
Other	13,934 (80.2%)	3,431 (19.8%)	<0.0001
Insurance			<0.0001
Medicaid	12,461 (83.2%)	2,516 (16.8%)	-
Medicare	11,505 (73.8%)	4,081 (26.2%)	<0.0001
Private	18,502 (79.6%)	4,746 (20.4%)	<0.0001
Other	3,686 (85.1%)	644 (14.9%)	<0.005

Legend: LOS: Length of hospital stay

Females were more likely to require emergent procedures (80.1% vs. 78.0%, $p<0.0001$) and underwent laparoscopic procedures more often (93.7% vs. 87.8%, $p<0.0001$). Black patients were more likely to undergo an emergent procedure than White patients (81.2% vs. 78.5%, $p<0.0001$). White patients underwent laparoscopic surgeries less often than Black patients (90.9% vs. 91.4%, $p=0.10$). As the age group increased, the likelihood of emergent presentations decreased (age 18-29: 86.1% vs. 70+: 73.4%, $p<0.0001$). Proportions of laparoscopic surgeries decreased

Table 4. Cholecystectomy Patient Characteristics By Procedure (2013-2016)

Variable	Laparoscopic	Open	p value
Mean LOS	3.58± 3.25	6.88± 6.21	<0.0001
Mean Charges	\$36,607± \$31,051	\$56,415±\$59,197	<0.0001
Gender			
Female	35,414 (93.7%)	2,390 (6.3%)	<0.0001
Male	17,852 (87.8%)	2,485 (12.2%)	-
Presentation			
Emergent	43,338 (93.9%)	2,816 (6.1%)	<0.0001
Elective	9,928 (82.8%)	2,059 (17.2%)	-
Age Group			<0.0001
18-29	8,112 (97.3%)	221 (2.7%)	<0.0001
30-49	18,285 (95.0%)	966 (5.0%)	<0.0001
50-69	17,615 (89.3%)	2116 (10.7%)	<0.0001
70+	9,254 (85.5%)	1,572 (14.5%)	-
Race			<0.0001
White	30,343 (90.9%)	3,026 (9.1%)	-
Black	6,770 (91.4%)	637 (8.6%)	0.10
Other	16,153 (93.0%)	1,212 (7.0%)	<0.0001
Insurance			<0.0001
Medicaid	14,053 (93.8%)	924 (6.2%)	-
Medicare	13,446 (86.3%)	2,140 (13.7%)	<0.0001
Private	21,736 (93.5%)	1,512 (6.5%)	0.0951
Other	4,031 (93.1%)	299 (6.9%)	0.04

Legend: LOS length of stay

as age increased (Ages 18-29: 97.3% vs. Above 70:85.5%, $p<0.0001$). Medicare patients were the least likely to have emergent operations (73.8% vs. Medicaid: 83.2%, $p<0.0001$). Medicare patients were also the least likely to undergo a laparoscopic procedure (86.3% vs. Medicaid: 93.8%, $p<0.0001$).

Multivariable analysis showed that male gender, open procedures, emergent presentation, and Black race predicted significant increases in LOS and total charges ($p<0.0001$) (Table 5). Medicare predicted decreased hospital charges but longer LOS ($p<0.0001$).

Discussion

The findings of this study offer several noteworthy observations. Univariable analysis confirmed the known nature of gallbladder disease. This disease disproportionately affects females, Black people and middle age, generally presents in emergent settings, and is overwhelmingly treated laparoscopically in modern medical practice.^{4, 5} Interestingly, we found that total admissions have been incrementally decreasing every year in the adult population of New York State, dropping 15.3% from 2013 to 2016. In a New York State study from 1995 to 2013, Alli et al. found that cholecystectomy procedures did not match the increase in population (1.23% procedural increase for a population increase of 6.32%).¹³ While the nationwide incidence is rising, we suggest there may be a population-specific fall of all biliary-type diseases in New York State.^{4,5,13} Our data did, however, show a rise in emergent admissions, which could be attributed to the specific rise of acute cholecystitis.^{2,20} Multi-regional analysis is warranted to better characterize these trends. One possible explanation for this fall in total cholecystectomy procedures is the shifting indications for elective laparoscopic procedures and more thoughtful decision-making by both surgeons and patients, who are better informed about the substantial risks of surgery. We believe this trend will continue in the years moving forward.

In accordance with the literature, we observed a rise in mean total charges and a decrease in LOS over the course of our study.²⁰ As hospital expenses continue to rise, monitoring ways to limit the economic burden of cholecystectomy becomes more important. We attribute the fall in hospital stays to enhanced patient fast-tracking and the use of multidisciplinary and multimodal teams to expedite rehabilitation.

Table 5. Multivariable Predictor for Length of Stay and Hospital Charges

Variables	Length of Stay				Hospital Charges			
	B Coefficient	95% CI		p value	B Coefficient	95% CI		p value
		Lower	Upper			Lower	Upper	
Age								
18-29	-1.04	-1.15	-0.93	<0.0001	-\$7,316	-\$8,426	-\$6,208	<0.0001
30-49	-0.93	-1.03	-0.84	<0.0001	-\$6,114	-\$7,078	-\$5,149	<0.0001
50-69	-0.70	-0.78	-0.61	<0.0001	-\$4,393	-\$5,244	-\$3,542	<0.0001
Over 70	-	-	-	-	-	-	-	-
Race								
White	-	-	-	-	-	-	-	-
Black	.65	.57	.72	<0.0001	\$7,010	\$6,238	\$7,781	<0.0001
Other	.30	.24	.36	<0.0001	\$5,700	\$5,119	\$6,280	<0.0001
Female Gender	-0.08	-0.13	-0.02	0.005	-\$1,605	-\$2,134	-\$1,076	<0.0001
Elective presentation	-1.04	-1.10	-0.98	<0.0001	-\$7,960	-\$8,153	-\$6,748	<0.0001
Laparoscopic technique	-2.35	-2.44	-2.26	<0.0001	-12,766	-\$13,678	-\$11,854	<0.0001
Year								
2013	.34	.27	.40	<0.0001	-\$7,450	-\$8,153	-\$6,748	<0.0001
2014	.19	.12	.26	<0.0001	-\$4,379	-\$5,080	-\$3,678	<0.0001
2015	.05	-0.2	.12	0.186	-\$2,720	-\$3,432	-\$2,010	<0.0001
2016	-	-	-	-	-	-	-	-
Insurance								
Medicaid	.37	.30	.43	<0.0001	-\$1,248	-\$1,908	-\$587	<0.0001
Medicare	.52	.44	.60	<0.0001	\$1,119	-\$317	-\$1,921	0.006
Private	-	-	-	-	-	-	-	-
Other	.15	.06	.25	0.002	-\$4,106	-\$5,087	-\$3,123	<0.0001
SOI Score								
Mild	-1.10	-1.15	-1.04	<0.0001	-\$7,650	-\$8,185	-\$7,114	<0.0001
Moderate	-	-	-	-	-	-	-	-
Major	3.05	2.97	3.14	<0.0001	\$21,203	\$20,327	\$22,079	<0.0001
Extreme	11.15	10.95	11.34	<0.0001	97,660	\$95,630	\$99,690	<0.0001

Comparative analysis between laparoscopic and open procedures suggests that laparoscopy limits hospital costs and patient stay.^{3,6,7} Interestingly, open procedures were disproportionately elective in nature. This was noteworthy because there is no indication to prefer the open technique in an elective setting, and some surgeons prefer open procedures in emergent cases due to the associated excess inflammation and necrosis.¹² A 2013 study by To et. al found that conversion rates to open procedures increased nearly two-fold in emergent settings.²¹ While the evidence is limited to support using open procedures more frequently in emergent settings, our findings indicate that open procedures are more often used in elective situations.²² Future research should evaluate the factors that may be influencing this interesting finding.

Geriatric procedures were more often elective in nature and used the open approach. This trend may be explained by concerns that laparoscopy poses increased risk through high physiologic demand, especially considering these patients often present with other comorbidities.¹¹ For example, insufflating carbon dioxide during laparoscopy may cause acid-base disturbances and changes in cardiopulmonary physiology that are otherwise avoided in the open approach.²³⁻²⁵ Despite these concerns, systematic studies indicate that laparoscopic procedures in elderly patients offer many advantages, such as lower pain and convalescence, and clinicians still tend to prefer laparoscopy in the elderly in both emergent or elective settings.^{11,26,27}

Our multivariable linear regression model illustrated those elective admissions, laparoscopic operations, and younger patient were associated with lower hospital stays and total costs.³ This model also showed that women had lower total costs and shorter hospital stays than men. Women are more often candidates for cholecystectomies, but men tend to have more complex and longer procedures which may explain their less favorable outcomes.^{28,29} In agreement with our findings, Carbonell et al. found in a US-nationwide study in 2000 that male gender was linked to higher charges, longer LOS, and increased morbidity and mortality after cholecystectomy.³

Black race was an independent predictor for increased LOS and total cost. Gahagan et al. conducted a 2009-2012 study using nationwide data that had similar findings. Namely, they found that white patients had shorter hospital stays and lower total charges, despite higher morbidity odds.³⁰ These findings are concerning and warrant further investigation, as they demonstrate a racial disparity in care beyond disease state and presentation. Likewise, compared to Medicaid patients, private insurance predicted a shorter hospital stay, yet a higher total cost. This suggests wealth disparities that could be attributable to several factors including overbilling, or additional treatments and testing. Overall, our data reinforces evidence of racial and insurance-based disparities in healthcare, specifically among cholecystectomy patients.

There are several limitations to this study. The SPARCS database receives administrative coding, which may not be standardized. This could result in variations in coding that alter the assumed specificity of the inclusion criteria used in this study. Additionally, we attempted to limit confounding factors that would influence outcomes by excluding patients with non-biliary primary diagnoses, which means our data does not reflect absolute values of admissions. Comorbidities were also addressed in our multivariable regression model by including APR severity of illness score. While this scoring system is believed to be valid, its efficiency in studies such as ours needs to be further assessed.¹⁹ Furthermore, the SPARCS database accounts for admissions and discharges, meaning an individual patient could account for multiple data entries. Although the SPARCS database has its flaws, it has been used in a variety of epidemiological and outcomes studies and offers great value in assessing trends in the New York State area.^{14,15} We suggest caution when inferring these results to nationwide trends. Future studies should include assessing morbidity and mortality, investigating potential causes for disparities seen among specific ethnic groups and insurance types, and examining trends in the pediatric population.

References

- McDermott K, Freeman WJ, Elixhauser A. Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals. Healthcare Cost And Utilization Project. 2014; 2017, 1-18.
- Halpin V. Acute cholecystitis. *BMJ Clin Evid*. 2014 Aug;04:11.
- Carbonell AM, Lincourt AE, Kercher KW, Matthews BD, Cobb WS, Sing RF, Heniford BT. Do patient or hospital demographics predict cholecystectomy outcomes? A nationwide study of 93,578 patients. *Surg Endosc*. 2005 Jun;19, 767-73.
- Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: Cholelithiasis and cancer. *Gut Liver*. 2012 Apr;6(2):172-87.
- Shaffer EA. Gallstone disease: Epidemiology of gallbladder stone disease. *Best Pract Res Clin Gastroenterol*. 2006;20(6):981-96.
- Sandblom G, Videhult P, Crona Guterstam Y, Svenner A, Sadr-Azodi O. Mortality after a cholecystectomy: A population-based study. *HPBA*. 2015;17, 239-243.
- Shea JA, Healey MJ, Berlin JA, Clarke JR, Malet PF, Starosciak RN, et al. Mortality and complications associated with laparoscopic cholecystectomy: A meta-analysis. *Ann Surg*. 1996 Nov;224(5):609-20.
- Fogli L, Boschi S, Patrizi P, Berta RD, Al Sahllani U, Capizzi D, et al. Laparoscopic cholecystectomy without intraoperative cholangiography: Audit of long-term results. *J Laparoendosc Adv Surg Tech A*. 2009 Apr;19(2):191-3.
- Livingston EH, Rege RV. A nationwide study of conversion from laparoscopic to open cholecystectomy. *Am J Surg*. 2004 Sep;188(3):205-11.
- Reynolds W Jr. The first laparoscopic cholecystectomy. *JSL*. Jan-Mar 2001;5(1):89-94.
- Lujan JA, Parrilla P, Robles R, Marin P, Torralba JA, Garcia-Ayllon J. Laparoscopic cholecystectomy vs open cholecystectomy in the treatment of acute cholecystitis: A prospective study. *Arch Surg*. 1998 Feb;133(2):173-5.
- Alli VV, Yang J, Xu J, Bates AT, Pryor AD, Talamini MA, et al. Nineteen-year trends in incidence and indications for laparoscopic cholecystectomy: the NY State experience. *Surg Endosc*. 2017 Apr;31(4):1651-1658.
- Polomsky M, Hu R, Sepesi B, O'Connor M, Qui X, Raymond DP, et al. A population-based analysis of emergent vs. elective hospital admissions for an intrathoracic stomach. *Surg Endosc*. 2010 Jun;24(6):1250-5.
- Bureau of Health Informatics Office of Quality and Health Safety. Statewide Planning and Research Cooperative System (SPARCS). New York State Department of Health.
- Thompson DA, Makary MA, Dorman T, Pronovost PJ. Clinical and economic outcomes of hospital acquired pneumonia in intra-abdominal surgery patients. *Ann Surg*. 2006 Apr;243(4):547-52.
- Chi M Ju, Lee C Yi, Wu S Chong. The prevalence of chronic conditions and medical expenditures of the elderly by chronic condition indicator (CCI). *Arch Gerontol Geriatr*. May-Jun 2011;52(3):284-9.
- Moy E, Coffey RM, Moore BJ, Barrett ML, Hall KK. Length of stay in EDs: Variation across classifications of clinical condition and patient discharge disposition. *Am J Emerg Med*. 2016 Jan;34(1):83-7.
- McCormick PJ, Lin H Mo, Deiner SG, Levin MA. Validation of the All Patient Refined Diagnosis Related Group (APR-DRG) Risk of Mortality and Severity of Illness Modifiers as a Measure of Perioperative Risk. *J Med Syst*. 2018 Mar 22;42(5):81.
- Wadhwa V, Jobanputra Y, Garg SK, Patwardhan S, Mehta D, Sanaka MR. Nationwide trends of hospital admissions for acute cholecystitis in the United States. *Gastroenterol Rep (Oxf)*. 2017 Feb;5(1):36-42.
- To KB, Cherry-Bukowiec JR, Englesbe MJ, Terjimanian MN, Shijie C, Campbell Jr. DA, et al. Emergent versus elective cholecystectomy: Conversion rates and outcomes. *Surg Infect (Larchmt)*. 2013 Dec;14(6):512-9.
- Andercou O, Olteanu G, Mihaileanu F, Stancu B, Dorin M. Risk factors for acute cholecystitis and for intraoperative complications. *Ann Ital Chir*. 2017;88:318-325.
- Safran DB, Orlando R. Physiologic effects of pneumoperitoneum. *Am J Surg*. 1994 Feb;167(2):281-6.
- Ho HS, Gunther RA, Wolfe BM. Intraperitoneal Carbon Dioxide Insufflation and Cardiopulmonary Functions: Laparoscopic Cholecystectomy in Pigs. *Arc Surg*. 1992 Aug;127(8):928-32; discussion 932-3.
- Hirvonen EA, Nuutinen LS, Kauko M. Ventilatory effects, blood gas changes, and oxygen consumption during laparoscopic hysterectomy. *Anesth Analg*. 1995 May;80(5):961-6.
- Ferrarese AG, Solej M, Enrico S, Falcone A, Catalano S, Pozzi G, et al. Elective and emergency laparoscopic cholecystectomy in the elderly: Our experience. *BMC Surg*. 2013;13 Suppl 2(Suppl 2):S21.
- Musabhi A, Abdulhannan P, Bhatti J, Dhar R, Rao M, Gopinath B. Outcomes and risk factors of cholecystectomy in high risk patients: A case series. *Ann Med Surg (Lond)*. 2020 Jan 3;50:35-40.
- Bazoua G, Tilston MP. Male gender impact on the outcome of laparoscopic cholecystectomy. *JSL*. Jan-Mar 2014;18(1):50-4.
- Alqahtani R, Ghannam W, Alqahtani M, Qatomah A, Alkhathami A, Alhashim A. Role of Male Gender in Laparoscopic Cholecystectomy Outcome. *Int J Surg Med*. 2015;1(2):38-42.
- Gahagan JV, Hanna MH, Whealon MD, Maximus S, Phelan MJ, Lekawa M, et al. Racial disparities in access and outcomes of cholecystectomy in the United States. *Am Surg*. 2016 Oct;82(10):921-5.

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Author Contributions

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The Impact of Previous Cardiology Electives on Canadian Medical Student Interest and Understanding of Cardiology

Bright Huo,¹ Wyatt MacNevin,² Todd Dow,³ Miroslaw Rajda.⁴

Abstract

Background: Most Canadian medical schools do not have mandatory cardiology rotations. This study investigates whether prior elective experiences affect medical student interest as well as understanding of cardiology before clerkship rotation selections. **Methods:** An online evidence-based cross-sectional survey was distributed to 122 second-year medical students at a Canadian medical school. Students were assessed on their interest and understanding of cardiology practice using a 5-point Likert Scale. Descriptive statistics, Chi-Square analysis and Cramer's V were used to assess the relationship between previous elective experience, medical student interest, and understanding of career-related factors pertaining to cardiology. **Results:** Fifty-three of 122 (43%) students responded to the survey. Overall, 26 (49.1%) students reported cardiology interest, while it was a preferred specialty for 9 (17.0%). Medical students reported low understanding of duration of patient relationships ($n=14$, 26.4%), spectrum of disorders ($n=13$, 24.5%), and in-patient care ($n=11$, 20.8%) associated with cardiology practice. Students with prior cardiology electives had increased understanding of in-patient care ($\chi^2 = 4.688$, Cramer's $V = 0.297$, $p = 0.030$) and were more likely to select cardiology as a top specialty choice ($\chi^2 = 7.983$, Cramer's $V = 0.388$, $p = 0.005$); however, cardiology electives prior to clerkship did not increase subjective student interest in cardiology ($\chi^2 = 1.345$, Cramer's $V = 0.159$, $p = 0.685$). **Conclusion:** Pre-clerkship medical students have a low understanding of cardiology practice. Increasing pre-clerkship exposure to cardiology may help students confirm cardiology as a top career choice before clerkship selectives are chosen.

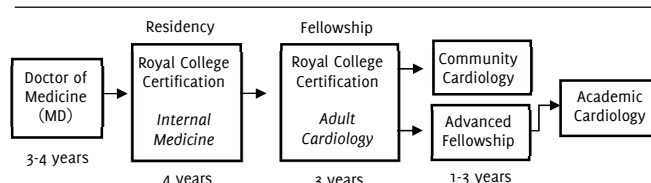
Key Words: Cardiology; Career Choice; Medical Education; Medical Students (Source: MeSH-NLM).

Introduction

Career choices made in medical school have long-term consequences. Up to 14% of physicians report regret with their career choice.^{1,2} This is particularly salient for Canadian medical students interested in pursuing a career in cardiology, as they must complete 4 years of internal medicine residency training before further cardiology subspecialty training.³ While other subspecialties in internal medicine also require the completion of this initial phase of training, it is increasingly common for cardiologists to pursue subspecialty fellowship training after residency to adapt to the increasing complexity of patient care and the newest procedural approaches (Figure 1).^{4,5} The pursuit of a career in cardiology can represent a long and arduous path which medical students must recognize when making career decisions.⁴

Choosing a career path is a difficult decision for medical students.^{6,7} Although some students initially have ideas about specialties, these change for most students throughout their undergraduate medical education due to preferences for lifestyle, perceived competence, and clinical exposure.⁸⁻¹⁰ Canadian undergraduate medical education consists of a pre-clerkship phase with a larger emphasis on didactic teaching, followed by clerkship training in various clinical settings. In pre-clerkship, formal clinical experience is acquired through electives, in which students have weekly protected time with a selected preceptor to explore a specialty of their choosing. Students then enter clerkship rotations and begin selectives, in which students experience a select number of specialties in a fixed number of weeks. For instance, for a mandatory clerkship rotation such as internal medicine, students can request selectives in medical specialties of their interest.

Figure 1. Training path to becoming a cardiologist in Canada.



Dalhousie students participate in three term-long electives during pre-clerkship. However, the timing and availability of pre-clerkship electives vary across Canadian medical schools, and some institutions do not offer formal electives. Yet, all Canadian medical students must choose their medical clerkship selectives during their last pre-clerkship year of training. This bears considerable implications on defining their clinical exposure and the opportunities to obtain reference letters for residency applications.¹¹ Despite the nuances of career planning, most Canadian medical schools do not provide mandatory rotations in cardiology, leaving potentially interested students with a lack of exposure to the specialty. Additionally, 40% of the ~1,500 cardiologists in Canada are 55 years of age or older, highlighting the importance of maintaining student interest in cardiology as a career to mitigate future physician shortages.¹² To further this issue, cardiology is a rapidly evolving field leading to insufficient medical student understanding of the specialty.^{13,14}

Despite the complex advancements in cardiology, there is limited research surrounding medical students' understanding and interest in

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the specialty.¹⁵⁻¹⁷ Existing literature suggests that students are interested in cardiology due to factors such as high income potential and status among colleagues.¹⁴ However, no studies have been conducted to examine these factors among Canadian medical students. To address this gap, a survey was developed to examine the interest and understanding of cardiology as a specialty among second-year medical students.

