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2 Classroom

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7 **Discussion Points:**

- 8 • “What helps us medical students learn more?” “What attracts us to surgical theatres?” “Am I the only
9 medical student worried about not having enough time?” “Am I the only one just focused on passing my
10 exams?” This review aims to address these crucial questions that can be incorporated together to better
11 understand medical students and their priorities. Utilizing surgical theatres in our medical education has
12 proved to be pivotal if done correctly. Unsurprisingly, medical education is demanding and without
13 proper learning techniques medical school becomes all the more difficult. Hence, this review compiles
14 all the factors that influence medical students’ learning during surgical theatre sessions. From the
15 literature available, this review addresses the current surgical education practices and how they
16 enhance or inhibit medical students from learning more. This also tries to incorporate the students’,
17 surgical residents’ and surgeons’ opinions on making the most of surgical theatre experiences.
- 18 • #MedicalStudents #SurgicalEducation #SurgicalRotations #MedicalEducation #Learning
19 #MedicalSchoolTips

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1 **ABSTRACT.**

2

3 **Background:** Medical school is an academic institution that trains eligible students for a medical degree (MD).
4 As part of the clinical years in the MD program, students attend surgical theatre sessions to learn medical
5 concepts from hands-on experience in theatre. This review aims to provide a comprehensive overview of the
6 role surgical theatre plays in the learning process and clinical experience of medical students. **Methods:** Google
7 Scholar, PubMed and NCBI databases were searched for articles from 1990 to March 2022 using search terms
8 'Operating Room' or 'Operating Theatre' or 'Surgical Theatre' and 'Learning', 'Medical Students' and
9 'Surgeons'. Only articles on medical students' perception on their learning experience in the surgical theatre
10 were included. **Results:** 33 articles were eligible for inclusion. Unpreparedness, anxiety, lack of clear learning
11 outcomes, fear and intimidation were the commonest reported experiences by students. These demotivate
12 medical students from attending theatre, along with poor surgical field visibility, resulting in a negative learning
13 experience. Positive experiences during theatre time were more likely to attract students to choose a future
14 surgical career. **Conclusion:** Limitations include inclusion of surgical residents' perspectives and exclusion of
15 other surgical team members' perspectives. Studies included students across different clinical years and results
16 were mostly based on subjective perceptions. Evidently, the surgical theatre is a great learning opportunity for
17 medical students. However, for this learning environment to be beneficial, students need to be included during
18 surgical discussions and procedures. Additionally, clear learning outcomes need to be present, whilst adequately
19 training students prior to their first surgical attendance.

20 **Key Words:** *Medical Education, Medical Students, Learning, Operating Room, Education* (Source: MeSH-
21 NLM).

22

1 INTRODUCTION.

2

3 A medical school is an academic institution providing a complete teaching course to all eligible applicants
4 leading to a medical degree (MD). Such, MD graduates can then move on to practice as physicians. This
5 medical program is a four-to-five-year long journey, depending on the country.^{1,2} Mainly, the program is sub-
6 divided into pre-clinical and clinical years of study whereby, the first phase includes two years of scientific
7 teaching namely, physiology, pathology, anatomy among others. The second phase includes two-to-three years
8 of clinical studies with clinical rotations, clinical examinations, and history-taking tutorials among others. The
9 curriculum may vary between medical schools but commonly, surgical attachments include medical students
10 shadowing their assigned surgeon during surgical procedures in theatre.²

11

12 A medical student's perspective and clinical experience of medical school changes once one steps into the
13 surgical theatre for the first time. The monitors' sounds, the nurses all neatly walking past each other and the
14 "smell of burning flesh" heighten the senses, making the surgical theatre an unforgettable experience.³⁻⁵ As a
15 result, the surgical theatre has become a significant teaching tool among medical students whereby, surgical
16 conditions and procedures are discussed, observed and if possible, participated upon. Thus, the surgical theatre
17 environment can enhance medical student pro-activity for their own learning and knowledge retention. Given
18 the aforementioned stimuli, it targets all forms of senses, enabling all students with different learning styles
19 (visual, auditory, sensory) to find the surgical theatre fruitful.⁵