Methods

Study Design

A literature search was performed using PubMed, Google Scholar and Embase to guide the creation of an evidence-based questionnaire between December 7th, 2019 to January 3rd, 2020. Reference lists of included studies were manually searched. Keywords are listed in Figure 2. Articles entered a first round of screening by the primary investigator and two co-investigators independently. They were screened by title and abstract to capture studies that investigated student perceptions of cardiology. Studies were included if they examined undergraduate medical student interest or understanding of cardiology. Non-English studies and those examining postgraduate medical trainee perceptions were excluded. Conflicts were resolved by the supervising investigator (Figure 2).

The second round of screening was completed by the primary investigator and co-investigators independently by performing full text reviews of remaining articles. Conflicts were resolved by the supervising investigator. Similar inclusion and exclusion criteria were applied, yielding a total of 3 articles (Figure 2). In addition to studies investigating the general career-related factors which medical students consider when exploring specialties, these articles were used to create a survey. All investigators collaborated to generate a final list of career factors.

Setting & Participants

Medical student interest and understanding of cardiology was analyzed using a cross-sectional approach by surveying second-year medical students at Dalhousie University in Halifax, Nova Scotia, Canada. Respondents had experienced three mandatory electives prior to completing the survey. All students who wished to pursue cardiology electives were able to secure one. Participants of the study were applicants to a 2-week elective summer program at Dalhousie Medicine designed to improve transition to clerkship through a combination of specialty and skills exposure.

Electronic surveys were distributed via email and administered using *Opinio* (Object Plant, Oslo, Norway). Data was collected anonymously through a secure web browser during a four-week study period from January 13th to February 9th, 2020. Participation in the study was voluntary with no exclusion criteria applied. Students submitted their informed consent with survey completion.

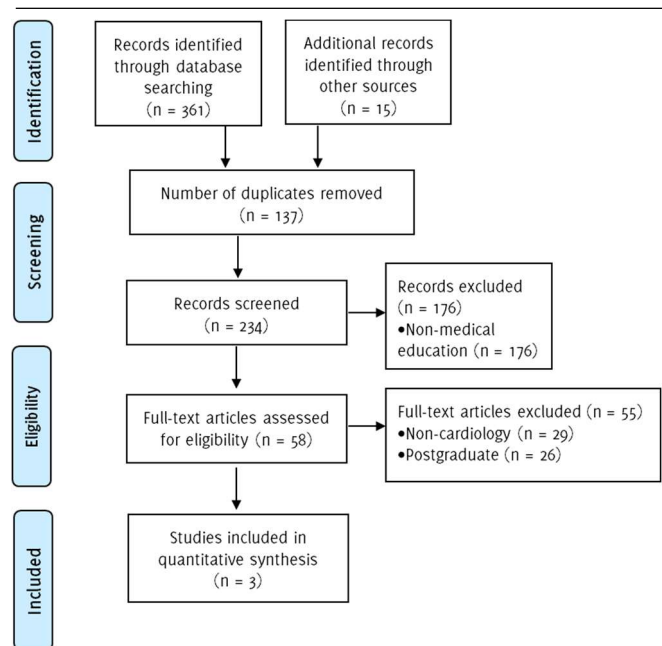
Variables & Assessment

The primary objective of this study was to establish student interest towards and understanding of cardiology prior to clerkship. The secondary objectives were to determine relationships between student demographic factors, career factor preference and prior elective exposure with interest in cardiology to identify trends within students interested in the specialty.

The survey was designed to include demographic questions such as age, gender, education, desired practice location, and rural versus urban upbringing (Supplementary Material). Previous clinical elective exposure and specialty interest were also assessed. Using a 5-point Likert scale, students reported their understanding of career factors pertaining to cardiology such as the spectrum of medical issues treated, common procedures performed, income potential (for Canadian cardiologists), and other features associated with the general practice of cardiology and the patient population served. The following scale for

understanding of career factors pertaining to cardiology was used: 1 – Very Low, 2 – Low, 3 – Neutral, 4 – High, 5 – Very High.

Figure 2. Literature Search. Keywords included “medical student”, “medical students”, “cardiology”, “career choice”, “career choices” and “career navigation”. “cardiology service”, “decision making”, “career planning”, “career mobility”, and “medical student.”



Bias

The survey was purposefully worded to mitigate bias and all data collected was anonymous. The survey questionnaire was evaluated using the instrument provided by Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). Research ethics approval was provided by the Nova Scotia Health Authority Research Ethics Board (File No. 1023087). This study investigates medical student interest and understanding of cardiology practice and is part of a larger study aimed at quality improvement of a two-week elective program through procedural skills exposure, elective experience and simulation training.

Data Analysis

With a response rate of 44%, a total of 122 students were surveyed to attain a sample size of 53 responses to identify pre-clerkship student interest and understanding of cardiology with a 10% margin of error. Incomplete or missing responses were not included in statistical analysis.

Survey data was exported into IBM Statistical Package for the Social Sciences (SPSS) software (Version 25, IBM, New York, United States) and demographic characteristics were expressed using descriptive analysis as frequencies and percentages. Participant ratings of their understanding of career-related factors pertaining to cardiology practice were considered high for Likert-scale values of 4 and 5. Ratings of 1, 2, or 3 were considered low.

Chi-squared tests were used to analyze the relationship between demographic factors and interest in cardiology using Cramer's V, as well as for analysis between previous elective experience and understanding of career factors associated with cardiology. A reliability analysis was performed using Cronbach's alpha to assess the internal consistency of the cardiology perception factors scale using all 9 items with a minimum acceptable alpha of 0.7. A 90% confidence interval was used for determining statistical significance, set at $p < 0.10$.

Results

Demographics

A total of 53 (45.7%) Canadian second-year medical students from Dalhousie University responded to the survey (Table 1). Of all respondents, 32 (60.3%) were female, 27 (50.9%) were between 20-24 years of age, and 37 (69.8%) indicated that a Bachelor's degree was their highest level of education. Cronbach's alpha demonstrated that the questionnaire met acceptable reliability, $\alpha = 0.852$. All items were worthy for retention as was reduced when any single item was removed.

Table 1. Demographic Characteristics of Respondents (n = 53).

	Frequency (n)	Percentage (%)
Gender		
Male	21	40
Female	32	60
Undisclosed	0	0
Age		
20-24	27	51
25-26	15	28
27+	11	21
Education		
Bachelor's	37	70
Graduate	16	30
Marital Status		
Single	40	75
Common Law	5	9
Married	7	13
Other	1	2
Upbringing		
*Urban	46	87
**Rural	7	13
Desired Practice Location		
*Urban	46	87
**Rural	7	13
Desired Practice Setting		
Community	13	25
Hospital	21	40
Academic	17	32
Other	2	4
Prior Elective in Cardiology		
Yes	7	13
No	46	87
Considering Cardiology as a Career		
Yes	9	17
No	44	83

Legend: *Urban: Population >1000. **Rural: Population <1000

Student Interest in Cardiology

Student interest in cardiology was moderate at a mean of 3.34/5.00 (90% CI, 3.08 – 3.59) \pm (SD, 1.108). Overall, 26 (49.1%) students had an interest in cardiology, with cardiology being a top career choice among 9 (17%) participants (Table 1). Seven (13%) students participated in a previous clinical elective in cardiology with over half of these students also ranking their interest in cardiology as "High" or "Very High". Previous cardiology electives did not increase student interest in the specialty ($\chi^2 = 1.345$, *Cramer's V* = 0.159, $p = 0.685$; Table 2). However, students with previous cardiology electives were more likely to select cardiology as a top specialty choice compared to those without a prior elective experience ($\chi^2 = 7.983$, *Cramer's V* = 0.388, $p = 0.005$).

When analyzing the impact of student demographics on cardiology interest, there was a significant increase in cardiology interest in those with an urban upbringing compared to those that were from a rural setting ($p = 0.037$; Table 2). Students ≥ 27 years of age also had an increased interest in cardiology ($p = 0.027$). Of the students who indicated a "High" or "Very High" interest in cardiology, 20 (76.9%) students desired to work in a hospital/academic-based practice

compared to a community-based career ($p = 0.016$; Table 2). Factors such as education obtained, marital status, having children, or desired practice location had no effect on cardiology interest (Table 2).

Career Influencing Factors and Cardiology Interest

Students that valued high interest in the medical conditions treated by a specialty ($p = 0.009$), having a strong relationship with a cardiologist mentor ($p = 0.088$) and long-term patient relationships ($p = 0.072$) were more likely to report increased interest in cardiology (Table 2). Students valuing other factors such as acceptable weekly hours, high income potential, status among colleagues and long-term patient relationships did not have an increased interest in cardiology (Table 2).

Table 2. The Impact of Demographic, Career Factors and Previous Cardiology Electives on Interest in Cardiology.

Factor	χ^2	Cramer's V	p-value
Demographics			
Gender	0.154	0.054	0.695
Age	0.468	0.094	0.494
Education	0.475	0.095	0.491
Marital Status	0.774	0.121	0.379
*Upbringing	4.337	0.286	*0.037
Desired Practice Location	0.124	0.048	0.725
Desired Practice Setting	12.177	0.479	*0.016
Career Factors			
Acceptable Weekly Hours	0.167	0.056	0.682
High Income Potential	0.034	0.025	0.854
Status Among Colleagues	1.615	0.175	0.204
Urgency of Care	0.475	0.095	0.491
Medical Conditions Treated	6.839	0.359	*0.009
Strong Relationship with Mentor	2.908	0.234	0.088
Patient Population	0.339	0.080	0.560
Long-Term Patient Relationships	3.228	0.247	0.072
Previous Cardiology Elective	1.345	0.159	0.685

Legend: *Urban upbringing. Cramer's V scores were considered as follows: 0-0.25 (weak), 0.25-0.5 (moderate), 0.5-1 (strong).

Student Understanding of Cardiology as a Career

Students were most confident in their understanding of the higher status among colleagues (Mean \pm SD: 3.66 \pm 0.96) and income potential (3.53 \pm 1.05) associated with cardiology practice (Table 3). Students indicated low levels of understanding of the duration of patient relationships (2.92 \pm 0.76), urgency of care (2.92 \pm 0.87), the spectrum of disorders in the field (2.96 \pm 0.73) and the proportion of in-patient care (3.08 \pm 0.83).

Previous Elective Exposure and Understanding of Career-Related Aspects of Cardiology

Previous elective experiences in cardiology increased student understanding of the proportion of in-patient care ($p = 0.030$). However, the understanding of weekly work hours, income potential, spectrum of disorders, common procedures, patient population, and duration of patient relationships associated with cardiology was unaffected by elective experience (Table 4).

Table 3. Student Understanding of Career-Related Factors in Canadian Cardiology Practice using a 5-point Likert Scale.

Aspects of Cardiology	Mean (90% *CI)	Standard Deviation
Quantity of Weekly Hours	3.36 (3.15 - 3.57)	0.901
Income Potential	3.53 (3.29 - 3.77)	1.049
Status Among Colleagues	3.66 (3.44 - 3.88)	0.960
Urgency of Care	2.92 (2.72 - 3.13)	0.874
Proportion of In-Patient Care	3.08 (2.88 - 3.27)	0.829
Spectrum of Disorders	3.19 (2.98 - 3.40)	0.900
Common Procedures	3.32 (3.07 - 3.57)	1.070
Patient Population	3.23 (3.03 - 3.42)	0.847
Duration of Patient Relationships	2.92 (2.75 - 3.10)	0.756

Legend: *CI – Confidence Interval

Table 4. The Impact of Previous Electives on Understanding of Career-Related Aspects of Cardiology.

Aspects of Cardiology	χ^2	Cramer's V	p-value
Quantity of Weekly Hours	0.183	0.059	0.669
Income Potential	0.092	0.042	0.761
Status Among Colleagues	0.030	0.024	0.863
Urgency of Care	1.306	0.157	0.253
Proportion of In-Patient Care	4.688	0.297	*0.030
Spectrum of Disorders	0.001	0.005	0.974
Common Procedures	0.089	0.041	0.765
Patient Population	0.008	0.012	0.929
Duration of Patient Relationships	0.426	0.090	0.514

Legend: Cramer's V scores were considered as follows: 0-0.25 (weak), 0.25-0.5 (moderate), 0.5-1 (strong).

Career Interest in Cardiology and Understanding of Career-Related Aspects of Cardiology

Students with career interests in cardiology also reported a greater understanding of the proportion of in-patient care ($p = 0.021$) as well as the patient population associated with cardiology practice ($p = 0.011$). Career interest in cardiology otherwise did not impact student-reported understanding of a cardiologist's weekly work hours, income potential, spectrum of disorders managed, nor common procedures performed (Table 5).

Table 5. The Impact of Career Interest in Cardiology on Understanding of Career-Related Aspects of Cardiology.

Aspects of Cardiology	χ^2	Cramer's V	p-value
Quantity of Weekly Hours	0.018	0.019	0.893
Income Potential	0.468	0.094	0.494
Status Among Colleagues	0.151	0.053	0.697
Urgency of Care	1.355	0.160	0.244
Proportion of In-Patient Care	5.307	0.316	*0.021
Spectrum of Disorders	0.006	0.010	0.941
Common Procedures	0.454	0.093	0.500
Patient Population	6.526	0.351	*0.011
Duration of Patient Relationships	0.004	0.009	0.947

Legend: Cramer's V scores were considered as follows: 0-0.25 (weak), 0.25-0.5 (moderate), 0.5-1 (strong).

Discussion

This study examined the perceptions of Canadian undergraduate medical students in their second year of training at Dalhousie University. Students generally demonstrated a low understanding of cardiology practice. Students with an interest in cardiology were moderately more likely to value having an interest in the medical conditions treated in a given specialty, compared to those without cardiology interest. Students with prior electives in cardiology were more likely to select cardiology as a top career choice compared to those without previous clinical time in cardiology. Elective exposure has been previously shown to increase student interest in that specialty.^{18,19} However, to our knowledge this is the first Canadian study demonstrating that elective exposure is associated with increased likelihood of medical student selection of cardiology as a top career choice. This is pertinent for Canadian medical students as clerkship selectives are chosen during pre-clerkship training.

Demographic factor analysis demonstrated that age .27 years was associated with greater interest in cardiology which align with studies showing that cardiology applicants tend to be of increased age compared to other medical specialties.²⁰ Although an interesting finding, due to the relatively low sample size of this study, further investigations are required to fully determine the reasons why cardiology attracts older students. Furthermore, students with an urban upbringing were more interested in pursuing cardiology than their rural counterparts, which to our knowledge has yet to be reported. This may reflect decreased exposure to specialty cardiology practice in rural

settings secondary to either expanded scope of general internists, or decreased access to cardiology care for these populations.²¹⁻²⁵ As students tend to return to the communities that they were raised in, undergraduate medical schools may increase admissions to students from rural communities to improve rural physician recruitment. While our results do not support that elective experience increases medical student interest in cardiology as a specialty, rural medical students may be a unique group due to differences in exposure to medical specialties. Future studies may examine whether elective experience impacts rural students differently compared to urban students, as the latter group comprised the majority of our study population.

Cardiology was a specialty with substantial cohort interest as almost half of the students were interested in cardiology. However, less than one fifth of students ranked cardiology in their top three career choices. A similar discrepancy between interest in cardiology practice and desire to pursue the specialty has been described previously. The perceived competitiveness and inflexible hours may be a deterrent to medical students choosing cardiology as a career despite high interest.¹⁵ This high baseline interest may further explain why having an elective in cardiology had minimal impact on career interest in the specialty, but significantly increased student selection of cardiology as a top career choice. Other studies demonstrate a slightly lower rate of medical students selecting cardiology as a top career choice, though geographical differences in upbringing and training may account for this difference.²⁶

Students valuing personal interest in the medical conditions managed by a specialty were more likely to be interested in cardiology. Participants who valued high income potential, high status, and acceptable work hours had no correlation with cardiology interest. This suggests that medical students are not primarily attracted to cardiology for the lifestyle-related factors of the profession, but because of sincere interest in the medicine and pathology associated with cardiovascular disease. Furthermore, students valuing long-term patient relationships were more likely to be interested in cardiology, a result which to our knowledge has yet to be reported.

Students were most confident in their understanding of the status and income potential associated with cardiology yet reported lower levels of understanding of the range of medical conditions seen by cardiology. As this cohort of students had already submitted their medicine subspecialty selections for clerkship rotations, some students may not have had sufficient cardiology exposure before determining their rotation preferences, which may have career implications. To improve early career navigation among medical students, increasing early clinical exposure to cardiology in pre-clerkship training may help students discern whether they simply find cardiology interesting as a specialty, or if they would select it as a top career choice. This is supported by the finding that students with a previous elective in cardiology were more likely to choose cardiology as a career, and as such clinical electives may help students gain a deeper understanding of the pathology associated with cardiology practice.

Student understanding of in-patient cardiology care was low. Since these students had already received their formal classroom teaching on the diagnosis and management of cardiovascular diseases, it may indicate that didactic teaching may not sufficiently teach students how much in-patient care is involved in cardiology practice, as well as what conditions would be managed on an in-patient ward. Furthermore, students with previous cardiology electives had a higher understanding of in-patient cardiology care compared to those without electives. As students with prior cardiology electives were more likely to choose cardiology as a career, and this suggests that a greater understanding of in-patient cardiology care may entice students toward choosing a career in cardiology. Qualitative studies should be conducted to distinguish whether this finding is better explained by a pre-existing inclination toward cardiology as a specialty among medical students

with prior cardiology electives. To support early career navigation among medical students, undergraduate medical schools may look toward promoting student-led programs that enable students to gain clinical exposure to medical specialties outside of traditional undergraduate medical curricula, as these initiatives may increase student interest in these specialties.^{18,19,27}

The strengths of this study include the assessment of career-related factors of cardiology used in previous literature.^{16,17} Additionally, the decision to assess the interest and understanding of students at the end of their pre-clerkship curriculum addresses the fact that medical students make career-impacting decisions early in their training without being fully informed. Using a cross-sectional approach, this study provides insight into medical student understanding at the pre-clerkship level which reflects clinical pre-clerkship exposure. Moreover, medical student interest in cardiology and understanding of the profession is under-represented in the literature in general. Limitations of this study include the small sample size, as student respondents were a subgroup from a single institution in Canada, which may affect the generalizability of the results. Furthermore, although the proportion aligns with those in previous studies, the use of a survey presents the potential for volunteer bias which would have resulted in a

misrepresentation of students interested in cardiology in our sample.¹⁵⁻¹⁷ Due to the nature of this study, it is possible that the experiences of clerkship may be more impactful on cardiology interest compared to interest at the pre-clerkship level. Additionally, student interest in cardiology at the pre-clerkship level may not directly translate to a future pursuit of cardiology. To address this limitation, further longitudinal studies should be performed to follow pre-clerkship students into residency. In addition, larger-scale studies conducted at institutions in other areas of Canada may improve the generalizability of these findings.

Pre-clerkship medical students generally have a low understanding of cardiology practice, though have a high interest in the specialty. Although cardiology interest was not increased through elective experiences, students were more likely to rate cardiology as a top specialty with prior cardiology electives. Canadian medical students who wish to confirm whether cardiology is their top career choice may consider pursuing a cardiology elective in pre-clerkship, given the timing of clerkship selectives. Canadian undergraduate medical schools may consider the incorporation of pre-clerkship electives to ensure the availability of this opportunity for career navigation among their students.