20

21 Medical education, as defined by the General Medical Council (GMC), is there to certify graduates who are able
22 to make effective decisions and function properly in their first year as a physician.⁶ Despite such regulations,
23 studies show 26.4% of medical students do not believe they will be taught suturing skills by the end of their
24 medical education.^{7,8} The surgical theatre has unfortunately been perceived as a poor "teacher" because first
25 year doctors do not perform surgical procedures alone. As a result, medical students find this teaching irrelevant
26 to their near future job.^{9,10} Conversely, generic clinical skills are a recommended priority and is a focus point for
27 medical students.^{7,9,11}

28

29 This literature review aims to provide a comprehensive overview of the role the surgical theatre plays as part of
30 the learning environment for medical students and its importance in shaping them into future physicians. The
31 objective is to identify what factors facilitate and inhibit the ability for medical students to be taught during a
32 surgical theatre session, what opportunities may arise during such sessions while identifying ways to improve
33 medical students' experience in a surgical theatre.

34

1 **METHODS**

2

3 A critical narrative analysis was followed by undergoing systematic identification of the articles related to surgical
4 theatre learning by medical students and teaching by surgeons, while identifying factors that may facilitate or
5 hinder this interaction.

6

7 As shown in figure 1, literature searches were performed through Google Scholar, PubMed and NCBI
8 databases. The keywords and terms used included 'Operating Room' or 'Operating Theatre' or 'Surgical
9 Theatre' and 'Learning' and 'Medical Students'. The latter term was switched to 'Surgeons' to assess the
10 surgeons' perspective of medical students learning in the surgical theatre. The 'Career Choice' term was used
11 to assess the effect of the theatre learning experience on medical students when choosing a specialty. The
12 'Recommendations' term was used to analyze any tips other medical students or surgeons gave to facilitate
13 learning in the surgical theatre.

14

15 Inclusion criteria included research papers originating from any study design published between 1990 and
16 March 2022. The only exception was an early study done in 1908, that paved the way to later studies that
17 confirmed the main results of the study in 1908. Opinion articles written from other HCW perspectives and
18 articles targeting other health care student perspectives were excluded. Furthermore, published abstracts
19 without access to the full text were also excluded. After careful selection depending on the aforementioned
20 inclusion and exclusion criteria, 33 articles were included.