References

- Maudsley G, Williams L, Taylor D. Medical students' and prospective medical students' uncertainties about career intentions: Cross-sectional and longitudinal studies. *Med Teach*. 2010 Mar 10;32(3):e143-e151.
- Dyrbye LN, Burke SE, Hardeman RR, Herrin J, Wittlin NM, Yeazel M, et al. Association of clinical specialty with symptoms of burnout and career choice regret among US resident physicians. *JAMA*. 2018 Mar 26;320(11):1114-30.
- Horn L, Tzanetos K, Thorpe K, Straus SE. Factors associated with the subspecialty choices of internal medicine residents in Canada. *BMC Med Educ*. 2008 Jun 26;8(37):1-8.
- Ephrem G. A Career of Lifelong Learning, Not Lifelong Training: An Early Cardiologist's Perspective. *J Am Coll Cardiol*. 2015 June 23;65(24):2664-6.
- Goldfarb MJ. The push to subspecialize: Choosing a career in cardiology. *J Am Coll Cardiol*. 2014 Nov 18;64(20):2174-5.
- Walsh S, Arnold B, Pickwell-Smith B, Summers B. What kind of doctor would you like me to be? *Clin Teach*. 2016 Jun 14;13(2):98-101.
- Querido S, van den Broek S, de Rond M, Wigersma L, Ten Cate O. Factors affecting senior medical students' career choice. *Int J Med Educ*. 2018 Dec 15;9:332-9.
- Cleland J, Johnston PW, French FH, Needham G. Associations between medical school and career preferences in Year 1 medical students in Scotland. *Med Educ*. 2012 May;46(5):473-84.
- Vo A, McLean L, McInnes MDF. Medical specialty preferences in early medical school training in Canada. *Int J Med Educ*. 2017 Oct 28;8:400-7.
- Scott I, Gowans MC, Wright B, Brenneis F. Why medical students switch careers: Changing course during the preclinical years of medical school. *Can Fam Physician*. 2007 Jan;53(1):94-5.
- Ruth Wilson C, Bordman ZN. What to do about the Canadian Resident Matching Service. *Cmaj*. 2017 Nov 27;189(47):E1436-7.
- Canadian Medical Association. Cardiology Profile. Available from: https://www.cma.ca/sites/default/files/2019-07/cardiology-e_o.pdf. Last updated Dec 2019; cited Jun 23, 2021.
- Trouton T. So you want to be a Cardiologist. *Ulster Med J*. 2014 Jan;83(1):73.
- Stępień K, Połetek K, Komornik M, Siudak Z, Tokarek T, Dudek D. New methods and techniques in interventional cardiology. Evaluation the knowledge of medical students of Jagiellonian University Medical College. *Folia Med Cracov*. 2018 Mar 31;58(1):97-106.
- Coyle C, Evans H. A career in cardiology: Why? *Heart*. 2018 Nov 10;105(6):498.
- Azu OO, Naidu E, Naidu J. Choice of speciality amongst first-year medical students in the Nelson R. Mandela School of Medicine, University of KwaZulu-Natal. *African J Prim Heal Care Fam Med*. 2013 Jun 28;5(1):1-7.
- I. Elzain Y, Alawad AAMA, S. Khan W, O. Khalil H, M. Abdelrazig Y, B. Ahmed O, et al. Factors influencing the choice of internal medicine as a career among undergraduate medical students. *Int J Heal*. 2014 Jun;2(2):22-5.
- Sheppard E, Smyth M, Dow T, Haupt TS, McVeigh S. The Effect of a 2-Week Pre-clerkship Residency Exploration Program on Specialty Interest and Understanding of Physical Medicine and Rehabilitation. *Arch Rehabil Res Clin Transl*. 2019 Mar;2(1):1-7.
- Smyth M, Toguri JT, Dow T, Haupt TS, Roberts A, Raju K. Medical student exposure to anesthesiology through the Pre-clerkship Residency Exploration Program: impact on career interest and understanding of anesthesiology. *Can J Anesth*. 2019 May 21;66(9):1126-8.
- Smith F, Lambert TW, Pitcher A, Goldacre MJ. Career choices for cardiology: Cohort studies of UK medical graduates. *BMC Med Educ*. 2013 Jan 25;13(1):1.
- Baldwin L-M, Chan L, Andrilla CHA, Huff ED, Hart LG. Quality of Care for Myocardial Infarction in Rural and Urban Hospitals. *J Rural Heal*. 2012 Aug 23;26(1):51-7.
- Clark RA, Eckert KA, Stewart S, Phillips SM, Yallop JJ, Tonkin AM, et al. Rural and urban differentials in primary care management of chronic heart failure: New data from the CASE study. *Med J Aust*. 2007 May 7;186(9):441-5.
- Lutfiyya MN, Bhat DK, Gandhi SR, Nguyen C, Weidenbacher-Hoper VL, Lipsky MS. A comparison of quality of care indicators in urban acute care hospitals and rural critical access hospitals in the United States. *Int J Qual Heal Care*. 2007 Apr 18;19(3):141-9.
- Rush KL, Burton L, Van Der Merwe F, Hatt L, Galloway C. Atrial fibrillation care in rural communities: A mixed methods study of physician and patient perspectives. *BMC Fam Pract*. 2019 Oct 24;20(1):1-11.
- Gamble JM, Eurich DT, Ezekowitz JA, Kaul P, Quan H, McAlister FA. Patterns of care and outcomes differ for urban versus rural patients with newly diagnosed heart failure, even in a universal healthcare system. *Circ Hear Fail*. 2011 Mar 10;4(3):317-23.
- Kanmounye US, Temgoua M, Endomba FT. Determinants of Residency Program Choice in Two Central African Countries: An Internet Survey of Senior Medical Students. *Int J Med Students*. 2020 Apr 30;8(1):20-5.
- Haupt TS, Dow T, Smyth M, Toguri JT, Roberts A, Raju K, et al. Medical student exposure to Radiation Oncology Through the Pre-clerkship Residency Exploration Program (PREP): Effect on Career Interest and Understanding of Radiation Oncology. *Can J Anesth*. 2019 Jan 23;66(9):1126-8.

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Predictors of Cerebral Arteriovenous Malformation Mortality: A Single-center, Five-year Retrospective Study

Patricio García-Espinosa,¹ Edgar Botello-Hernández,¹ Gabriela Torres-Hernández,¹ Clarissa Guerrero-Cavazos,¹ Estefania Villareal-Garza,² Andrea Flores-Rodríguez.¹

Abstract

Background: Arteriovenous Malformations (AVMs) are abnormalities in intracranial vessels between the arterial and venous systems. This study aimed to identify the predictors of mortality in patients that presented to our hospital with AVMs, ruptured or unruptured, and correlate them to those available in the literature. **Methods:** An analytical, observational, retrospective study was performed to review data of patients with cerebral AVMs in the University Hospital "Dr José Eleuterio González" from January 2016 to December 2020. Clinical files were reviewed based on AVMs diagnosis according to the International Classification of Diseases 10th Revision, ICD-10. Variables were subjected to a univariate analysis and those found significant (p -value < 0.05) were subjected to a logistic regression. **Results:** A total of 80 patients were included in our study. Most of the participants were females (56.3%) and three were pregnant. The most common presenting symptom was holocranial headache (34 cases) occurring between the hours of 22:00 to 7:00. The most significant predictors of mortality were a total bleeding volume greater than 9.18 cm³ ($p = 0.010$), the presence of more than one symptom ($p = 0.041$), and a history of previous cerebral intraparenchymal hemorrhage ($p = 0.014$). **Conclusion:** Results demonstrated an important association between intracranial bleeding and mortality. Ultimately, more prospective studies are needed to determine predictor factors for mortality in AVMs patients.

Key Words: Arteriovenous Malformation; Cerebral Hemorrhage; Intracranial Hemorrhages; Nervous System Malformation (Source: MeSH-NLM).

Introduction

Arteriovenous Malformations (AVMs) are abnormalities in intracranial vessels between the arterial and venous systems.¹ They consist of abnormal dilation of vascular structure, forming a nest between the two systems without capillaries, causing arterial blood to reach the venous system.² In turn, the formed nest has its own circulation system, formed by its own arteries (referred to as vasa-vasorum); however, unlike healthy blood vessels, these lack normal innervation and therefore lack the ability to self-regulate arterial flow within the nest.³

Although in adults AVMs are regarded as acquired malformations, in infants they are believed to be congenital.⁴ The pathogenesis of congenital AVMs is poorly understood. It is suggested that they develop during the embryogenesis of the primordial vascular system between the third and twelfth week of gestation, and are therefore present at birth.⁴ The most common clinical presentation of cerebral AVMs in pediatric patients is sudden rupture. The first signs and symptoms are usually those associated with intracerebral hemorrhage in 41-79% of cases.⁵ We have not come across any epidemiological study to determine the most common cause of AVM onset in Mexican pediatric patients.

The average age of AVM appearance is between the ages of 20 and 40, without specific gender prevalence.⁶ Despite being more common in adults, the probability of a rupture is comparatively lower in the adult population than in the pediatric one. However, rupture and consequent hemorrhage are still the most common cause of symptoms onset.⁶ When left untreated, the probability of rupture ranges between 2.10-4.12%.⁷ There is a suggested association between hormonal changes in

puberty and AVM rupture, which is why it is believed that the hormonal changes of pregnancy could also represent a period of increased rupture risk.⁶

The most important classification for cerebral AVMs was described by Spetzler and Martin in 1986, which is used to determine the most appropriate therapeutic approach for these patients.¹⁰ The Spetzler Martin Grading Scale ranges from I to VI, where Grade I represents a small, superficial malformation in a non-eloquent portion of the cortex, Grade V represents a large, deep malformation in an eloquent portion of the cortex, and Grade VI is inoperable. For the diagnosis and visualization of AVMs, angiography is considered to be the gold standard because it gives a visualization of the pathology that allows for both diagnostics and treatment planning.^{11,12} Initial visualization is intended to be non-invasive, for which Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) are often used, especially in patients with diffuse or non-specific symptoms such as seizures or headaches. A CT scan is considered superior to MRI for observing vasculature, however, an MRI is a better choice for visualizing adjacent structures and planning treatment.¹³⁻¹⁵

Therapeutic management includes different modalities of surgical resection, endovascular embolization, and stereotactic surgery (particularly in those with a nest size smaller than 3 cm at the largest diameter).¹⁶ Currently attempts have been made to develop a non-invasive medical treatment, or a "wait-and-see" treatment approach, with little to no recovery period, for patients with unruptured AVM.^{17,18}

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Current literature on this subject is not specific to the Mexican community or even the population of Central/South America in general. Due to the socio-demographic variants of this population, which are far from the economically developed societies of Northern America and Europe where most AVM studies have been performed, the literature cannot fully be generalized for the adult or pediatric AVM population of Mexico. In the current AVM literature, variables such as previous history of ruptured AVMs, pattern of venous drainage, and the location of the AVM itself have been found to be significant, however, these risk factors have been proposed mostly by single-center studies, and have not been always replicated, as highlighted by Rutledge WC, et al in 2014.¹⁹ In addition, although some data is available in the Hispanic literature, they are of suboptimal quality, as they represent a low number of cases and do not show the results of all departments that may be involved in the review of ruptured AVMs.^{6,14} For this reason, the present study reviewed the experience of a single, tertiary-care centre in Mexico to seek a representation of the present phenomenon, to try to replicate results from the literature, and to give rise to further research in treating AVMs in the field with the objective of generating AVM epidemiological datasets from which predictors of mortalities could be extracted, among the Latin-American population.

Methods

Study Design

This was an analytical, observational, retrospective study. A review of the clinical records for each participant was carried out by senior medical students. We included patient data from the last five years because that is the maximum time a patient's file is kept after their hospitalization. Finally, an Excel database was created in order to extract relevant data using an Excel processor. Consent for publication and ethical approval came from the Ethical and Research Commitment from Hospital Universitario "Dr. José Eleuterio González" at Universidad Autónoma de Nuevo León (UANL) Institute, with the approval code NR18-0002.

Participants

We reviewed available data of patients who were hospitalized at the UANL, University Hospital from January 2016 to December 2020 for cerebral AVMs, regardless of whether their malformation had ruptured. The data was provided by the statistics department of our institution and the clinical files and CT images were reviewed by a neurology resident. In order to obtain all the existing patient data from our institution, patient files were identified using the following codes of the tenth revision of International Classification of Diseases (ICD-10): Q27, Q28, I60, I62 and I69 – with our main focus on Q28.²⁰

The sample was taken by convenience method of sampling since the studied sample was the total number patients who visited our center in the last five years. We included all patients from every department or division within our hospital who were diagnosed with a cerebral AVM. We excluded patients who were found not have a cerebral AVM and whose pathology-oriented medical assessment revealed a differential diagnosis such as cavernous angioma or capillary telangiectasias, among others.

Variables

Clinical and demographic data obtained included sex, age, time of symptoms evolution, treatment details, imaging findings, all other predictive factors that were previously known, and comorbidities. In addition, data extracted from patient registries included treatment outcome, subsequent or previous rupture at the time of diagnosis, number of hospitalization days, and time and place of rupture. The population studied was divided into those with a rupture and those without a rupture of an AVM at the moment of arrival in our institution.

Statistical Analysis

For the analysis, IBM SPSS Software 23.0 version,²¹ RStudio version 4.0.2 (2020-06-22), and ggplot2 package were used. To compare the data

between the groups, Student's-t test and Chi-squared test were used depending on the type of variable, T-test on variables with normal distribution and Chi-squared test on independent random variables with standard normal distribution. For correlations, Pearson's correlation coefficient was reported. A p-value <0.05 was considered statistically significant. Variables that resulted in statistically significant value in univariate analysis were subjected to a logistic regression model.

Results

Sociodemographic Characteristics

Using the ICD-10 codes, a total of 486 files were obtained. After applying our inclusion and exclusion criteria, we included 80 patient files for subsequent analysis. The average age of our patients was 26.9 ± 17.5 years, and just over half of the population was female $N=45$ (56.3%), with three ($n=3$) of them being pregnant at the time of their first consultation.

Clinical Presentation

Most common presenting symptom was holocranial headache, found in 34 (23.9%) patients, followed by a generalized tonic-clonic seizure in 29 (20.4%) patients, and lastly a loss of consciousness in 24 (16.9%) patients. Only 6 (7.5%) patients presented without any symptoms, and 1 (1.25%) patient had attended a scheduled consultation at the neurosurgery facility. A total of 47 (58.8%) patients presented with active bleeding from AVM rupture and a holocranial headache was the most common symptom reported, being present in 12 (25.7%) of these cases, followed by altered state of consciousness in 10 (21.2%) patients. The onset of symptoms occurred between the hours of 22:00 to 7:00 in the majority of patients (61.3%), which are the hours that are regularly not dedicated to work or school in our country. At symptom onset, most patients were asleep, resting at home, or waking up. (Table 1)

Relevant Past History

Among comorbidities and predictive factors, the most common were the existence of previous cerebral intraparenchymal hemorrhage observed in 23 (28.7%) patients, followed by Type 2 Diabetes Mellitus as the second most common comorbidity in 15 (18.8%) patients, and Systemic Arterial Hypertension in third place in 14 (17.5%) patients. Inquiring more about personal history, we found that almost half of our included patients led a sedentary lifestyle or were smokers (45% and 40%, respectively).

Outcome

The median AVM size was 10.29 cm^3 ($2.49 \text{ cm}^3 - 35.66 \text{ cm}^3$). Forty-one (51.2%) had AVM on their right side, mainly found in the frontal lobe in 24 (30%) patients. The middle cerebral artery was the most common nutrient artery in 34 (32.1%) patients. In the venous system, the collateral veins of the superior sagittal sinus in 21 (20.8%) patients were the most commonly affected ones. For diagnosis and classification, CT scans were performed. For more detailed characteristics, consult Table 2.

For treatment, angio-embolism alone, or accompanied by radiosurgery or surgical excision by craniotomy, were the most common treatment options (41 patients, 39.8%), followed by craniotomy in 37 (35.92%) and radiosurgery in 13 (12.6%) patients. A conservative approach was chosen by 12 (11.7%) patients, showing that the vast majority decided not to resort to the "wait-and-see" treatment (Table 1).

Figure 1 illustrates AVMs size as a predictor of mortality. A total volume in cubic centimeters greater than 9.18 cm^3 (OR 0.063 (0.008 - 0.519)), as well as the presence of more than one symptom (OR 4.022 (1.026 - 15.467)), and a history of previous cerebral intraparenchymal hemorrhage (OR 4.533 (1.359 - 15.126)), were significant predictors for mortality ($p < 0.05$), as shown in Table 3.

Table 1. General characteristics population.

Characteristic	n (%)
Female gender	45 (56.3)
Age in years [†]	26.9 ± 17.5
Symptomatology	
Holocranial headache	34 (23.9)
Tonic-Clonic Seizures	29 (20.4)
Loss of Consciousness	24 (16.9)
Hemibody paralysis	10 (7.0)
Vomiting	9 (6.3)
Asymptomatic	6 (4.2)
Hemicranial headache	5 (3.5)
Aphasia	4 (2.8)
Other	21 (14.8)
Comorbidities and Predictors	
Diabetes	15 (18.8)
Hypertension	14 (17.5)
Cancer	2 (2.5)
BMI	
Obesity (> 30)	37 (46.3)
Overweight (25 - 29.9)	32 (40.0)
Normal weight (18.5 - 24.9)	11 (13.8)
Smoker	32 (40.0)
Sedentary lifestyle	36 (45.0)
Pregnancy	3 (3.8)
Event characteristics	
Temporality	
22:00 - 7:00	49 (61.3)
7:01 - 21:59	31 (38.8)
Place or action of the patient	
Asleep	22 (27.5)
House	16 (20.0)
Waking up	12 (15.0)
Elective consultation	11 (13.8)
Working, school	9 (11.3)
Showering	6 (7.5)
Exercising	3 (3.8)
Street	1 (1.3)
Hemorrhage	
All-age hemorrhage	47/80 (58.8)
Pediatric hemorrhage (0 -17 years)	24/30 (80.0)
Adult hemorrhage (>18 years)	23/50 (46.0)
Previous hemorrhage	23 (28.7)
Posterior hemorrhage	10 (12.5)
Treatment used	
Angio-embolism	41 (39.8)
Surgical excision by craniotomy	37 (35.9)
Radiosurgery	13 (12.6)
Conservative management	12 (11.7)
Mortality	
All-age mortality	14/80 (17.5)
Pediatric mortality (0-17 years)	10/30 (33.3)
Mortality in adults (>18 years)	4/50 (8.0)

Legend: † Represents the use of the mean and standard deviation to represent the data.

Discussion

This analytical, retrospective study analyzed AVM mortality risk factors in 80 patient files from University Hospital "Dr José Eleuterio González" from January 2016 to December 2020.

Table 2. Characteristics of arteriovenous malformations

Characteristic	n (%)
Laterality (n=80)	
Right	41 (51.2)
Left	37 (46.3)
Bilateral	2 (2.5)
Cerebral location (n=80)	
Frontal	24 (30.0)
Occipital	15 (18.8)
Temporary	12 (15.0)
Frontoparietal	8 (10.0)
Frontotemporal	6 (7.5)
Parietal	3 (3.8)
Cerebellum	3 (3.8)
Other	9 (11.3)
Nutritional arteries (n=106)	
Deep middle cerebral artery	34 (32.1)
Deep posterior cerebral artery	28 (26.4)
Deep anterior cerebral artery	27 (25.5)
Posterior inferior cerebellar artery	8 (7.5)
Internal carotid artery	8 (7.5)
Middle meningeal artery	1 (0.9)
Venous drainage (n=101)	
Collaterals of the superior sagittal sinus	21 (20.8)
Vein of Galen	14 (13.9)
Deep circulation	10 (9.9)
Superior longitudinal sinus	8 (7.9)
Internal cerebral vein	8 (7.9)
Superficial cerebral veins	8 (7.9)
Other	32 (31.7)
Spetzler-Martin arteriovenous malformation grading system	
I	7 (8.8)
II	37 (46.3)
III	19 (23.8)
IV-VI	17 (21.3)

Legend: * Represents the use of median and interquartile index to represent the data. Spetzler -Martin VI is not used in the institution part of this research.

We found that the average age of AVM presentation was 26.8 years, with a slightly higher prevalence among the female sex. Obesity, Type 2 Diabetes Mellitus, Systemic Arterial Hypertension, and sedentary lifestyle were present in a substantial part of the study cohort. The most significant predictors of mortality were a total volume greater than 9.18 cm³, the presence of more than one symptom, and a history of previous cerebral intraparenchymal hemorrhage. The most common presenting symptom was a holocranial headache occurring between the hours of 22:00 to 7:00. The timing of symptomatology presentation, as a predictor of mortality, could be one of the most important findings of the present study.

Our findings differ from those provided by the National Hospital of Neurology and Neurosurgery of Mexico, which report an average presenting age of 32.9 years and no gender predilection.²² We also found that holocranial headache was the most common presenting symptom which coincides with what was previously reported by Mariano Rinaldi in 2015.²³ Rinaldi not only found that holocranial headache was most commonly reported at symptom onset, but that 30.8% of patients were classified as Spetzler-Martin class III. We found that 23.8% of our patients were a class III Spetzler-Martin. It has been reported that grades I and II have good results with microsurgery, while grades III and IV mostly benefit from endovascular embolism.²³ In our center, 68 (85%) subjects had a surgical approach, and at least 23 (33.8%) shared an approach through craniotomy and/or radiosurgery in addition to angio-embolism. These approaches are in accordance with AHA 2017 recommendations for AVMs Spetzler-Martin III and IV.²⁴

We found other similarities to Rinaldi's previously reported results, such as the distribution of AVMs towards the right side and mainly in the frontal lobe, in 51.2% and 30% of cases, respectively. Another important factor in this context was the patient's history of past cerebral intraparenchymal haemorrhage (28.7%), as it is one of the

variables that has been most represented in the literature as a predictor of mortality in bleeding AVMs, which our results replicate.²³

An interesting finding in our study was regarding pregnant women. According to what has been reported in the literature, it was found that, although rare, AVMs are responsible for about 50% of subarachnoid hemorrhages in pregnant women and are the third cause of non-obstetric maternal mortality. However, there are discrepancies in the literature regarding the influence of pregnancy on the natural history of AVM.^{25,26,27} We did not find a higher mortality risk for pregnant patients in our study. Although it should be noted that the number of included pregnant patients in our study was small.