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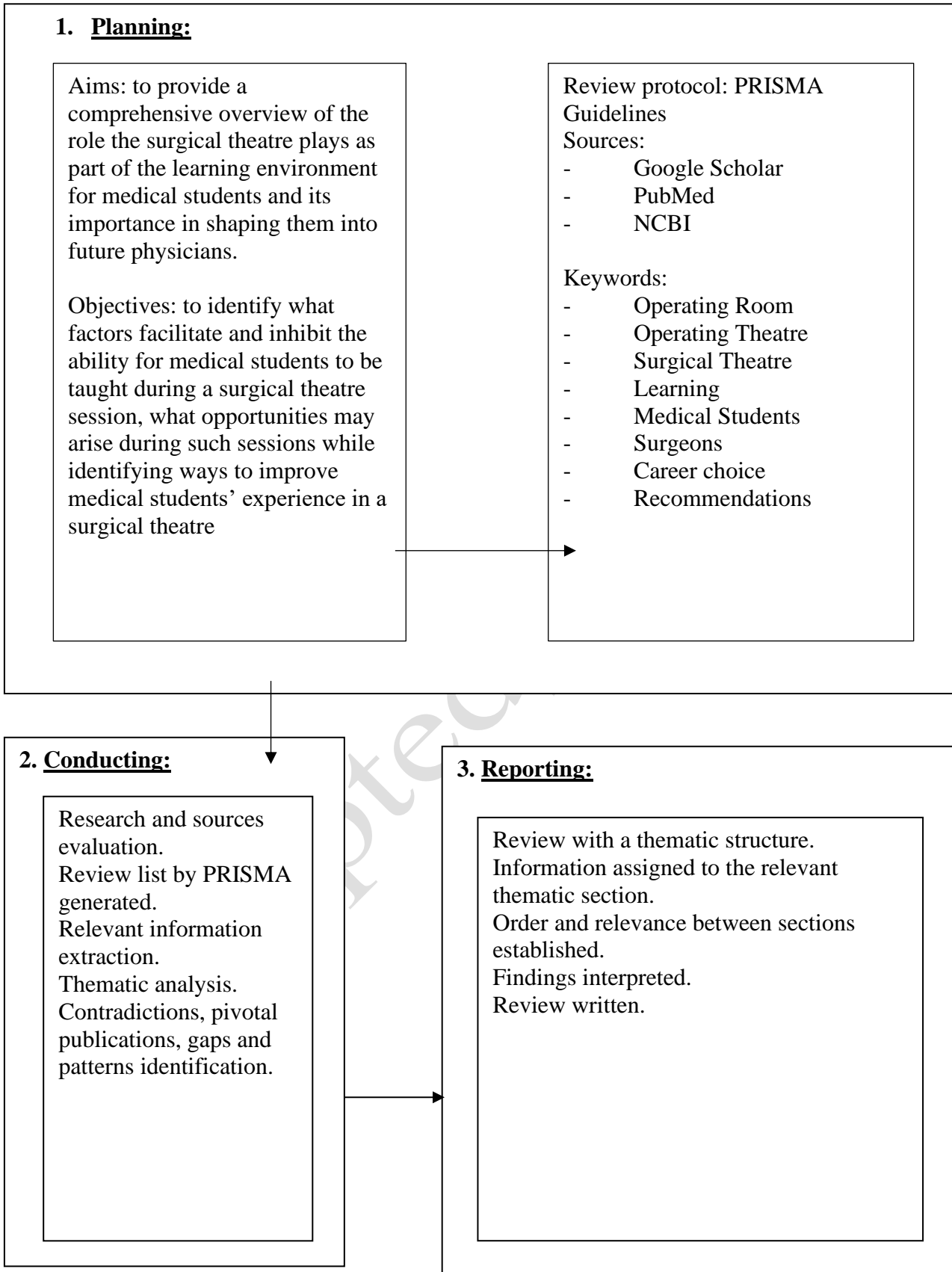
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1 **Figure1. The Study Description**



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1 **RESULTS.**

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3 Thirty-three papers were included and under-went full text analysis and thematic review. Table 1 illustrates the
4 themes identified in the articles used.

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Table 1: The Primary Sources

The thirty-three sources utilized to extract information for the literature review.

Author	Year	Country	Themes Identified
Yerkes RM. <i>et al</i> ⁹	1908	USA	Students report fear of contaminating sterile equipment especially those unfamiliar to theatre etiquette.
Lewis L. <i>et al</i> ⁶	2000	USA	Recorded surgeries incorporated in tutorials or lecture may aid learning.
Taylor I. ¹¹	2003	UK	Medical students focus on generic clinical skills. Active participation aids visibility during theatre hence, is to be discussed by the surgeon and students. Topics taught by other staff members will depend on their specialty; this aids students' learning.
Lyon PM. <i>et al</i> ¹⁶	2003	Australia	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members.
Lyon PM. ¹⁸	2003	Australia	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members. Medical students commonly feel unwelcome in theatre. Clear learning objectives are commonly absent. Shifting positions and eating before theatre are preventive of syncope.
Stark P. ³⁵	2003	UK	Longer procedures negatively correlate with medical student attendance.
Schwind CJ. <i>et al</i> ²⁷	2004	USA	A positive learning experience is enhanced if the surgeon acts as a positive role model and the staff supportive in teaching medical students.
Agha RA. <i>et al</i> ⁹	2005	UK	The surgical theatre is perceived by students as a poor "teacher" in their medical education. Medical students focus on generic clinical skills.
Fernando N. <i>et al</i> ²²	2007	UK	Surgeons' and students' opinions of their learning objectives and the level of student participation in theatre are differs. "Friendliness and approachability" were ranked vital towards a positive learning experience whilst, most students report feeling burdensome in theatre.
Fernando N. <i>et al</i> ²⁴	2007	UK	Consultants are unsure of the learning objectives to be covered during theatre. A minority of students describe a positive theatre experience. Unable to visualize the procedure negatively impacted students' learning.