Overall mortality in our sample of 80 patients was 17.5% (14 patients, 10 pediatrics and 4 adults). The pediatric mortality was 33.3% (10 patients out of 30). The adult mortality was only 8% (4 patients out of 50). The mortality in the adult population is similar to those reported by Hillman, et al.²⁸ and Rinaldi et al.²³, who reported a 13.46% mortality rate. Other studies also reported a mortality rate ranging from 10 to 15%.^{17,22} However, the mortality in the pediatric population is vastly different from that of the literature, being 33.3% in our study and 12% in a study published by Riordan, et al.²⁹

Finally, hemorrhage is an important factor when it comes to mortality, which was the most common presentation in our study together with its associated symptomatology, the holocranial headache. Hemorrhage occurred in 24 out of 30 pediatric patients, accounting for a pediatric hemorrhage mortality of 42%. While in adults hemorrhage was present in only 23 out of 50 patients, with a mortality rate of about 17%. High rates of bleeding in pediatrics could explain their high mortality rates. While in adults, the mortality in ruptured AVMs does approach the 10-20% ratio in our study, which is consistent with what other authors have reported.^{30,31}

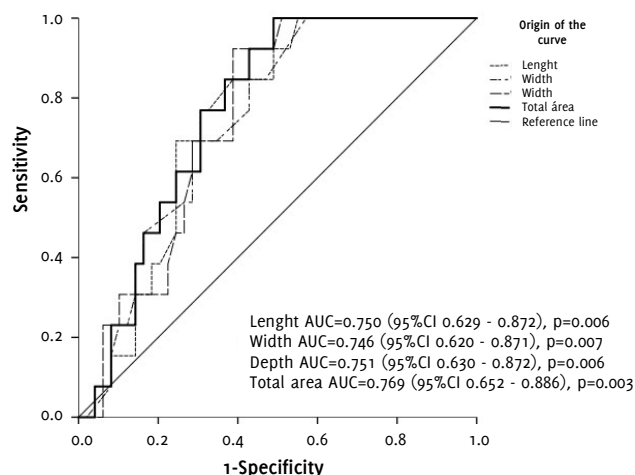
Interestingly, the chronobiology of AVM's rupture is not actually described in the literature, but it has been seen that in children the onset of symptoms can generally be found in the morning hours, regardless of their daily activities and waking up time.^{32,33,34} The time of symptomatology presentation has been highlighted as a poor prognostic factor in both children and adults in our study, without being demonstrated by the literature.³²⁻³⁸ We found a high prevalence of symptom onset in non-working hours, warranting a more specific analysis focusing on this parameter.

Table 3. Odds ratio of the analyzed variables as predictors of mortality

Characteristic	Odds ratio (95% Confidence interval)	p-value
Arteriovenous Malformation Size		
Total area (cm ³)		
≤9.18 cm	0.063 (0.008 - 0.519)	0.01
>9.18 cm	16.00 (1.926 - 132.899)	0.01
Length		
≤3.36 cm	0.150 (0.042 - 0.539)	0.004
>3.36 cm	6.667 (1.854 - 23.973)	0.004
Width		
≤1.92 cm	0.077 (0.010 - 0.622)	0.016
>1.92 cm	13.00 (1.607 - 105.146)	0.016
Depth		
≤1.77 cm	0.053 (0.006 - 0.439)	0.007
>1.77 cm	18.947 (2.276 - 157.757)	0.007
Number of symptoms		
≤1 symptom	0.242 (0.062 - 0.946)	0.041
>1 symptom	4.022 (1.026 - 15.467)	0.041
Hemorrhage		
Previous hemorrhage	4.533 (1.359 - 15.126)	0.014
Current hemorrhage	12.235 (1.513 - 98.966)	0.019
Posterior hemorrhage	2.299 (0.514 - 10.280)	0.276
Laterality		
Left	1.192 (0.579 - 6.318)	0.288
Right	0.590 (0.179 - 1.950)	0.387
Bilateral	5.33 (0.683 - 41.622)	0.11
Age		
≤ 17 years	5.750 (1.610 - 20.553)	0.007
≥18 years	0.174 (0.049 - 0.621)	0.007
Sex		
Female	0.737 (0.232 - 2.341)	0.605
Male	1.357 (0.427 - 4.311)	0.605

Legend: An odds ratio with a 95% confidence interval greater than 1 was interpreted as a clinically significant risk factor. On the contrary, a 95% confidence interval value less than 1 was interpreted as a clinically significant protective factor. A p value less than 0.05 was interpreted as statistically significant.

Figure 1. Receiver operator curve of arteriovenous malformation size as a predictor for mortality.



Limitations

The main limitation of this study is that it is retrospective in nature. More ambispective and prospective studies are necessary in order to identify other potential predicting factors. Another limitation is that, due to the patient privacy rules of our hospital, patient files can only be kept for five years from their last visit, and thus no information was available for previous years. Finally, it is possible that not all AVMs were documented, since analysed clinical records do not always contain reliable and complete data.

Conclusions

In this study we presented the relationship between mortality and age. Despite the fact that AVMs are more common in adults, they have a lower mortality when compared to children. Because there is no research comparing paediatric and adult populations on this topic in Mexico, and few studies focused on AVMs in general, it is critical to underline the significance of this disease, which is considered silent but lethal when active bleeding occurs. Identifying epidemiological characteristics of the country's main tertiary care centres could serve as a springboard for more targeted and beneficial studies into the pathogenesis, prevention, and treatment of AVMs.

References

- Ajiboye N, Chalouhi N, Starke RM, Zanaty M, Bell R. Cerebral arteriovenous malformations: evaluation and management. *ScientificWorldJournal*. 2014 Oct 15;2014:649036-.
- Tranvinh E, Heit JJ, Hachein-Bey L, Provenzale J, Wintermark M. Contemporary imaging of cerebral arteriovenous malformations. *Am J Roentgenol*. 2017 Jun;208(6):1320-30.
- Chen C-J, Ding D, Derdeyn CP, Lanzino G, Friedlander RM, Southerland AM, et al. Brain arteriovenous malformations: A review of natural history, pathobiology, and interventions. *Neurology*. 2020 Nov 17;95(20):917-27.
- Komiyama M. Pathogenesis of Brain Arteriovenous Malformations. *Neurol Med Chir (Tokyo)*. 2016 Jun 15;56(6):317-25.
- StatPearls Publishing. Arteriovenous Malformation (AVM) Of The Brain. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK430744/>. Last updated Jun 30, 2020; cited Jan 10, 2021.
- Di Rocco C, Tamburrini G, Rollo M. Cerebral arteriovenous malformations in children. *Acta Neurochir (Wien)*. 2000 Feb;142(2):145-8.
- Hofmeister C, Stapf C, Hartmann A, Sciacca RR, Mansmann U, terBrugge K, et al. Demographic, morphological, and clinical characteristics of 1289 patients with brain arteriovenous malformation. *Stroke*. 2000 Jun 1;31(6):1307-10.
- Abecassis IJ, Xu DS, Batjer HH, Bendok BR. Natural history of brain arteriovenous malformations: a systematic review. *Neurosurg Focus*. 2014 Sep;37(3):E7.
- El-Ghanem M, Kass-Hout T, Kass-Hout O, Alderazi YJ, Amuluru K, Al-Mufti F, et al. Arteriovenous Malformations in the Pediatric Population: Review of the Existing Literature. *Interv Neurol*. 2016 Sep;5(3-4):218-25.
- Spetzler RF, Martin NA. A proposed grading system for arteriovenous malformations. *J Neurosurg*. 1986 Oct;65(4):476-83.
- Turjman F, Massoud TF, Viñuela F, Sayre JW, Guglielmi G, Duckwiler G. Aneurysms related to cerebral arteriovenous malformations: superselective angiographic assessment in 58 patients. *AJNR Am J Neuroradiol*. 1994 Oct;15(9):1601-5.
- Mossa-Basha M, Chen J, Gandhi D. Imaging of cerebral arteriovenous malformations and dural arteriovenous fistulas. *Neurosurg Clin N Am*. 2012 Jan;23(1):27-42.
- Friedlander RM. Clinical practice. Arteriovenous malformations of the brain. *N Engl J Med*. 2007 Jun 28;356(26):2704-12.
- Brown RDJ, Flemming KD, Meyer FB, Cloft HJ, Pollock BE, Link ML. Natural history, evaluation, and management of intracranial vascular malformations. *Mayo Clin Proc*. 2005 Feb 1;80(2):269-81.
- Choi JH, Mohr JP. Brain arteriovenous malformations in adults. *Lancet Neurol*. 2005 May 1;4(5):299-308.
- Pollock BE, Flickinger JC. A proposed radiosurgery-based grading system for arteriovenous malformations. *J Neurosurg*. 2002 Jan;96(1):79-85.
- Mohr JP, Parides MK, Stapf C, Moquete E, Moy CS, Overbey JR, et al. Medical management with or without interventional therapy for unruptured brain arteriovenous malformations (ARUBA): a multicentre, non-blinded, randomised trial. *Lancet (London, England)*. 2014 Feb 15;383(9917):614-21.
- Elhammady MS, Heros RC. the ARUBA study: where do we go from here? *J Neurosurg*. 2017 Feb;126(2):481-5.
- Rutledge WC, Ko NU, Lawton MT, Kim H. Hemorrhage rates and risk factors in the natural history course of brain arteriovenous malformations. *Transl Stroke Res*. 2014 Oct;5(5):538-42.
- World Health Organization. Chapter XVII: Congenital malformations, deformations and chromosomal abnormalities. *International Statistical Classification of Diseases and Related Health Problems 10th Revision*. Available from: <https://icd.who.int/browse10/2019/en>. Last updated 2019; cited Sep 01, 2021.
- IBM Corp. (2015). IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.
- Rodríguez-Parra V, Aburto-Murrieta Y, Zenteno-Castellanos MA. [Description of clinical and angiographic factors associated with hemorrhage in cerebral arteriovenous malformations treated with embolization]. *Arch Neurocién*. 2010 Oct;15(4):211-6. Spanish
- Rinaldi M, Mezzano E, Berra MS, Parés HR, Olocco RV, Papalini FR. Arteriovenous Malformations - checking and descriptive analysis of 52 AVMs treated for the 2000-2010 period. *Surg Neurol Int*. 2015 Oct 12;6(Suppl 20):S511-S523.
- Derdeyn CP, Zipfel GJ, Albuquerque FC, Cooke DL, Feldmann E, Sheehan JP, et al. Management of Brain Arteriovenous Malformations: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke*. 2017 Jun 22;48(8):e200-24.
- Carvalho CS, Resende F, Centeno MJ, Ribeiro I, Moreira J. [Anesthetic Approach of Pregnant Woman with Cerebral Arteriovenous Malformation and Subarachnoid Hemorrhage during Pregnancy: Case Report]. *Brazilian J Anesthesiol*. 2013 Mar-Apr;63(2):223-6. Spanish

26. Goya MM, Plasencia WM, Domingo J, Arencibia A, Barber MA, García-Hernández JA. [Intracranial hemorrhage associated with arteriovenous malformations]. Clin Invest Ginecol Obstet. 2004;31(10):370-5.Spanish
27. Vega-Basulto SD, Lafontaine-Terry E, Gutiérrez-Muñoz FG, Roura-Carrasco J, Pardo-Camacho G. [Intracranial hemorrhage due to aneurysms and arteriovenous malformations during pregnancy and puerperium. Neurosurgery]. 2008;19(1):25-34. Spanish
28. Hillman J. Population-based analysis of arteriovenous malformation treatment. J Neurosurg. 2001 Oct;95(4):633-7.
29. Riordan CP, Orbach DB, Smith ER, Scott RM. Acute fatal hemorrhage from previously undiagnosed cerebral arteriovenous malformations in children: a single-center experience. J Neurosurg Pediatr. 2018 Sep;22(3):244-50.
30. Sahlein DH, Mora P, Becske T, Huang P, Jafar JJ, Connolly ES, et al. Features predictive of brain arteriovenous malformation hemorrhage: extrapolation to a physiologic model. Stroke. 2014 Jul 12;45(7):1964-70.
31. Schramm J, Schaller K, Esche J, Boström A. Microsurgery for cerebral arteriovenous malformations: subgroup outcomes in a consecutive series of 288 cases. J Neurosurg. 2017 Apr;126(4):1056-63.
32. Xie DX, Dedmon MM, O'Connell BP, He LL, Wellons III JC, Rivas A. Surgical management of a hemorrhagic pediatric brainstem cavernous malformation-A case report. Otolaryngol Case Reports. 2017;3:7-9.
33. Riordan CP, Orbach DB, Smith ER, Scott RM. Acute fatal hemorrhage from previously undiagnosed cerebral arteriovenous malformations in children: a single-center experience. J Neurosurg Pediatr. 2018 Sep;22(3):244-50.
34. Tascu A, Pascal C, Florea SM, Mircea S. Spontaneous intracranial hemorrhage in children – ruptured lobar arteriovenous malformations: report of two cases. Romanian Neurosurgery. 2015 Mar 15;22(1):85-92.
35. Pezeshkpour P, Dmytriw AA, Phan K, Shroff MM, Dirks P, Kulkarni A V, et al. Treatment strategies and related outcomes for brain arteriovenous malformations in children: a systematic review and meta-analysis. Am J Roentgenol. 2020 Aug;215(2):472-87.
36. Richard SA, Shrestha SS, Zhang C, Fu W, Wang T, Cong W, et al. Successful treatment of a child with ruptured arteriovenous malformation using onyx embolization: a case report. Open J Mod Neurosurg. 2017 Oct;7(4):153-63.
37. Sappenfield EC, Jha RT, Agazzi S, Ros S. Cerebral arteriovenous malformation rupture in pregnancy. BMJ Case Rep. 2019 Jul 23;12(7):e225811.
38. Nuñez M, Quintana V, Pereira S. [Cesarean section in a patient with a large cerebral arteriovenous malformation: anesthetic considerations]. Anest Analg Reanim. 2012;25(1):39-42.Spanish.

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Splenic Rupture in a COVID-19 Patient – A Case Report

Anna C. Crowley,¹ Raul R. Magadia,² Arianna B. Lanpher.³

Abstract

Background: It is well known that the Coronavirus disease 2019 (COVID-19) causes coagulation changes, requiring frequent monitoring for potential sequelae such as myocardial infarction and stroke. Non-traumatic splenic rupture is a rare and poorly understood occurrence in the clinical setting. Possible causes of nontraumatic splenic rupture include neoplasm, infection, inflammatory disease, iatrogenic and mechanical causes. Furthermore, increased intrasplenic tension, increased abdominal pressure, and thrombotic vascular occlusion are possible mechanisms. **The Case:** We report a case of splenic rupture in a COVID-19 patient. Our patient was a 52-year-old black man, presenting with diarrhea and moderate dyspnea, who was found to be COVID-19 positive. He had a past medical history significant for end-stage renal disease, chronic anemia, and aortic valve replacement. In an otherwise uneventful, 7-day hospital course, the patient's stay abruptly resulted in a nontraumatic splenic rupture and demise. In this report, we have evaluated the likelihood of COVID-19 causing splenic rupture in a patient with no prior splenic disease. **Conclusion:** This case highlights the possibility of splenic rupture in otherwise normally recovering COVID-19 patients, particularly in the presence of comorbid conditions of renal failure and anticoagulation, with increased abdominal pressure during routine defecation. This information may assist in furthering the pathophysiology of COVID-19 and its life-threatening complications. In patients with COVID-19, non-traumatic splenic rupture should be considered as one of the differential diagnoses in patients who present with abdominal pain and early recognition of the same, owing to a high index of suspicion, can be lifesaving.

Key Words: Case report; COVID-19; Splenic rupture (Source: MeSH-NLM).

Introduction

While the Coronavirus disease 2019 (COVID-19) is known to present with significant pulmonary and cardiac manifestations, other systemic complications and interactions with pre-existing pathology are being recognized.¹ As the pandemic has evolved, hypercoagulability and microvascular changes are becoming more prevalent causes of mortality.² Here, we describe a case of nontraumatic splenic rupture in a COVID-19 patient being treated with anticoagulants and routine hemodialysis. Atraumatic splenic rupture is exceedingly rare and a potentially fatal condition. Causes of atraumatic splenic rupture include neoplasms, infection, iatrogenic, mechanical and inflammatory states.³ This case illustrates how interactions with chronic renal disease and anticoagulation use may be important considerations in the treatment of complicated COVID-19 patients.

The Case

History of Present Illness

A 52-year-old Black male presented to the Emergency Department with a chief complaint of diarrhea for 1 day, followed by moderate dyspnea. At the time of admission, the BUN/Cr ratio was 44/11.3, and on admission, the SARS-CoV-2 antigen by IFA (in-house, Sofia) was positive. The patient was afebrile (36.9 °C), and the oxygen saturation was 100% on room air.

Past Medical History

He had a past medical history of hypertension, hepatitis B (2006), end-stage renal disease (2005), hyperlipidemia, severe anemia (2008), and aortic valve replacement (2019). Current medications included warfarin (10mg daily, in addition to supplemental 5mg on M/W/F) due to past mechanical aortic valve replacement. The patient's goal INR was 2.5-

Highlights:

- Presentation of a unique case of COVID-19 complicated by non-traumatic splenic rupture.
- Diagnostic dilemma of conflicting coagulation studies in a COVID-19 patient with chronic renal failure requiring hemodialysis and valve replacement requiring warfarin therapy, leading to splenic rupture, a complication that is associated with hypocoagulable state.
- Highlights possibility of fatal splenic rupture in COVID-19 patients with comorbid renal disease and complex coagulation states, reminding clinicians that rapid diagnosis and surgical correction can be life-saving.

3.5. The patient had a history of hemodialysis noncompliance and often did not attend the recommended treatments. From laboratory data in 2019, the patient's average BUN/Cr was 34.2/6.5, respectively. Patient denied any recent travel. He did not have any personal or family history of leukemia, lymphoma, coagulopathies, DVT/PE, auto-immune pathology, or other neoplasms.

Investigations

Laboratory results on admission were significant for pancytopenia, elevated inflammatory markers, and elevated coagulation studies. From laboratory data in 2019, the patient had a history of leukopenia, anemia, platelet count of 160.7 (10³/μL), and an average Hgb/Hct of 8.2/25.6 (g/dL/%), respectively. Physical exam revealed normal lung sounds, no hepatosplenomegaly, or lymphadenopathy. Prior to this current admission, the patient was evaluated for further renal disease progression in December 2018. There was no evidence of splenic injury or splenomegaly on the 2018 abdominal CT. The patient's pancytopenia

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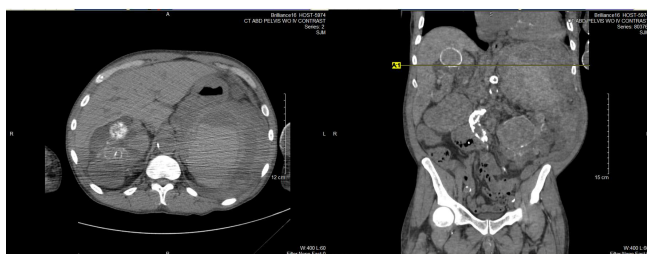
was evaluated during his stay at the hospital; both nutritional and viral etiologies, as well as bone marrow failure, were ruled out with appropriate investigations, as shown in **Table 1**. Peripheral smear was unremarkable.

Hospital Course: On the second day of admission, the patient received dialysis, and over the next six days underwent a total of three hemodialysis treatments coupled with three separate packed RBC transfusions because of his severe anemia. His chest radiograph remained clear and diarrhea subsided by Day 2. Due to the belief that the patient's symptoms were due to COVID-19 initially, no abdominal imaging was performed on admission. On Day 5, the INR increased to 5.13 and remained above the therapeutic range (2.5-3.5) for the remainder of his hospital course. After the patient's increase in coagulation studies, his regular warfarin treatment regimen (10mg daily, in addition to supplemental 5mg on M/W/F) was discontinued on day 6.

On Day 8, when attempting defecation, the patient felt a "pop" and developed tearing and burning LLQ flank pain at 8:00. This bowel movement was blood-tinged and loose. His abdominal pain progressed throughout the day, and at 16:00, the internist's physical examination revealed a firm abdomen with no rebound tenderness. CT scan of the abdomen was compatible with acute splenic hemorrhage. Before emergency splenectomy could be performed, the patient became hypotensive, developed cardiac arrest at 18:55, and expired at 19:12.

The abdominal CT detected a large amount of heterogenous material surrounding the spleen with small to moderate amount of free fluid around the spleen, compatible with acute splenic hemorrhage, as shown in Figure 1. Due to the abrupt onset of acute intra-abdominal hemorrhage, the patient died prior to splenectomy or other life-saving interventions. No autopsy was performed.

Figure 1. Abdominal CT confirming splenic rupture



Legend: Impression Per Radiology: 1. Large amount of heterogenous material surrounding the spleen with small to moderate amount of free fluid in the abdomen compatible with acute splenic hemorrhage. 2. Renal findings compatible with autosomal dominant polycystic kidney disease. 3. Small bilateral pleural effusions, greater on the left. 4. Atherosclerosis

Throughout the patient's stay, he received the standard in-house COVID-19 treatment, including five days of Ascorbic acid (50 mL 2000mg/4 mL IV), Thiamine HCl (2mL 200 mg/2 mL IV), and Zinc Sulfate (20 mg oral QD), along with his continued warfarin anticoagulation as previously prescribed until its discontinuation on Day 6.

Discussion

We believe this case of non-traumatic splenic rupture in a COVID-19 patient was caused by interactions from COVID-19-related coagulation changes. Based on recent data, COVID-19 has been shown to cause both hypercoagulable and hyperfibrinolytic states in patients.² Because our patient was on chronic warfarin therapy and reached supratherapeutic levels during hospital days 5-8, we believe the effects of COVID-19 affected our patient's coagulability and possibly led to his hemorrhagic state and splenic rupture.

While the exact etiology of nontraumatic splenic rupture is not fully understood, three possible mechanisms could explain this patient's unfortunate clinical course: increased intrasplenic tension, increased

abdominal pressure, and altered coagulation.⁴ We believe the supratherapeutic warfarin levels and hyperfibrinolytic state caused by COVID-19 led to our patient's altered coagulation studies. The process of defecation is a known inciting event for splenic rupture due to the rising intrabdominal pressure and stretching of the splenocolic ligament causing rupture of pre-existing subcapsular hematoma. While the patient had no evidence of pre-existing splenic hematoma or splenomegaly, we believe this was the chief inciting event leading to splenic rupture.⁵

It is relevant to eliminate the other causes of nontraumatic splenic rupture. Because our patient did not receive an autopsy following his death, we cannot be certain that our patient did not have an underlying primary splenic neoplasm (i.e., splenic marginal zone lymphoma) or primary myelofibrosis. However, these etiologies are extraordinarily rare.⁶ Our patient did not present with any clinical or laboratory findings suggestive of an underlying hematological malignancy, and there was no hepatosplenomegaly, enlarged lymph nodes, or systemic B symptoms. Mature B- or T-cell leukemias are unlikely because the patient's lymphocyte count was within the normal range. Hairy cell leukemia can be ruled out because peripheral blood smear typically reveals a pancytopenia with monocytopenia. Primary myelofibrosis typically presents with an enlarged spleen and liver with tear drop cells on blood smear, which was not detected in our patient. Epstein Barr Virus and cytomegalovirus were not suspected due to the absence of atypical lymphocytes and leukocytosis.

Even though microvascular changes, coagulation changes, and defecation can be regarded as the principal causes of splenic rupture in this case, the consequences of repetitive hemodialysis from chronic renal disease cannot be overlooked. This is a rare reported complication of hemodialysis, and its exact incidence is not known. However, in a previous study of nontraumatic splenic rupture in a hemodialyzed patient, important risk factors included the use of anticoagulants during hemodialysis, uremic coagulopathy, susceptibility to infections, and impaired immune function. These risk factors can occur as long-term complications of hemodialysis, but they are also complications of severe coronavirus infection, which paradoxically is associated with coagulation changes.⁷ The exact etiology and pathogenesis cannot be confirmed due to the lack of an autopsy, and because of the extremely low incidence of splenic rupture due to hemodialysis, and the absence of known risk factors in our patient (e.g., infectious mononucleosis, hematologic disease, splenomegaly, neoplasm). Therefore, we believe COVID-19 infection was a contributing cause of splenic rupture in our patient.

There have been other recently reported cases of nontraumatic splenic rupture in the setting of COVID-19. Research demonstrates that COVID-19 has a direct effect on the body's secondary lymph tissue. Following these studies, there is further reason to suspect the virus has the potential to have a direct effect on the spleen by causing "lymphoid follicle attrition and nodular atrophy in addition to microvascular thrombosis and necrosis," as stated in a case report by Shaikat and colleagues.⁸

In monitoring COVID-19 progression, clinicians monitor inflammatory markers, such as C-reactive protein (CRP), lactate dehydrogenase (LDH), ferritin, and lymphocytes. As shown in Table 1, several other laboratory values are now closely monitored to evaluate the coagulation changes related to the COVID-19 pathogenesis including d-dimer, fibrinogen, prothrombin time, partial thromboplastin time, platelet count, and other specific quantifications such as calcium.⁹ Although the mechanism is still unknown, elevated coagulation markers support studies documenting many critically ill COVID-19 patients who suffer from a thrombotic microvascular event.¹⁰ Studies have suggested that in the setting of COVID-19, symptoms such as abdominal pain may be an indication for abdominal CT scan on admission and frequent monitoring throughout the patient's disease progression. In a reported case of splenic rupture in Poursina Hospital in Rasht, Iran, a COVID-19

Table 1. Inpatient laboratory values.

Test	Ref. Range	Day 0	D1	D2	D3	D4	D5	D6	D7
WBC (10 ³ /L)	4.5-10.4	1.5	1.6	1.7	1.8	2.8	3.5	5.2	5.4
RBC (10 ⁶ /L)	3.7-5.3	2.41	2.37	2.11	2.29	2.10	1.64	2.04	1.91
Hgb(g/dL)/HCT (%)	11.0-16.0/35.0-47.0	7.8/23.5	7.4/22.9	6.6/20.8	6.9/22.2	6.5/20.4	5.2/16.5	6.5/19.9	6.0/18.2
Platelet (10 ³ /L)	140-440	54	62	60	59	76	68	72	69
INR		2.93	--	2.24	2.22	2.84	5.13	4.65	4.73
PT (s)	9.8-11.6	29.8	--	23.1	22.9	28.9	50.8	46.2	47
aPTT (s)	23.1-31.6	56.6	--						
AST (unit/L)	2-33	24							
ALT (unit/L)	13-61	12							
Albumin (gm/dL)	3.4-5	2.7							
Ferritin (ng/mL)	8.0-252.0	2184.6	--						
CRP (mg/L)	0.0-3.0	24.5	--						
Procalcitonin (ng/mL)	<0.10	0.52	--						
Sed Rate (mm/h)	0-30	53	--						
D-dimer	0.19-0.5	2.92	--						
LDH (unit/L)	87-241	360	--						
BUN/Cr	7-18/0.6-1.3	44/11.3	--						
Lymphocyte (%)		25.5	43.0	36.5	32.6	27.3	25.1	22.9	16.5
Monocyte (%)		9.4	13.3	17.1	11.4	9.1	13.6	12.9	11.9

patient had vague abdominal symptoms and subsequent signs of decompensation. Urgent laparotomy was performed, revealed atraumatic splenic rupture, and splenectomy was performed. Fortunately, the acuity of these physicians' actions were able to save the patient's life.¹¹

Due to the multisystem involvement of COVID-19, coagulation studies are becoming increasingly relevant in that the virus can cause both hypercoagulable and hemorrhagic changes. We are assuming that our patient's hyperfibrinolytic state led to his splenic hemorrhage. While

the coronavirus remains a heavily studied topic both microbiologically and clinically, it is pertinent that clinicians grow more cognizant of emerging complications related to COVID-19. This case highlights the importance of monitoring coagulation studies while maintaining a high index of suspicion for rare but life-threatening intra-abdominal complications. In patients with COVID-19, non-traumatic splenic rupture should be considered as one of the differential diagnoses in patients who present with abdominal pain and early recognition of the same, owing to a high index of suspicion, can be lifesaving.

References

1. Temgoua MN, Endomba FT, Nkeck JR, Kenfack GU, Tochie JN, Essouma M. Coronavirus Disease 2019 (COVID-19) as a Multi-Systemic Disease and its Impact in Low- and Middle-Income Countries (LMICs). *SN Compr Clin Med.* 2020;1-11.
2. Kelsey Gockman, Alyssa Harbaugh, Yogendra Kanthi, Jason S. Knight, Daniel A. Lawrence, Jacqueline A. Madison, et al. Plasma tissue plasminogen activator and plasminogen activator inhibitor-1 in hospitalized COVID-19 patients. *Scientific Reports.* 2021 Jan;11:1580.
3. D. Candinas, B. Gloor, A Hostettler, P. Renzulli, A. M. Schoepfer. Systematic Review of Atraumatic Splenic Rupture. *Br J Surg.* 2009 Oct;96(10):1114-21. doi: 10.1002/bjs.6737.
4. Ayfer Aktas, Mustafa Aldemir, Ercan Gedik, Sadullah Girgin, Mustafa Aldemir, Celalettin Keles, Mehmet Cudi Tuncer. Non-Traumatic Splenic Rupture: Report of Seven Cases and Review of the Literature. *World Journal of Gastroenterology.* 2008 Nov; 14(43):6711-6.
5. Chikashi Gotoh, Kouji Masumoto, Kentaro Ono, Toko Shinkai, Yasuhisa Urita. A Rare Mechanism of Delayed Splenic Rupture Following the Nonoperative Management of Blunt Splenic Injury in a Child. *Surgical Case Reports.* 2018 Dec; 4:75.
6. M. M. Al-Hawary, S. Azar, R. K. Kaza, I.R. Francis. Primary and Secondary Neoplasms of the Spleen. 2010 Aug; 10(1):173-82.
7. Se-Ho Chang, Hyun-Jung Kim, Gyeong-Won Lee, Jong Deog Lee, Dong Jun Park. Spontaneous Splenic Rupture in a Hemodialysis Patient. *Yonsei Medical Journal, Yonsei University College of Medicine.* 2005 Jun 30; 46(3):435-8.
8. Shaukat I, Khan R, Diwakar L, Kemp T, Bodasing N. Atraumatic splenic rupture due to covid-19 infection. *Clinical infection in practice.* 2021 Apr 1;10:100042.
9. Ronghui Du, Guohui Fan, Ying Liu, Zhibo Liu, Ting Yu, Fei Zhou, et al. Clinical Course and Risk Factors for Mortality of Adult Inpatients with COVID-19 in Wuhan, China: a Retrospective Cohort Study. *The Lancet.* 2020 Mar; 395(10229):1054-62.
10. David Berlin, Joanna Harp, Jeffrey Laurence, Cynthia Magro, J. Justin Mulvey, Steven Salvatore, et al. Complement Associated Microvascular Injury and Thrombosis in the Pathogenesis of Severe COVID-19 Infection: A Report of Five Cases. *Translational Research: The Journal of Laboratory and Clinical Medicine.* 2020 Jun; 220: 1-13.
11. Mobayen, M., Yousefi, S., Mousavi, M., & Anbaran, A. S. (2020). The presentation of spontaneous splenic rupture in a COVID-19 patient: a case report. *BMC surgery*, 20(1):1-5.
12. Judith A. James, Doruk Erkan, Joan T. Merrill, Jerald Winakur. Emerging Evidence of a COVID-19 Thrombotic Syndrome Has Treatment Implications. *Nature Reviews Rheumatology.* 2020 July; 16:581-9.

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Pneumatocele-Induced Pneumothorax in a Patient with Post-COVID-19 Pneumonitis. A Case Report

Kevin O. Wortman II,¹ Kevin O. Wortman Sr.²

Abstract

Background: The COVID-19 pandemic has been challenging medical professionals and facilities for over a year now. Much of the literature describes pathologic lung changes and complications associated with SARS-CoV-2, with pneumothorax and pneumatoceles not being uncommon. **The Case:** We describe a case involving a patient that presented to the emergency department with a pneumothorax. Three weeks prior, the patient was hospitalized for 10 days in acute respiratory distress secondary to SARS-CoV-2 pneumonia, which did not require ventilator support. Follow up imaging revealed a 7 cm (AP) x 4.6 cm (transverse) x 2.5 (cc) cm pneumatocele. **Conclusion:** We speculate that antecedent rupture of an unrecognized pneumatocele likely caused lung collapse leading to the patient's pneumothorax. This review delves into the etiology of both pneumothoraces and pneumatoceles along with their relation to SARS-CoV-2 pneumonia.

Key Words: COVID-19; Pneumatocele; Pneumothorax; Tension Pneumothorax; SARS-CoV-2 (Source: MeSH-NLM).

Introduction

This article describes the clinical course of a patient that presented to an Emergency Department (ED) with a spontaneous pneumothorax post-SARS-CoV-2 pneumonia, with a pneumatocele discovered on radiography. While pneumatoceles are more common within the post-pneumonia, pediatric population,¹ a retrospective study has shown pneumatocele development as a missed diagnosis in up to 37% of their 78 patients with the coronavirus disease.² Additional studies show varying numbers with pneumatocele development seen in 10% of 81 symptomatic patients in the study by Shi et al.³ and in 5.3% of 57 SARS-CoV-2 positive patients in the study Qi et al.⁴ Radiologic studies use terms such as 'cystic air spaces',² 'cystic changes',³ and 'emphysema',⁴ which are synonymous with pneumatocele. Pneumatoceles, in relation to COVID-19, are highly variable in size; some are categorized as 'giant bullae'⁵ and typically present in multiples rather than a singular lesion.⁶

A predictable complication of pneumatoceles is pneumothorax.^{1,5} A few case studies report pneumothoraces as a rare complication of COVID-19.^{7,8} Risk factors for pneumothorax include young age, chest trauma,¹ individuals with imaging demonstrating fibrotic lung changes,⁹ individuals with a more severe clinical course, prolonged pneumonitis duration, and higher neutrophil counts.¹⁰ In our experience with COVID-19 management, pneumothorax is more common in mechanically ventilated patients, which is as high as 13% in one study,¹¹ likely due to barotrauma. However, patients are presenting with pneumothoraces well before ventilatory support is provided.

The Case

A 28-year-old African American male presented to an ED reporting chest and back pressure/pain along with shortness of breath. Three weeks prior, the patient presented to the same ED in respiratory distress secondary to PCR confirmed SARS-CoV-2 pneumonia. He was hospitalized for 10 days and received oxygen, remdesivir, dexamethasone, tocilizumab, and enoxaparin therapy. The patient did not require mechanical ventilation during his prior hospitalization.

Highlights:

- COVID-19 recovery complications are not emphasized in literature as much as pathophysiology, clinical treatment, and epidemiology.
- As the pandemic is taking its course, many patients are recovering from COVID-19 but may be at risk for complications.
- To ensure pneumatoceles are diagnosed and tracked in anticipation of spontaneous pneumothorax, we recommend that patients post-COVID-19 pneumonitis are assessed radiographically before hospital discharge and within two weeks after discharge. This will lead to early detection of pneumatoceles and will provide an insight into a subgroup of COVID-19 patients that may be at risk for multiple pathological pulmonary events after COVID-19 hospitalization. This will aid physicians in being cognizant regarding this subgroup of patients who will benefit from a more stringent monitoring.
- Larger studies are warranted to distinguish between Long COVID/Long-haul COVID/Post-acute sequelae SARS-CoV-2 (PASC) and Post-COVID-19 pneumonitis as well as the complications related to both these conditions.

During the current presentation to the ED for respiratory distress the patient was saturating at 82% on room air, which improved to 92% on 4 liters per minute of nasal cannula oxygen. Chest radiographs revealed a large right pneumothorax with subsequent mediastinal shift to the left (**Figure 1**). A pigtail catheter was inserted at the 2nd intercostal space along the midclavicular line.

After two days, the catheter accidentally dislodged from the patient's pleural space and serial CXRs were performed to determine whether the pneumothorax had resolved. Although the patient was clinically asymptomatic, the radiographs showed worsening of the pneumothorax; therefore, a pigtail catheter was reinserted at the 4th intercostal space along the mid axillary line. The CXR on Day 4 also showed formation of a round lesion with central air-fluid levels that was speculated to be a pneumatocele (**Figure 2**). On subsequent imaging, the pneumothorax appears to have improved, although not completely resolved (**Figure 3**). The lesion was monitored by a local

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Figure 1. (A): Patient's chest x-ray taken during the previous hospitalization, showing extensive bilateral interstitial airspace opacities throughout the right and left lungs. (B): Patient's chest x-ray at presentation showing a large right pneumothorax, with the majority of the right lung collapsed. There is mild to moderate mediastinal shift to the left. Both lungs show evidence of bilateral airspace/interstitial disease.

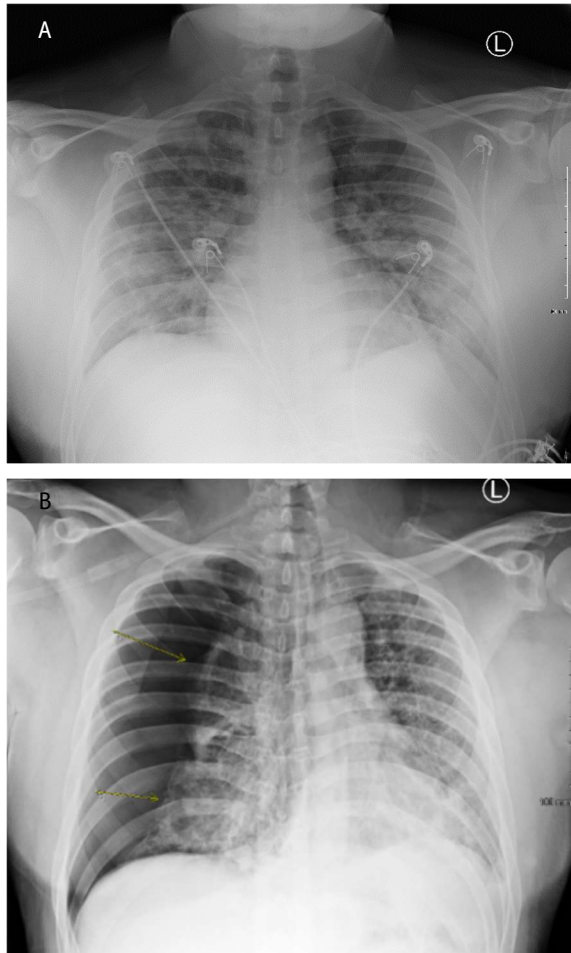
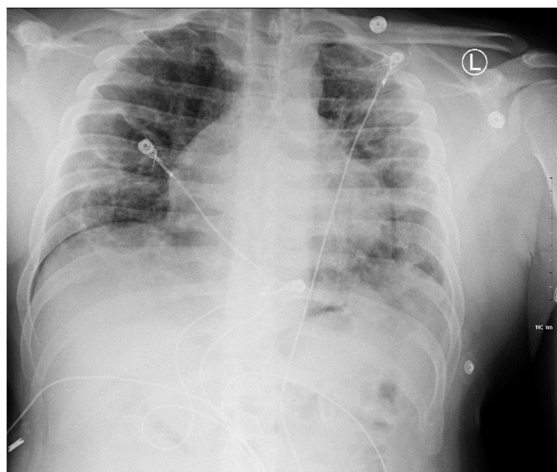


Figure 2. Follow up chest x-ray on Day 4 showing an unresolved right pneumothorax (20-30%) and ill-defined pulmonary opacities throughout both lungs, deduced to be bilateral interstitial disease. A round lesion with central air-fluid levels formed within the right mid lung and was speculated to be a pneumatocele



pulmonologist and treated daily with fluticasone inhaled therapy, until resolution 7 weeks later.

Discussion

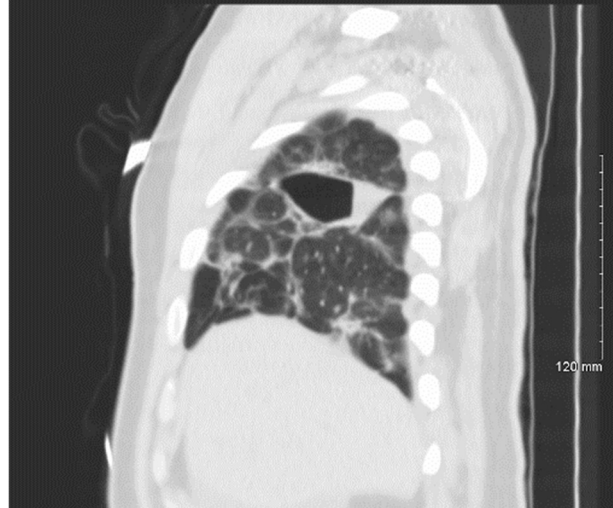
Textbook pneumothorax patients often have a history of a connective tissue disorder, such as Marfan syndrome or Ehlers-Danlos syndrome, and/or have a characteristic marfanoid habitus, COPD, smoking, or pregnancy.¹² Our patient denied a recent history of trauma, denied a history of smoking, and had a body mass index of 35.9 kg/m². This patient does not fit into the standard demographic of patients at an increased risk of pneumothorax and there are still uncertainties regarding COVID-19-related lung changes and complications. This led us to hypothesize that pneumatoceles may well be a potential mechanism behind this pneumothorax.

The percentage of COVID-19 cases that are complicated by pneumatocele development has yet to be determined. Pneumatoceles typically appear 5-6 days after the infectious process secondary to SARS-CoV-2.¹³ However, spontaneous pneumothorax is a known, rare complication of COVID-19 and can occur in the absence of mechanical ventilation,¹⁴ with studies showing that pneumothorax occurs within a window of 14-37 days after hospitalization.⁷ Pneumothorax is also not a common sequel to pneumatoceles as the majority of pneumatoceles resolve spontaneously within a few weeks to a year, without intervention.¹ In this case, while no pneumatocele was identified before or at presentation, antecedent rupture of an unacknowledged pneumatocele could have led to the pneumothorax. The single pneumatocele lesion likely formed due to parenchymal inflammation secondary to acute respiratory distress syndrome (ARDS), which is not uncommon.¹⁵ There have not been any studies that deduce a specific mechanism for COVID-19 infection itself eliciting pneumatocele formation, without pneumonitis underplay.

Pneumothoraxes are rarely fatal; however, they have recurrence rate of up to 32% within 12 months according to one meta-analysis.¹⁶ This patient's pneumothorax pathology could have occurred either through pneumatocele rupture, which has been reported in other case studies,⁸ or due to COVID-19-induced pulmonary parenchymal injury and necrosis with development of air leaks into the pleural cavity. While the former has not been thoroughly studied due to the relative novelty of COVID-19, the latter was noted previously during the SARS outbreak.^{16,17} If pulmonary necrosis led to pneumothorax, then the pneumatocele seen in this patient was likely an incidental finding.

As per the World Health Organization (WHO), most COVID-19 patients experience a mild-to-moderate clinical course, with 10-15% of patients progressing to a severe clinical presentation and 5% progressing to critical illness. In general, recovery can take anywhere from 2-6 weeks, depending on the severity of the case. Unfortunately, some patients experience symptoms for weeks to months, regardless of disease severity.¹⁸ These patients were colloquially deemed 'long COVID' or 'COVID long-haulers,' which later became 'post-acute sequelae of SARS-CoV-2 (PASC)'. Studies suggest that roughly one-third of those infected with SARS-CoV-2, whether asymptomatic during infection or not, may develop PASC.^{19,20} According to a study conducted by Lambert et al.²¹, of the 5,875 COVID-19 survivors surveyed, 5,163 reported symptoms persisting longer than 21 days. The most common symptom reported was fatigue (79.0%) and followed by headache/migraines (55.3%), shortness of breath (55.3%), difficulty concentrating (53.6%), cough (49.0%), changed sense of taste (44.9%), diarrhea (43.9%), muscle/body aches (43.5%), and heart palpitations (39.5%).²¹ Another study surveying 3,762 respondents from 56 countries reported the most frequent symptoms being fatigue (77.7%), post-exertional malaise (72.2%), and cognitive dysfunction (55.4%).²² Risk factors for PASC include hypertension, obesity, prior mental health conditions,²¹ and female gender (two times increased risk as compared to males).²³ While COVID-19 is at the forefront of research, a clear distinction must be made between individuals suffering from PASC and post-COVID-19

Figure 3. Non-contrast CT scans showing resolution of the pneumothorax. Laterally in right upper lobe, there is oval-shaped lucent lesion measuring 7 cm (AP) x 4.6 cm (transverse) x 2.5 cm (cc). Wall is thin and barely perceptible. Inner margin of the cavity is smooth. There is an internal air-fluid level. It is difficult to tell if this collection is tracking along the minor fissure. Numerous scattered ground-glass pulmonary opacities are present throughout each lung.



pneumonitis, as well as their respective complications. Larger retrospective cohort studies and case reports, pertaining to both PASC and Post-COVID-19 pneumonitis, are warranted.

Conclusion

Cystic lesions, pneumatoceles, and subsequently pneumothoraces are likely to result from prolonged SARS-CoV-2 pneumonia causing air leaks. This is similar to the clinical course observed in patients with SARS, caused by a virus within the same *Coronaviridae* family, during the 2003 outbreak. To ensure pneumatoceles are diagnosed and tracked in anticipation of spontaneous pneumothorax, we recommend that patients with post-COVID-19 pneumonitis, especially those given

ventilator support, are assessed radiographically before hospital discharge and within two weeks after discharge. This will lead to early detection of pneumatoceles and will provide an insight into a sub-group of COVID-19 patients that may be at risk for multiple pathological pulmonary events after COVID-19 hospitalization. This could physicians in being cognizant regarding this sub-group of patients, who could benefit from more stringent monitoring. Furthermore, larger studies are warranted to distinguish between Long COVID/Long-haul COVID/Post-acute sequelae SARS-CoV-2 (PASC) and Post-COVID-19 pneumonitis, as well as the complications related to both these conditions.

References

- Jamil A, Kasi A. Pneumatocele. StatPearls. Treasure Island (FL): StatPearls Publishing. 2021 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK556146/>. Last updated Aug 11, 2021; cited Apr 10, 2021.
- Werberich GM, Marchiori E, Barreto MM, Rodrigues RS. Computed Tomography Findings in a Brazilian Cohort of 48 Patients with Pneumonia due to Coronavirus Disease. *Rev Soc Bras de Med Trop*. 2020 Jul 20;53:e20200405.
- Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, et al. Radiological Findings from 81 Patients with COVID-19 Pneumonia in Wuhan, China: a Descriptive Study. *Lancet Infect Dis*. 2020 Apr;20(4):425-34.
- Qi S, Guo H, Shao H, Lan S, He Y, Tiheiran M, et al. Computed Tomography Findings and Short-Term Follow-up with Novel Coronavirus Pneumonia. *MedRxiv* 2020:20042614 [Preprint].
- Sun R, Liu H, Wang X. Mediastinal Emphysema, Giant Bulla, and Pneumothorax Developed during the Course of COVID-19 Pneumonia. *Korean J Radiol*. 2020 May;21(5):541-4.
- Reed JC. Multiple Lucent Lesions. In: *Chest Radiology: Plain Film Patterns and Differential Diagnoses*. 7th ed. Elsevier. 2017.
- Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and Clinical Characteristics of 99 Cases of 2019 Novel Coronavirus Pneumonia in Wuhan, China: a Descriptive Study. *Lancet*. 2020 Feb 15;395(10223):507-13.
- Mallick T, Dinesh A, Engdahl R, Sabado M. COVID-19 Complicated by Spontaneous Pneumothorax. *Cureus*. 2020 Jul 9;12(7):e9104.
- Zantah M, Castillo ED, Townsend R, Dikengil F, Criner GJ. Pneumothorax in COVID-19 Disease- Incidence and Clinical Characteristics. *Respir Res*. 2020 Sep 16;21:236.
- Sihoee ADL, Wong RHL, Lee ATH, Lau LS, Leung NYY, Law KI, et al. Severe Acute Respiratory Syndrome Complicated by Spontaneous Pneumothorax. *Chest*. 2004 Jun;125(6):2345-51.
- Chopra A, Al-Tarbsheh AH, Shah NJ, Yaqoob H, Hu K, Feustel PJ, et al. Pneumothorax in Critically Ill Patients with COVID-19 Infection: Incidence, Clinical Characteristics and Outcomes in a Case Control Multicenter Study. *Respir Med*. 2021 Aug 1;184:106464.
- McKnight CL, Burns B. Pneumothorax. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. 2021 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK441885/>. Updated Aug 11, 2021; cited Apr 10, 2021.
- Sanivarapu, RR, Farraj K, Sayedy N, Anjum F. Rapidly Developing Large Pneumatocele and Spontaneous Pneumothorax in SARS-CoV-2 Infection. *Respir Med Case Rep*. 2020 Dec 2;31:101303.
- Zantah M, Castillo ED, Townsend R, Dikengil F, Criner GJ. Pneumothorax in COVID-19 Disease- Incidence and Clinical Characteristics. *Respir Res*. 2020 Sep 16;21:236.
- Chennu G, Przydzial P, Tchao Y, Isedeh A, Madan N. Pneumatocele after Acute Respiratory Distress Syndrome in an Adult Patient: A Case Report. *Case Rep Acute Med*. 2020 Oct 30;3(3):73-8.
- Walker SP, Bibby AC, Halford P, Staddon L, White P, Maskell NA. Recurrence Rates in Primary Spontaneous Pneumothorax: a Systematic Review and Meta-Analysis. *Eur Respir J*. 2018 Sep 6;52(3):1800864.

17. Kao HK, Wang JH, Sung CS, Huang YC, Lien TC. Pneumothorax and Mortality in the Mechanically Ventilated SARS Patients: a Prospective Clinical Study. Crit Care. 2005 Jun 22;9:R440.
18. World Health Organization. Coronavirus Update 36 What We Know About Long-Term Effects of COVID-19: The Latest on the COVID-19 Global Situation & Long-Term Sequelae. Available from: <https://www.who.int/publications/m/item/update-36-long-term-effects-of-covid-19>. Updated September 9, 2020; cited August 24, 2021.
19. Nehme M, Braillard O, Alcoba G, Perone SA, Courvoisier D, Chappuis F, et al; COVIDCARE Team. COVID-19 Symptoms: Longitudinal Evolution and Persistence in Outpatient Settings. Ann Intern Med. 2021 May;174(5):723-5.
20. Huang Y, Pinto MD, Borelli JL, Mehrabadi MA, Abrihim H, Dutt N, et al. COVID Symptoms, Symptom Clusters, and Predictors for Becoming a Long-Hauler: Looking for Clarity in the Haze of the Pandemic. MedRxiv 2021:21252086 [Preprint].
21. Lambert N, El-Azab SA, Ramrakhiani NS, Barisano A, Yu L, Taylor K, et al; Survivor Corps. COVID-19 Survivors' Reports of the Timing, Duration, and Health Impacts of Post-Acute Sequelae of SARS-CoV-2 (PASC) Infection. MedRxiv 2021:21254026 [Preprint].
22. Davis HE, Assaf GS, McCorkell L, Wei H, Low RJ, Re'em Y, et al. Characterizing Long COVID in an International Cohort: 7 Months of Symptoms and Their Impact. MedRxiv 2020:20248802 [Preprint].
23. Nabavi N. Long Covid: How to Define It and How to Manage It. Brit Med J. 2020 Sep 7;370:m3489.

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A Case Report of Acute Severe Myelitis and Meningitis Secondary to Varicella Zoster Virus Reactivation in a Patient with Acquired Immunodeficiency Syndrome

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Abstract

Background: Myelitis post Herpes-Zoster is a rare condition that is typically associated with immunocompromised states. It usually starts as an acute loss of sensory and motor functions below the affected spinal cord level. The condition can range in severity from a mild to a fatal presentation. Other neurological complications include meningitis, atypical presentations should encourage the search for undiagnosed immunosuppression states. **The Case:** We describe the case of a 42-year-old man, with previously undiagnosed HIV, who developed acute myelitis and meningitis after the appearance of the classic zoster lesions. On lumbar puncture and subsequent CSF analysis, the patient was found to have Froin's Syndrome. The patient was initiated with ceftriaxone, vancomycin, and acyclovir regimen and prophylactic antipneumococcal treatment was also added. After 14 days in the hospital, the fever, headache, and neck stiffness subsided while the sphincter function and lower limb paraplegia did not improve. **Conclusion:** Varicella zoster virus reactivation suggests underlying immunosuppression. This case demonstrates the importance of being cognizant to the wide range of clinical manifestations that may suggest spinal cord involvement after clinical reactivation. Furthermore, physicians also need to be mindful that Acquired Immunodeficiency Syndrome (AIDS) and other immunodeficiency states could present with atypical clinical manifestations.

Key Words: Immunosuppression; Myelitis; HIV; Acquired Immunodeficiency Syndrome; Varicella-Zoster Virus Infection; Herpes Zoster (Source: MeSH-NLM).

Introduction

Varicella-Zoster Virus (VZV) is a highly infectious, exclusively human virus with worldwide prevalence. Primary infection of VZV leads to acute varicella, and after primary infection, the virus is established on a cranial nerve and dorsal root ganglia with a lifelong latency.¹ Reactivation leads to Herpes Zoster (HZ) which presents as an exanthem of vesicular lesions in a dermatomal distribution and is highly painful. HZ is an opportunistic infection with an increased risk in patients who are immunocompromised.¹ However, the incidence of HZ has decreased in HIV/AIDS patients since the introduction of antiretroviral therapy (from 2,955 per 100,000 in 1992-1996 to 628 per 100,000 between 2009 and 2011).² Neurological complications secondary to HZ can occur, with meningitis being the most frequent.³

Myelopathy is a less common neurological complication secondary to HZ, with an estimated incidence of less than 1 per 1,000 cases, and affects most often immunocompromised patients or older patients in general, representing less than 0.3% among the patients with HZ virus infection.⁴

The onset of HZ myelitis is usually acute or subacute, usually occurring after two weeks of vesicular rash appearance.⁴ The pathophysiology is still unknown, but tissue findings include inflammation with mononuclear infiltration and microglial proliferation, hemorrhagic necrosis, and degeneration of motor and sensory roots.⁴ Additionally, cellular immunity deficits seen in AIDS may lead to a fatal form of myelitis, spinal cord infarction, or progression of the disease and involvement of the diaphragm.⁵ Commonly, it presents as a mild and self-limited syndrome, but the spinal cord can become severely inflamed

Highlights:

- Post-herpes zoster myelitis is a very uncommon presentation.
- This case presents the importance of screening for undetected HIV infections.
- Introduction of clinical and images to improve curiosity about the case.

and cause serious complications such as recurrent HZ myelitis, loss of sensation and ability to ambulate, bacterial superinfection, postherpetic neuralgia, and fatal myelitis that is mostly seen in immunocompromised patients.^{6,7}

Froin's syndrome is defined by the presence of xanthochromia (yellow or pink color), the elevation of protein levels (>500 mg/dl), and hypercoagulation state on CSF cytology, and is an unusual condition that is presented after irritation and blockage of CSF (usually due to a mass or abscess). The combination of these three signs is considered pathognomonic; due to the effect on the spinal cord, the neurologic examination could expose paralysis of the lower limbs, decreased sensation, and other components of myelopathy.⁸

Here, we present the case of an AIDS patient with meningitis and severe myelitis due to VZV reactivation, with a less described presentation, and this also represents one of the few reported cases that developed Froin's syndrome.

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The reported cases of Froin's syndrome, in the context of a CNS invasion by VZV, are mostly related to encephalitis, with only one case associated with myelitis. VZV myelitis usually presents in more advanced age, as in the case presented by Kleinschmidt-DeMaster *et al.*, wherein 2016 they presented the case of a 54-year-old man with a known history of several comorbidities.⁹ In our case, the patient was healthy before, as he was only known to have high blood pressure and was diagnosed with HIV after the onset of the symptomatology.⁹

The Case

A 42-year-old man complaining of burning constant pain with distribution in T8-T10 dermatome was admitted to the emergency department. The pain did not radiate and did not have any aggravating nor relieving factors. The pain started 10 days before his admission, in the aforementioned dermatomes, with the subsequent appearance of vesicles and erythema in the same zone (**Figure 1**). The oppressive holocranial headache appeared 72 hours before admission, with occipital predominance, and was accompanied by symptoms of fever, vomiting, urinary retention, and lower limb weakness. The patient has a history of systemic arterial hypertension, alcoholism, and an exploratory laparotomy with cystography 20 years ago secondary to abdominal trauma.

Figure 1. Herpes-Zoster distribution.



Legend: Vesicles and erythema in a dermatomal distribution (T8-10) associated with the clinical symptomatology established the clinical diagnosis of herpes zoster in this patient.

On examination, there was moderate paraparesis (3/5 Medical Research Council scale, MRC) and neck stiffness, with the rest of the exam unremarkable. These findings raised the suspicion of a central nervous system (CNS) infectious process, so the patient underwent a cranial simple computed tomography (CT), lumbar puncture, viral panel. Empiric treatment for meningitis was initiated (ceftriaxone 2g IV q12h, vancomycin 1g IV q8h, acyclovir 750 mg IV q8h).

The viral panel was performed and positive for HIV-1 and the cluster of differentiation 4 (CD4) count was markedly low (104 cells/uL). The CT scan showed no pathological changes, but the lumbar puncture demonstrated xanthochromia, pleocytosis with lymphocyte predominance, hyper proteinorachie (1430 mg/dl), hypoglycorrhachia (21 mg/dl), and hypercoagulation, consistent with viral meningitis and Froin's Syndrome. BioFire® meningitis/encephalitis panel was performed with a positive result for VZV. Because of the condition,

coinfection with bacteria or mycobacteria could not be ruled out, so anti-Tuberculosis treatment (doTbal®) was added, and cultures for fungi and mycobacteria were obtained. A GeneXpert® MTB/RIF test was run with a negative result. GeneXpert® MTB/RIF is a real-time polymerase-chain-reaction-based (RT-PCR) method used for rapid and accurate detection of active tuberculosis and to determine resistance for rifampicin. The decision was made to discard extrapulmonary tuberculosis as an etiological agent or tuberculosis as a coinfection (tuberculosis is considered endemic in the author's state). RT-PCR performed to detect the presence of VZV resulted positive.

On the second day of hospitalization, the patient developed bowel incontinence and an increase in the lower limb weakness (2/5 MRC) with anesthesia. This raised the suspicion of inflammatory myelitis and treatment with methylprednisolone was initiated (1 g IV q24h for 5 days). Magnetic resonance imaging (MRI) of the dorsal spine was performed, showing a widened spinal cord at T4-T7 levels, with hydrosyringomyelia above this level (T1-T4) and a T2 weighted hyperintensity zone near the conus medullaris (T11-L1). This established the diagnosis of acute transverse myelitis (**Figure 2 A, B**).

Figure 2. Magnetic Resonance Imaging.



Legend: (A) Sagittal T2 weighted MRI of dorsal spine showing a widened spinal cord at T4-T7 levels (arrows). (B) Different view of sagittal section, T2 weighted MRI of dorsal spine showing hydro-syringomyelia at T1-T4 levels (arrowheads) and a hyperintensity zone at levels T11-L1 (arrows).

After 14 days in the hospital and treatment with ceftriaxone, vancomycin, acyclovir and, doTbal®, the patient was discharged with outpatient follow-up. The fever, headache, and neck stiffness subsided, but sphincter function and lower limb paraplegia did not improve.

Discussion

This case report was about disseminating how atypical clinical symptoms of myelitis are in patients with HZ reactivation, in addition to the complications that these reactivations can have on a patient's lifestyle as a result of not improving after treatment.

Post HZ myelitis and meningitis are rare but very well described CNS complications.⁹ The infection of the meninges has a clinical presentation easy to recognize and is more common than myelitis in the immunocompetent population.^{9,10}

Besides being rarer than meningitis, the HZ myelitis tends to be harder to suspect due to the clinical presentation, which tends to be atypical in patients with decreased immune function.¹⁰ HZ myelitis usually manifests as an acute onset of sensory loss, focal weakness, and

sphincter dysfunction (bladder dysfunction being more common than bowel) below the affected level.¹⁰

Immunocompromised patients tend to have atypical presentations of Herpes Zoster, even without the appearance of characteristic herpetic skin lesions, and may show a variation in the temporal relationship between these lesions and the medullary symptoms (usually 1-2 weeks).¹⁰ However, the frequency of topographic dissociation between the affected dermatomes and the level of the myelitis is not significantly different with immunocompetent patients.¹⁰ In this case, the patient presented with urinary retention (described more in sacral spine involvement) and bowel incontinence, two less common features but equally important to consider, especially if other typical symptoms do not appear.⁴

To confirm the diagnosis, VZV DNA and VZV IgG detection by real-time PCR and serology, respectively, are the methods of choice and must be done simultaneously.¹¹ DNA decreases within the first 7 days of symptomatology start while antibodies increase proportionally.¹² Serology must be measured on paired serum and CSF.¹² The typical MRI findings include T2 hyperintensities and focal swelling, sometimes large enough to occlude the subarachnoid space, which, like in this case, caused Froin's syndrome, which is characterized by the triad of xanthochromia, elevation of protein levels (>500 mg/dL), and hypercoagulation state as well as the clinical manifestations of

myelopathy.^{13,14} It is believed that the hypercoagulation state is responsible for starting a series of diffusion processes that lead to the aforementioned findings of Froin's syndrome.^{14,15} The reported cases of Froin's syndrome, in the context of a CNS invasion by VZV, are mostly related to encephalitis, with only one case associated with myelitis. However, none have been found to be associated with myelitis and meningitis simultaneously, which makes this case unique.^{5,16,17}

Standard treatment has not been established, and some authors have proposed using acyclovir combined with a corticosteroid regimen, while others opt for the single use of antivirals, with differences and inconsistencies in the outcomes.^{8,9,14,15} This explains the need to carry out more specific studies that establish a treatment that improves the prognosis of these patients.

This case highlights the importance of focusing on the whole range of manifestations that may suggest a spinal cord involvement following Herpes Zoster reactivation. It shows the importance of suspecting this condition in immunocompromised patients, in whom the disease can cause excessive inflammation and progress rapidly towards a fatal outcome or important sequelae. In this specific context, it is necessary to be cognizant about multiple differential diagnoses with a wide range of possible etiological agents that can lead to confusion and delay in beginning a specific treatment may improve the clinical outcome.

References

- Pergam SA, Limaye AP. AST Infectious Diseases Community of Practice. Varicella zoster virus (VZV) in solid organ transplant recipients. *Am J Transplant*. 2009 Dec;9 Suppl 4(Suppl 4):S108-15.
- Grabar S, Tattevin P, Selinger-Leneman H, de La Blanchardiere A, de Truchis P, Rabaud C, et al. Incidence of herpes zoster in HIV-infected adults in the combined antiretroviral therapy era: results from the FHDH-ANRS CO4 cohort. *Clin Infect Dis*. 2015 Apr 15;60(8):1269-77.
- Chamizo FJ, Gilarranz R, Hernández M, Ramos D, Pena MJ. Central nervous system infections caused by varicella-zoster virus. *J Neurovirol*. 2016 Aug;22(4):529-32.
- Gilden D, Nagel MA, Cohrs RJ, Mahalingam R. The variegated neurological manifestations of varicella zoster virus infection. *Curr Neurol Neurosci Rep*. 2013 Sep;13(9):374.
- Corti M, Trione N, Villafañe MF, Risso D, Yampolsky C, Mamanna L. Acute meningoencephalomyelitis due to varicella-zoster virus in an AIDS patient: report of a case and review of the literature. *Revista da Sociedade Brasileira de Medicina Tropical*. 2011 Oct;44:784-6.
- Agrawal MM, Mahajan RS, Bilimoria FE, Ninama KR. Myelitis: A Rare Neurological Complication of Herpes Zoster. *Indian J Dermatol*. 2016 Nov;61(6):687-9.
- Nakano T, Awaki E, Araga S, Takai H, Inoue K, Takahashi K. Recurrent herpes zoster myelitis treated with human interferon alpha: A case report. *Acta Neurol Scand*. 1992 May;85:372-5.
- Dancel R, Shaban M. Images In Clinical Medicine. Froin's Syndrome. *N Engl J Med*. 2016 Mar 17;374(11):1076.
- Kleinschmidt-DeMasters BK, Mahalingam R, Shimek C, Marcoux HL, Wellish M, Tyler KL, Gilden DH. Profound cerebrospinal fluid pleocytosis and Froin's Syndrome secondary to widespread necrotizing vasculitis in an HIV-positive patient with varicella zoster virus encephalomyelitis. *J Neurol Sci*. 1998 Aug 14;159(2):213-8.
- Kim SH, Choi SM, Kim BC, Choi KH, Nam TS, Kim JT, Lee SH, Park MS, Kim SJ. Risk Factors for Aseptic Meningitis in Herpes Zoster Patients. *Ann Dermatol*. 2017 Jun;29(3):283-287.
- Hung CH, Chang KH, Kuo HC, Huang CC, Liao MF, Tsai YT, Ro LS. Features of varicella zoster virus myelitis and dependence on immune status. *J Neurol Sci*. 2012 Jul 15;318(1-2):19-24.
- Kedar S, Jayagopal LN, Berger JR. Neurological and Ophthalmological Manifestations of Varicella Zoster Virus. *J Neuroophthalmol*. 2019 Jun;39(2):220-231.
- Noaillon M, Breining A, Greffard S, Sagot C, Verny M. Post-Herpes zoster myelitis in a very old patient: A complication not to be missed. *Geriatr Gerontol Int*. 2016 Jan;16(1):145-6.
- Garispe A, Naji H, Dong F, Arabian S, Neeki M. Froin's Syndrome Secondary to Traumatic and Infectious Etiology. *Cureus*. 2019 Dec 6;11(12):e6313.
- Greenfield JG. Original Papers: ON FROIN'S SYNDROME, AND ITS RELATION TO ALLIED CONDITIONS IN THE CEREBROSPINAL FLUID. *J Neurol Psychopathol*. 1921 Aug;2(6):105-41.
- Kennedy PG. Issues in the Treatment of Neurological Conditions Caused by Reactivation of Varicella Zoster Virus (VZV). *Neurotherapeutics*. 2016 Jul;13(3):509-13.
- Abbas SA, El Helou J, Chalah MA, Hilal H, Saliba G, Abboud H, et al. Longitudinal Extensive Transverse Myelitis in an Immunocompetent Older Individual-A Rare Complication of Varicella-Zoster Virus Reactivation. *Medicina (Kaunas)*. 2019 May 23;55(5):201.

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Severe Esophagitis and Chemical Pneumonitis as a Consequence of Dilute Benzalkonium Chloride Ingestion: A Case Report

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Abstract

Background: Benzalkonium chloride (BAC) has been used as an active ingredient in a wide variety of compounds such as surface disinfectants, floor cleaners, pharmaceutical products and sanitizers. Solutions containing <10% concentration of BACs typically do not cause serious injury. As the available data regarding acute BAC toxicity is limited, we report a case of dilute benzalkonium chloride ingestion resulting in bilateral chemical pneumonitis and significant gastrointestinal injury requiring mechanical ventilatory support. **The Case:** A 42-year-old male presented with chief complaints of nausea, vomiting and excessive amount of blood-mixed oral secretions after accidental ingestion of approximately 100ml of BAC solution (<10%). Later he developed respiratory distress with falling oxygen saturation for which he was intubated and mechanical ventilatory support was administered. Computed tomography (CT) chest was suggestive of bilateral chemical pneumonitis and upper gastrointestinal (GI) endoscopy revealed diffuse esophageal ulcerations. The patient was managed with intravenous fluids, corticosteroids, proton pump inhibitor, empiric antibiotics and total parenteral nutrition. **Conclusion:** The present case report emphasizes that dilute BAC compounds can cause severe respiratory and gastrointestinal injuries. Immediate and aggressive medical treatment is crucial for improving patient outcomes and reducing the complication rates.

Key Words: Ammonium Chloride; Benzalkonium Chloride; Esophagitis; Quaternary Ammonium Compounds; Chemical Pneumonitis; Esophageal Ulceration (Source: MeSH-NLM).

Introduction

Benzalkonium chlorides (BACs), reported for the first time in 1935 by Gerhard Domagk, are a class of quaternary ammonium compounds (QACs).¹ Also known as alkyl dimethyl benzyl ammonium chlorides, alkyl dimethyl (phenylmethyl) quaternary ammonium chlorides, ammonium alkyl dimethyl (phenylmethyl) chlorides, or ammonium alkyl dimethyl benzyl chlorides, they are widely used as a mixture of compounds with different alkyl chain lengths in the formulation of disinfectants and bactericidal sanitizers.² Although BACs have been in clinical use for a long period of time, their toxicity is not well established.³ The toxic effects, which can sometimes be fatal, depend on the dose and the route of administration.⁴ Commercially BAC compounds are available in different concentrations depending upon the purpose. Ingestion of BAC can cause local corrosive and systemic effects. Corrosive effects are likely caused by the dissociation of cellular membrane lipid bilayers, leading to cell death from loss of membrane integrity.⁵

Caustic injuries can be categorized as alkaline or acid caustic injuries, however the risk of injury is dependent on the concentration of the solution rather than pH. While lower concentrations (<10%) are not considered to cause significant injury, concentrated solutions (>10%) are known to cause severe upper gastrointestinal and respiratory tract injury.^{6,7}

Highlights:

- Solutions containing <10% concentration of Benzalkonium Chloride (BAC) are generally considered to be of lower risk.
- In this case report, we describe that dilute BAC compounds can potentially lead to serious gastrointestinal and respiratory injury.
- The modality of treatment vary from supportive therapy to emergency surgical intervention.

We describe a case in which ingestion of a relatively dilute solution of BAC resulted in considerable injury to the upper gastrointestinal tract and bilateral chemical pneumonitis requiring mechanical ventilatory support. As the available data regarding BAC ingestion and the resultant toxicity are limited, this case report presents a brief assessment of the clinical management of BAC toxicity and aims to provide a strategy for managing similar situations. Informed consent of publication was obtained from the patient.

The Case

A 42-year-old male presented to emergency department after accidental ingestion of approximately 100ml of BAC solution under inebriated condition two hours ago. The solution consisted of alkyl dimethyl

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benzyl ammonium chloride (<10%) and didecyl dimethyl ammonium chloride (<10%) being used for surface disinfection. Patient complained of nausea, abdominal pain, and hematemesis with copious amount of blood-mixed frothy sputum. He also complained of itching all over the body.

On initial clinical examination, he was found to be conscious and oriented to time, place and person. BP was 140/90mmHg with a pulse rate of 104/min, SpO₂ 97% on room air, and respiratory rate of 16/min. Chest was clear on auscultation with bilateral vesicular breath sounds without any adventitious sound. Cardiac examination demonstrated normal heart sounds, but mild tachycardia. Abdominal examination was notable for mild epigastric tenderness without guarding or rebound. The neurological examination was grossly intact without any focal deficit.

His initial laboratory analysis demonstrated normal hemoglobin (13.7 g/dl) and platelets (1.6 lac/cumm). TLC was 8100/cumm with relative neutrophilic predominance (90.8%). Liver function test, renal function test, serum electrolytes, random blood sugar, arterial blood gas analysis and serum lactate levels were within normal limits. Chest and abdominal X-rays and ECG revealed no abnormality.

Patient was shifted to medical intensive care unit for close monitoring and was managed with intravenous fluids, anti-emetics, dexamethasone and a proton pump inhibitor. However, after an hour of initial stabilization, the patient's condition began to deteriorate with worsening respiratory distress and SpO₂ dipping to 70% (on room air). In view of excessive blood mixed oral secretions and falling oxygen saturation, patient was intubated and mechanical ventilatory support was administered.

Laryngoscopic examination revealed diffuse erythema and sloughing of mucosa in the oropharynx. Laryngeal edema was also evident. CT scan of the chest was done next day which demonstrated bilateral diffuse ground-glass opacities and bilateral pleural effusion with underlying atelectasis on right side as depicted in **Figure 1**. There was no evidence of any honeycombing or emphysema. RT-PCR for COVID-19 was negative.

Upper GI endoscopy was performed which revealed diffuse mucosal sloughing and ulcerations in the esophagus, suggestive of severe esophagitis with mild gastritis as shown in **Figure 2**. The patient was managed with empiric antibiotics, IV steroid therapy, a proton pump inhibitor and parenteral nutrition. During the ICU stay, patient maintained his vitals without any significant derangement of renal and liver functions and his condition improved with the treatment. He was gradually weaned off and extubated successfully on the 8th day of admission. Gradually he resumed oral intake, first with clear liquid and then advanced to a low-fat, low-fiber diet, which was well tolerated. On day 14, the patient was discharged under stable condition. At the one-month follow-up visit, the patient was doing well without any significant gastro-intestinal and respiratory complication, or sequelae.

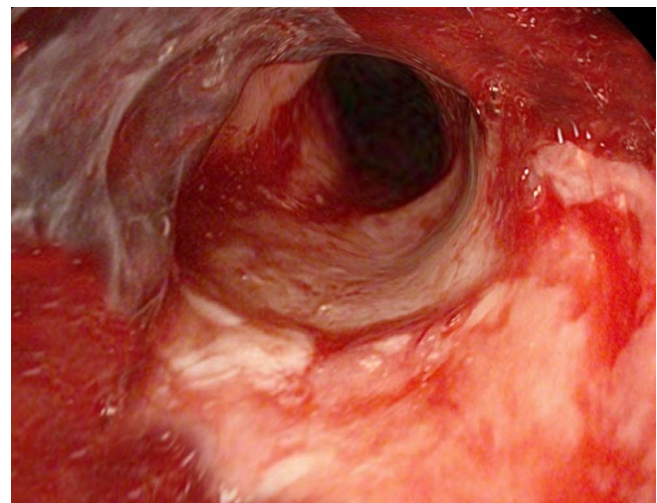
Discussion

Ingestion of both acid and alkali has a wide variety of initial presentations and severities, as well as later complications. The formulation ingested by the patient in the present report contained dual quaternary ammonium compounds i.e., alkyl dimethyl benzyl ammonium chloride (<10%) and didecyl dimethyl ammonium chloride (<10%). BAC is a cationic detergent that is not typically known for having strong corrosive qualities. Lower concentrations of BAC are generally considered to be of lower risk. Severe caustic injury due to BAC appears to be associated with solutions of concentration greater than 10%. In lower concentrations, BAC may produce a hypersensitivity type of reaction, and this has been suggested to be evidence of the irritant properties.⁸

Figure 1. CT Chest Image Showing Bilateral Ground-Glass Opacities



Figure 2. Upper GI Endoscopy Showing Diffuse Esophageal Ulcerations



The effects after ingestion of BAC appear to be due to caustic gastrointestinal tract injury and airway involvement causing tracheo-bronchitis and chemical pneumonitis. Clinical features include nausea, vomiting, dysphagia, dyspnea, corrosive injuries to the gastrointestinal tract, transaminase elevations, metabolic acidosis, renal failure and central nervous system depression. Neuromuscular paralysis can also occur due to cholinesterase inhibition at the neuromuscular junction.⁴ In the present report, the patient had developed nausea, vomiting, esophagitis and chemical pneumonitis after ingestion of BAC. The patient had also consumed alcohol prior to BAC ingestion. Although alcohol can cause erosive esophagitis in the long term, severe ulcerative esophagitis as observed in our patient was less likely to be caused by alcohol. Further, the patient was a chronic alcoholic and his acute condition could not be attributed only to intake of alcohol. Spiller HA (2014) reported a case in which the patient had developed significant gastro-esophageal and tracheo-bronchial injury following ingestion of a BAC solution.⁹ In another case reported by Kulbay H et al (2014), the patient was found to have multiple lesions in the esophagus and stomach caused due to accidental ingestion of a BAC compound.¹⁰ However, in both of these reported cases, the patients had consumed highly concentrated BAC solution (10%) whereas in the present report, the BAC solution was of lower concentration (<10%).

Endoscopy is important for evaluation of the extent and severity of gastrointestinal tract injuries. However there has been controversy regarding the ideal timing to perform it. Some experts recommend urgent endoscopy while others have suggested waiting for some time so as to determine the full extent of injury.^{11,12} There are four endoscopic grades of caustic injury: Grade 1, edema and erythema; Grade 2 (2a linear, 2b circumferential) hemorrhages, erosions, blisters, superficial ulcers, and exudates; Grade 3, multiple deep brownish-black or gray ulcers; Grade 4, perforation.¹¹⁻¹³ In the present case, upper GI endoscopy revealed grade 2 injury in the esophagus with mild gastritis. Other conditions causing esophageal ulcerations include gastroesophageal reflux, infections such as candida species, herpes simplex, cytomegalovirus, drugs such as NSAIDs, bisphosphonates, some antibiotics, alcohol and esophageal carcinoma.^{14,15} However, in the context of history of ingestion of a BAC compound with acute nature of the injuries in the form of diffuse mucosal sloughing and ulcerations with erythema in the esophagus, oropharynx and larynx, other causes seemed to be unlikely.

Chemical pneumonitis, as was present in our patient, can also be seen with BAC ingestion. It can be caused by aspiration of the caustic compound, through necrotic extension from an extensively injured upper gastrointestinal tract, or through involvement of the mediastinum. Pulmonary edema may also accompany chemical pneumonitis. COVID-19 infection can also cause similar lung picture of diffuse ground-glass opacities on CT imaging, but the interpretation of the CT findings has to be combined with the clinical features and in our case, clinical signs and symptoms were not consistent with COVID-19 infection and RT-PCR was negative.

Prognosis depends upon the ingested dose consumed and time to treatment initiation. Treatment depends on the patient's clinical

condition, the severity of toxicity, and the complications. Treatment includes aggressive therapy with stringent monitoring as well as emergency surgical intervention, if required, in the case of complications. The treatment goal is to prevent perforation and stricture formation. The role of corticosteroids has not been well established yet and is controversial. However, there is supportive evidence that corticosteroids can reduce the formation of stricture in grade 2 injuries.¹⁶ Empiric antibiotics were administered to our patient in view of risk of secondary bacterial infection. However, there are no human studies supporting the routine use of antibiotics.

The delayed gastrointestinal complications of caustic ingestions include esophageal stricture and stenosis, antral stenosis, carcinoma of the esophagus and stomach. The rate of stricture formation is dependent on the severity and degree of injury, with around one third of patients with second and third-degree burns developing strictures.¹⁷ Other late complications comprises of tracheal stenosis, tracheo-bronchial fistula and gastro-colic fistulization.

Conclusion

Although generally less frequently encountered, dilute BAC compounds can potentially cause serious injuries to the gastrointestinal and respiratory systems. Treatment strategies should primarily focus on hemodynamic and airway management. Endoscopy should be performed to evaluate the extent of injury. A gastroenterologist and a surgeon should be involved in potentially seriously injured cases. We report here a case of accidental ingestion of dilute BAC solution causing bilateral chemical pneumonitis and gastro-esophageal injury.

References

- Price PB. Benzalkonium chloride (zephiran chloride) as a skin disinfectant. *Arch Surg*. 1950;61(1):23-33.
- Merchel Piovesan Pereira B, Tagkopoulos I. Benzalkonium chlorides: uses, regulatory status, and microbial resistance. *Appl Environ Microbiol*. 2019;85(13):e00377-19.
- Marple B, Roland P, Benninger M. Safety review of benzalkonium chloride used as a preservative in intranasal solutions: an overview of conflicting data and opinions. *Otolaryngol Head Neck Surg*. 2004;130:131-41.
- Hitosugi M, Maruyama K, Takatsu A. A case of fatal benzalkonium chloride poisoning. *Int J Legal Med*. 1998;111(5):265-6.
- Van Berkel M, de Wolff FA. Survival after acute benzalkonium chloride poisoning. *Hum Toxicol*. 1988 Mar;7(2):191-3.
- Tiess D, Nagel KH. Contribution to the morphology and analysis of invert soap poisoning: 2 cases of fatal acute poisoning caused by oral consumption of the disinfectant C4. *Arch Toxikol*. 1967;22(5):333-48.
- Seymour Stanton Block. *Disinfection, Sterilization and Preservation*. 5th ed. Lippincott Williams & Wilkins; 2001.
- Basketter DA, Marriott M, Gilmour NJ, White IR. Strong irritants masquerading as skin allergens: the case of benzalkonium chloride. *Contact Dermatitis*. 2004 Apr;50(4):213-7.
- Spiller HA. A case of fatal ingestion of a 10% benzalkonium chloride solution. *J Forensic Toxicol Pharmacol*. 2014;3(1). DOI:10.4172/2325-9841.1000113.
- Külbay H, Çevik ŞE, Vural Z. A case of accidental benzalkonium chloride (10 %) ingestion. *Turkish Journal of Family Medicine and Primary Care*. 2014;8(4):129-132.
- Havanond C, Havanond P. Initial signs and symptoms as prognostic indicators of severe gastrointestinal tract injury due to corrosive ingestion. *J Emerg Med*. 2007 Nov;33(4):349-53.
- Kikendall JW. Caustic ingestion injuries. *Gastroenterol Clin North Am*. 1991 Dec;20(4):847-57.
- Zargar SA, Kochhar R, Nagi B, Mehta S, Mehta SK. Ingestion of strong corrosive alkalis: spectrum of injury to upper gastrointestinal tract and natural history. *Am J Gastroenterol*. 1992 Mar;87(3):337-41.
- Popa CC, Badiu DC, Andronache LF, Costea RV, Neagu SI, Stoian AP, et al. Differential Diagnosis in Esophageal Cancer. Review on literature. *Rev Chim*. 2019 Jan;70(1):331-5.
- Chiejina M, Samant H. Esophageal Ulcer. In StatPearls. StatPearls Publishing. 2021 Jul.
- Schaffer SB, Hebert AF. Caustic ingestion. *J La State Med Soc*. 2000 Dec;152(12):590-6.
- Gumaste VV, Dave PB. Ingestion of corrosive substances by adults. *Am J Gastroenterol*. 1992 Jan;87(1):1-5.

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COVID-19 Volunteering Experience In Vietnam

Tran Thi Lan,¹ Vo Trong Khanh,¹ Nguyen Tran Minh Duc.^{2,3}

The Experience

Vietnam was assessed as having the pandemic under control nationwide after the first wave of coronavirus disease 2019 (COVID-19). However, on 24/7/2020, the Ministry of Health announced the first community infection case in Da Nang after 99 days with no new cases.¹ Since then the number of new cases has constantly been increasing with dozens of cases per day. The most livable city in Vietnam suddenly became the epicenter of the largest outbreak in the country. Living at the heart of the pandemic, I did not expect my life to be turned upside down again because of this virus.² As a medical student, I wanted to contribute a small part of my own strength to repel this pandemic, so as soon as I saw the announcement of recruiting volunteers to participate in anti-epidemic action for the city,³ I immediately registered to join. Not only me but also many medical students all over the world had spirit to defeat the pandemic whenever it came to their country.⁴

Our family did not know about our participation due to the epidemic's complicated situation, and thus we intended to keep our participation concealed from them. This was a tough decision, however, a week later they found out. Instead of banning me, the family was very supportive, although I know my mom worries about me a lot. Everyone's support is like fuel to our enthusiasm to work against the pandemic. I was sometimes nervous, of course, same as the medical students in Nigeria,⁵ but I tried to put the negative feelings aside and get the task done as a medical student. Before joining, we were trained by the school and equipped with knowledge about the SARS-CoV-2 virus such as taking swab samples, protecting ourselves, and tracing contacts. We were also tested first – if the result was negative, we were ready to fight. (Figure 1)

Figure 1. Training for wearing personal protective equipment.



More than 400 medical student volunteers from first to fifth year are divided into eight groups: seven districts in the city and the Center for Disease Control (CDC). We were then assigned to the Medical Center, Medical Station, to participate in activities locally. The senior students will return to the CDC to participate in data entry and support at the laboratory. As junior students we joined the locally supporting teams. My group consisted of seven members with the initial task of tracing

suspicious infected cases. Our mission included temperature measurement, monitoring the health of a residential area with confirmed cases, data entry, managing information on the NCOVI online system, participating in and supporting nasal swab testing in the community, etc. (Figure 2)

We had to wear personal protective equipment (PPE) to protect ourselves and others. In the first COVID-19 wave of the pandemic, I really admired the health care staff who were wearing the blue protective suits. They were so heroic and admirable, and now this was my turn. It turned out that wearing the PPE was not as great as I thought, as they were scorching and highly inconvenient. This is where I began to truly understand how much commitment and determination the doctors and other health care staff need to treat patients wholeheartedly in the front line.

Our day started at 5:30 am and usually ended at 5 pm, or even until 6 pm. On the first day, it was difficult for us to catch up with the operational flow of the assigned jobs due to learning how to wear PPE and getting to know members of the team. We worked every day, and each day our tasks were different. It only took two days for us to get

Figure 2. Volunteers are doing contact tracing (picture taken through a protective phone cover).



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acquainted with everyone and work at the volunteer site, maybe because everyone was so friendly.

Regarding our team's tracking mission – when we found new cases, we verified the exposure cases with Fo, followed by going to every house, knocking on the door and taking the history from each person. It sounded simple, but with each case, the number of contacts was exceptionally high, so the number of hits could be hundreds to thousands. So going from door-to-door and knocking from house-to-house, was quite tricky. Of importance, a great application was born: – Bluezone. It helps track contacts and warn users if there is close contact with Fo.⁶ When two users of the app pass by within a distance of 2 meters, the app uses a low-energy Bluetooth signal between devices overtime to estimate the proximity and record the contact history between the users. After a user tests positive for COVID-19, the Ministry of Health will use the infected person's Bluezone app ID code to track the infected person's schedule and notify those who have contacted them. Thanks to the application, traceability has been much more manageable.

We are still volunteering locally; the number of new cases is increasing, but fewer than before. The pandemic in the region is basically under control and we are hoping the outbreak will soon be extinguished so that life will return to the same level as before. I miss life before COVID-19 so much! Good luck to over 100 volunteer members of the school in Tien Son COVID hospital; however, we hope that there will be a limited number of new COVID-19 cases and the field hospital being built will not be needed at all and the pandemic will be defeated as soon as possible. (Figure 3)

Figure 3. Always be optimistic because Vietnam will overcome the pandemic.



References

1. Ministry of Health (Vietnam). Thủ tướng: Không để dịch bệnh bùng phát, lan rộng ở Đà Nẵng và các địa phương khác. Available from: https://moh.gov.vn/hoat-dong-cua-lanh-dao-bo/-/asset_publisher/TW6LTp1ZtwaN/content/thu-tuong-khong-e-dich-benh-bung-phat-lan-rong-o-a-nang-va-cac-ia-phuong-khac?inheritRedirect=false/. Date accessed: Aug 12, 2020. In Vietnamese
2. Nguyen Tran Minh D, Pham Huy T, Nguyen Hoang D, Quach Thieu M. COVID-19: Experience from Vietnam Medical Students. *Int J Med Students*. 2020 Jan-Apr;8(1):62-3.
3. Ministry of Health (Vietnam). Bộ Y tế huy động 800 sinh viên Đại học Kỹ thuật Y dược Đà Nẵng và Trường Quân sự Quân khu 5 chống dịch tại Đà Nẵng. Available from: https://moh.gov.vn/tin-lien-quan/-/asset_publisher/vjYyM709aWnX/content/bo-y-te-huy-dong-800-sinh-vien-ai-hoc-ky-thuat-y-duoc-a-nang-va-truong-quan-su-quan-khu-5-chong-dich-tai-a-nang/. Date accessed: Aug 15, 2020. In Vietnamese
4. Botello-Hernández E, García-Espinosa P, Ruiz-Padilla JP, Torres-Hernández G, Fernández-Garza LE. Medical Students' Perception Towards the COVID-19 Pandemic in Mexico: Distance Learning, Assisting Hospitals, and Vaccination. *Int J Med Students*. 2021 Jan-Apr;9(1):33-6.
5. Aderounmu, B., Odedara, A. Clinical Volunteering through the Pandemic: An Experience from Final Year Medical Students in Nigeria. *Int J Med Students*. 2021 Jan-Apr; 9(1):66-7.
6. Ministry of Health (Vietnam). Bluezone - Contact detection, protect yourself, protect the community against COVID-19. Available from: <https://bluezone.gov.vn/>. Date accessed: Aug 20, 2020. In Vietnamese.

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Student Mobility and Research Capacity: A Global Health Experience

Letícia Nunes Campo,¹ Sura Wanessa Santos Rocha.²

The Experience

Introduction

Global health (GH) is a field of study, research, and practice that prioritizes the improvement of health outcomes and the achievement of health equity worldwide.¹ Nevertheless, disparities exist between the Global North and South, a geopolitical and economical conceptualization that respectively stands for high-income countries (HICs), such as from Europe and North America, and low- and middle-income countries (LMICs), such as from South America, Africa, and Asia.¹ Global South countries struggle to train and retain good researchers and practitioners to address local, regional, and GH challenges.² In comparison to other countries, Brazil has sent forth several scientists abroad with no mechanisms to incorporate these research skills upon return, which aggravates the brain drain phenomenon, characterized by researchers' substantial emigration usually to HIC settings.³

Therefore, it is necessary to train a new generation of Global South scientists adequately, aiming to develop these LMICs' research capacity that accounts for research workforce, structures, processes, and procedures.^{2,3} In this regard, international student mobility fosters collaboration among institutions and promotes GH education while building capacity.⁴ Student exchanges help share best practices, which enhances research quality and efficiency.⁴ Consequently, it is vital that exchange opportunities in a Global North-South format contain a framework that ensures bilateral collaboration to promote research balance.

The International Federation of Medical Students' Associations (IFMSA) operates the largest student-run medical exchange program worldwide, providing research exchange programs since 1991.⁵ The program depends on the workflow established by participating IFMSA member organizations that are responsible for defining their requirements and application process. To ensure a high-quality exchange program and endorsement from stakeholders, IFMSA promotes activities and materials focused on educational and academic opportunities.⁵ Hence, this article aims to report my experience in IFMSA research exchange as a Brazilian medical student from the Global South, in Germany, a Global North country.

Experience Report

The 4-week research exchange occurred in February of 2020 at the Medical Faculty of Ruhr Universität Bochum in Bochum, Germany (Figure 1). I worked in the neurophysiology department, associated with the University International Graduation School of Neurosciences, where I assisted with research projects that focused on investigating the mechanisms underlying memory and its dysfunction.

Figure 1. Ruhr Universität Bochum (RUB) campus in Bochum – Germany.



Legend: Authors' own source

All activities were in English and under the supervision of laboratory technicians and students pursuing their Master's and Doctorate degrees. In terms of assessment, my work was detailed in a logbook, shared with supervisors, and regularly discussed for providing feedback and tracking progress concerning my professionalism, collaboration, management, communication, and erudition skills. I was surprised with this rating system since my summative and formative assessments, most as multiple-choice exams, centered on theoretical contents from foundational sciences and organ systems by my medical school.

This exchange program allowed me to improve my skills in microtomy, histopathology, immunohistochemistry, and immunofluorescence. Although I was familiar with the techniques and paraffin wax histological slides due to my experiences in Brazil, the department had stains and cryostats that are financially inaccessible for my original institution. Moreover, I attended two of the department's journal clubs and lectures provided by the graduate school to first-year doctoral students. These educational opportunities enabled me to learn valuable skills including the critical appraisal of journal articles, project management and development, framing a research question, and a deeper understanding of bioethical issues. I also attended an International Neurosciences Conference about extinction learning, which occurred at Ruhr Universität Bochum. This was a topic that I was not acquainted with before my exchange, neither through curricular nor extracurricular activities (Figure 2).

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Figure 2. Exchange student participating in the Extinction Learning conference held in the Ruhr Universität Bochum campus.



Legend: Authors' own source

Participating in this research exchange allowed me to improve my cultural awareness, to become sensitive to the similarities and differences between cultures. Regarding the German scientists, I noticed that they were more willing to adopt an open and cooperative approach to research. Such perceptions may have occurred to me since obtaining resources and infrastructure is laborious in my original institution, generating a certain skepticism on sharing materials and methods with other researchers.

As a result of such a positive experience, back in Brazil, I decided to adopt a collaborative role and share all valuable learning experiences, methods, and protocols that would be useful for my primary group. Consequently, I noticed that the team improved the outputs from

histopathology and immunohistochemistry, techniques, benefiting our lab projects.

Furthermore, the German exchange team organized social programs outside of work in the lab. For example, I have attended parties, museums, expositions, theater, and local festivities. Through these exposures, I got accustomed to the country's history, language, food, and various ways that the German people express their culture. Consequently, the social programs outside the lab made me communicate and interact more effectively with the neurophysiology department peers.

Discussion

International student mobility has been associated with benefits at an individual level by stimulating cultural awareness and catalyzing personal and professional development.⁶ Additionally, exchanges are valuable from a medical student perspective, since it allows the student to experience the reality and challenges of the research settings to improve GH education.^{4,6} Student mobility plays a crucial role in research education since many medical trainees are interested in research while participating in short-term experiences in GH.⁷ In the long-term, exchanges are a cost-effective and sustainable alternative to stimulate and develop health-related research in the Global South, due to soft and scientific skills' development.⁸

During the exchange experience, I learned through being exposed to different environments, people, and scientific methodologies. This resulted in the acquisition and improvement of research-related skills including research design and implementation, ethics, and professionalism. Whereas the language of training can be a barrier to student exchange mobility,⁶ I am proficient in English, the language spoken at Ruhr Universität Bochum. Being fluent in English was crucial to this exchange experience, allowing me to participate in research project discussions, learning opportunities and develop friendships with laboratory staff and other students at the university. Since this article focuses on the experience of a single medical student, further research should investigate the impact of medical student exchange programs on building research skills and capacity on a larger scale.

Conclusion

Taking the reported experience into account, student exchange mobility in a Global North-South format benefits medical trainees by improving research skills. International exchange programs teach skills such as research methodology, ethics, professionalism and promote collaborative environments.

References

- Kim JU, Oleribe O, Njie R, Taylor-Robinson S. A time for new north-south relationships in global health. *Int J Gen Med*. 2017 Nov 7;10:401-8.
- Reidpath DD, Allotey P. The problem of "trickle-down science" from the Global North to the Global South. *BMJ Glob Heal*. 2019 July 24;4(4):2-4.
- Rev Fapesp. O impacto da circulação de cérebros. Available from: <https://revistapesquisa.fapesp.br/2019/09/05/o-impacto-da-circulacao-de-cerebros/>. Last updated September 12, 2019; cited May 3, 2021
- Mews C, Schuster S, Vajda C, Lindtner-Rudolph H, Schmidt LE, Bösner S, et al. Cultural competence and global health: Perspectives for medical education – Position paper of the GMA committee on cultural competence and global health. *GMS J Med Educ*. 2018 Aug 15;35(3):1-17.
- Pierre M, Moreno V, Challita C, Trejo A, Dirul D, Estokova J. Manual Academic Quality in SCORE. 1st ed. Copenhagen: International Federation of Medical Students' Associations (IFMSA); 2020.
- Brown M, Boateng EA, Evans C. Should I stay or should I go? A systematic review of factors that influence healthcare students' decisions around study abroad programmes. *Nurse Educ Today*. 2016 April 28;39:63-71.
- White MT, Satterfield CA, Blackard JT. Essential competencies in global health research for medical trainees: A narrative review. *Med Teach*. 2017 May 14;39(9):945-53.
- Franzen SRP, Chandler C, Lang T. Health research capacity development in low and middle income countries: Reality or rhetoric? A systematic meta-narrative review of the qualitative literature. *BMJ Open*. 2017 Jan 17;7(1).

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Opportunistic Conversations about Eating Disorders: An Encounter from my Pediatrics Elective

Brishti Debnath¹

The Encounter

My final year elective was starkly different from the one I had envisioned in my earlier years of medical school. Due to the ongoing global pandemic, my university advised against international travel for our elective. As the option to arrange one domestically was still permitted, I was very pleased when I managed secure it in the specialty of paediatrics, an area I wish to pursue for my future career as a qualified doctor. There were many thought-provoking encounters to be had during my time in the paediatrics department. An experience that has stayed with me is the one I am about to write about.

A GP had referred a 17-year-old girl with a family history positive for ulcerative colitis, who was rapidly losing weight. She had a negative faecal calprotectin, coeliac screen and all other blood results were normal. When she entered the room with her mother, I was struck first by how many layers and layers of clothing the patient was wearing despite the summer heat. When she spoke, she conveyed concerns about ongoing weakness and feeling faint. Food, her weight and body image were topics that brought her to silence. It rapidly became clear that this patient required more than a 10-minute consultation, as she was at the early stages of an eating disorder.

I was sat in with a consultant paediatrician, who, despite being time pressured with other patients to see that morning, conducted this appointment with both the patient and her mother for almost an hour. During the interaction, I was struck by how well-spoken, sharp-minded, direct and very much in control the patient projected herself to be. However, I was reminded that despite falling into the category of being one of the older patients met in this particular specialty, she was nonetheless still a child vulnerable to poor consequences without the additional input of those in a position of responsibility.

When pushed, she revealed that she was no longer having her periods. She was constantly cold, occasionally dizzy and eating food had become a chore for her. These were all red flags. "What is the future that you want to experience? Your feelings about food, is that feeling something you desire to keep with you for your future?" I could hear with the words

and tone that the consultant was employing - putting in the essential groundwork for a subsequent follow-up in the Children's Eating Disorder clinic as an outpatient - that she wanted it to hit home that things did not have to continue as they were for this young girl. But there was much more complexity underlying this patient's presentation than could be addressed in this one consultation. These included an experience of assault, previous psychiatry input during her childhood and a lot of competition within her current friendship group at school. The social isolation resulting from repeated lockdowns during this pandemic had also affected the relationship between both mum and daughter. I could see that she was struggling to appreciate how truly unwell she was.

When the doctor communicated her concerns about the patient's food intake and weight, I could see the gravity of the situation dawning on both mum and patient. Because she was at a stage of the illness where she could still see the broader picture when prompted to, she admitted that she needed help and wanted to get better. I felt overcome with emotion watching her cry with her mum as they both recognised that the battle had only begun. From witnessing these events, I considered how many young people encountered in the early stages of an eating disorder could potentially be prevented from further deterioration with these admittedly difficult but early conversations.

That had perhaps been the hope of the GP who had referred them to this general paediatrics clinic rather than straight to the Eating Disorder clinic. The term 'eating disorder' had not been broached by the paediatrician until the very end of the consultation and I could sense that this was deliberately timed so as not to lose trust with the patient prematurely. She had described and discussed everything that medically and psychologically we would recognise as features of eating disorders. But she knew that she could do so without alienating this girl with a label. Instead, she guided this patient into seeing for herself that something was not quite right with her relationship with food.

This encounter helped me appreciate how complex the nature of eating disorders can be. Because of the illness, there was a mismatch in this patient's sense of her own

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wellness compared to everyone else's. I learned not to underestimate the subconscious power eating disorders can have in continuing to influence children vulnerable to their control. But the timing of this conversation in the trajectory of her illness had made her amenable to wanting to make a change.

Courtesy of my reflections on this case, when permitted in my future practice, I shall attempt to be more opportunistic in having conversations with patients and their families, at

that critically early stage, about the trajectory of their health without prompt intervention. Empowering patients with knowledge, honest conversations and early support can make all the difference to the outcome we see for them. As healthcare providers, it should be our endeavour to make such a difference.

References

1. Hollande F, Satori N. [Eating disorders as a response to a traumatic assault]. *Soins Psychiatr.* Mar-Apr 2019;40(321):27-30
2. Madowitz J, Matheson BE, Liang J. The relationship between eating disorders and sexual trauma. *Eat Weight Disord.* 2015 Sep;20(3):281-93
3. Touyz S, Lacey H, Hay P. Eating disorders in the time of COVID-19 *J Eat Disord.* 2020 Apr 20;8:19.

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Lessons Learnt from Operationalizing an International Collaborative Multi-Centre Study

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The Experience

Clinician scientists are a varied group of healthcare professionals with roles in research and/or teaching alongside their clinic work.¹ They play a key role in implementing research findings into clinical practice. Given their importance, there is growing concern regarding the decline in the number of healthcare professionals seeking to pursue a career as a clinical scientist.² To tackle this issue, several initiatives to promote research activities among medical students have been launched to inspire the next generation of clinician scientists. They have ranged from incorporating publications and presentations into requirements when hiring for new positions³ to the creation of research mentoring schemes.⁴ Since active learning has long been known to be the optimum mechanism through which individuals learn,⁵ students have been enthusiastically encouraged to conduct their own research. Indeed, students have shown they can run national collaborative research studies effectively, with extensive protocols detailing how the studies were conducted.⁶ However, there is a lack of literature on how students can get involved in international research studies. To our knowledge, there is no published literature on students operationalizing an international collaborative multi-center cohort study. This article details the experience of a group of students who participated in leading roles in an international multi-center study run by the Global Health Research Group on Children's Non-Communicable Diseases (Global Children's NCDs) during the COVID-19 pandemic. Many lessons have been learnt from the successful operationalization of this study, which we hope to impart in this article.

Due to a lack of ability to travel or network in-person during the pandemic, to conduct this study effectively we had to mobilize attention and participation through effective use of

online methods. We created a WhatsApp group for each operational team and its respective members. This allowed us to communicate the team goals and offer guidance and motivation. As operational team leaders, this method proved effective, as it allowed us to systematically organize and delegate tasks to group members. While an application tool such as Slack may have allowed for more streamlined communication, the use of WhatsApp reduced any barriers to inclusion for a global team. All members were familiar with WhatsApp; the same was not true for Slack. Creating an inclusive environment was felt to be imperative for the success of a global collaboration, and WhatsApp was pivotal to this. Additionally, having an instant messaging platform as our communication tool enabled us to solve problems and provide constructive feedback to team members in a timely fashion throughout the duration of the study. Social media was also found to be the optimal method for recruiting global collaborators in the circumstances of the pandemic. This involved creating a public-facing image and communicating ideas from our protocol using graphics. We designed graphics to promote the objectives of the study and raise awareness about the importance of pediatric cancer research. Our graphics proved incredibly successful in generating interest, with Twitter analytics revealing they had yielded 43,500 impressions and prompted 4,679 visits. Developing our graphic design skills was not only beneficial for the current project, but will likely become increasingly important in our globalized world as we become progressively reliant on using online platforms to communicate ideas and generate interest. Studies have already highlighted how important Twitter is in generating interest for academic articles,⁷ and the effect of social media in generating interest can be enhanced with the use of graphics, such as visual abstracts.

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Once the collaborative network had been created, it was essential for us to maintain it and provide direction to over 1,000 interested researchers spread across 100 different countries. As a first step, we decided to designate one individual in each research center as the local study coordinator. Our next step involved connecting other collaborators with their respective local study coordinator. To ensure an effective workflow, a collaborator network database was created and organized by continent, country, and hospital. This structure also allowed for identification of regions where we had yet to generate interest, and therefore facilitated a targeted recruitment drive that aimed to maximize the number of countries captured within our collaborative network. Given the high volume of recruitment, multiple medical students needed to be involved in this part of the operational team to maintain the workflow. This posed an internal communication challenge to ensure that all members of the team were aware of the latest developments, and how to address and answer any questions or concerns. We employed two tools that were indispensable in meeting this challenge. First, a regularly updated online guide which contained algorithms for addressing common scenarios. Second, a series of template emails which could be edited to quickly address common scenarios in a standardized format. Whenever a new issue arose, it was escalated to a senior member of the team. Once we had a solution, the guide and template emails were updated to reflect this, and the solution was integrated into these to ensure the process was streamlined. Developing a team of medical students proficient in multiple languages also aided in the translation of documents and communication with collaborators who did not speak English.

We also recognized that several of our collaborators had never navigated the process of gaining ethical approval

locally. As such we set up a research support team. Our aim here was to ensure that collaborators felt supported in their efforts to gain the necessary approvals to participate at their institution as per their local ethical regulations. The novelty of our research support team was that it was composed of medical students, albeit supported by academics and clinicians. Previous research has highlighted that near-peer teaching benefits students by increases understanding as well as by fostering more comfortable learning and interpersonal connection.^{8,9} In conducting this approach, we hoped collaborators would develop transferable skills and the confidence to use what they gained from this study in their own future work. The skillset and awareness developed from this experience will allow us to feel more comfortable in leading our own studies in the future and supporting future generations of medical students.

In summary, being involved in running an international, multi-center cohort study provided an invaluable learning opportunity. Developing our ability to communicate scientific knowledge and the importance of a study through online channels will be useful in our future academic careers. Similarly, logistical management is important in any large-scale study, and developing an awareness of how to do this effectively at an early stage is valuable. The decline in interest in clinical academics is an international problem and there is a need for international mentorship to address this problem. Students can define the future of global research. Thus, it is imperative that they have the opportunity to develop skills at an early stage and learn from their mistakes. We actively encourage senior academics and policymakers to recognize the value of having medical students involved in leading international studies in order to facilitate the development of future clinician scientists.

References

1. BMA's Medical Academic Staff Committee (MASC). The Role of the Clinical Academic. British Medical Association. April 2014.
2. Meador KJ. Decline of clinical research in academic medical centers. *Neurology*. 2015 Sep 8; 85 (13): 1171-1176.
3. Borrelli MR, Farwana R, Gundogan B, Al Omran Y, Pidgeon TE, Agha R. How to apply for the academic foundation programme. *Ann Med Surg (Lond)*. 2018 Feb 2;29:5-9.
4. Gandhi SM, Ravi K, Jalloh-PA-R F, Peter N, Lakhoo. Building sustainable and consequential research capacity within a global alliance of paediatric surgical centres. *Pediatr Surg Int*. 2021 May 37, 677-678.
5. Deslauriers L, McCarty LS, Miller K, Callaghan K, Kestin G. Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*. 2019 Sep 116 (39): 19251-19257.
6. InciSioN UK Collaborative. Global health education in medical schools (GHEMS): a national, collaborative study of medical curricula. *BMC Med Educ*. 2020 Oct 20, 389.
7. Oska S, Lerma E, Topf J. A Picture Is Worth a Thousand Views: A Triple Crossover Trial of Visual Abstracts to Examine Their Impact on Research Dissemination. *J Med Internet Res*. 2020 Dec 4;22(12):e22327.
8. Burgess A, McGregor D, Mellis C. Medical students as peer tutors: a systematic review. *BMC Med Educ*. 2014 Jun 9;14:115.
9. Yu TC, Wilson NC, Singh PP, Lemanu DP, Hawken SJ, Hill AG. Medical students-as-teachers: a systematic review of peer-assisted teaching during medical school. *Adv Med Educ Pract*. 2011 Jun 23;2:157-72.

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