Lupien SJ. <i>et al</i> ^{β4}	2007	Canada	Anxiety negatively impacts students' performance and learning.
McIntyre TP. <i>et al</i> ^{β7}	2008	USA	Teleconferencing guarantees visibility and students' learning without disturbing the surgeon's work.
Karle H. ¹	2010	Denmark	Medical degree (MD) program organization.
Wilhelmsson B. ⁴	2012	Sweden	Outdoor environment reinforces learning.
Knight WR. <i>et al</i> ¹⁷	2013	UK	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members. Feeling unsafe or awkward prohibits learning. Students cautiously reflect on how worthwhile it is to attend long periods of surgery in comparison to other methods of learning.
Ravindra P. <i>et al</i> ^{β6}	2013	UK	Students taught by theatre staff found the surgical theatre more beneficial. Teaching should be delegated among all team members. Surgical theatre attendance was reported as poor and mainly hindered by absent learning objectives, absent participation opportunities, insufficient preparation during procedures and feeling unwelcome. Longer procedures negatively correlate with medical student attendance.
Chapman SJ. <i>et al</i> ³¹	2013	UK	Students report feeling insecure about their behavior in theatre. Most students report feeling burdensome on theatre staff.
Nagji A. <i>et al</i> ^{β3}	2013	Canada	Students report feeling insecure about their behavior in theatre. An optional theatre module can positively impact students' learning experience and personal development.
Bowrey DJ. <i>et al</i> ^{β8}	2014	UK	Anxiety, fear and shame are commonly felt by students in theatre mainly due to concerns of violating theatre protocols or fear of syncope. Students who felt welcome in theatre were more likely to attend and learn.
Stone JP. <i>et al</i> ^{β0}	2015	Canada	Students report fear of seeming incompetent.
Zundel S. <i>et al</i> ^{β2}	2015	Germany	Students report feeling insecure about their behavior in theatre. Knowing patients prior to surgery can positively impact learning.

Hartmann EK. ³	2016	Australia	Student's perspective of the first surgical theatre experience. Australian universities introduced a "surgical skills" module to prepare students prior to surgery.
Gaines S. <i>et al</i> ³	2017	USA	Sterility protocols.
Barnum TJ. <i>et al</i> ⁰	2017	USA	A Chicago university organizes orientation days to prepare students prior to theatre. The surgeon should remain updated with academic curricula. The surgeon introducing the students to the staff, aids their multi-disciplinary learning.
O'Neill R. <i>et al</i> ¹	2018	USA	Surgeons' and students' opinions of their learning objectives in theatre are differs. A significant number of surgeons and residents report students' presence in theatre as an asset.
Hexter AT. <i>et al</i> ²³	2018	UK	A curriculum ensures adequate preparation of students prior to theatre and discussion of relevant topics by surgeons.
Jensen RD. <i>et al</i> ²⁵	2018	Germany	Students ought to focus more on learning the surgeon's behavioral attitudes rather than surgical technique.
Croghan SM. <i>et al</i> ⁶	2019	UK	Students' surgical theatre experience; lack of clear learning objectives, fear, anxiety, humiliation, intimidation, lack of participation and visibility hinder their learning experience. The experience is perceived as multi-disciplinary. Burdensome and welcoming environments significantly impact learning. Display units can aid visibility of procedures, enhancing learning. Shorter surgeries may provide more teaching per unit time.
Twigg V. <i>et al</i> ⁸	2020	UK	Medical education is perceived by students as less likely to teach suturing skills.
Kent F. <i>et al</i> ¹⁰	2021	Scotland	The surgical theatre is perceived by students as a poor "teacher" in their medical education. It is perceived as an uncomfortable environment. Feeling unsafe or awkward prohibits learning. Medical students commonly feel unwelcome in theatre. Clear learning objectives are commonly absent.

			Participation aids learning during theatre.
Abdelwahab R. <i>et al</i> ¹⁵	2021	USA	Sterility accommodations for students of various religions to prevent embarrassment due to inadequate preparation.
Hunukumbure AD. <i>et al</i> ¹⁹	2022	UK	Acquiring knowledge on sterility and theatre etiquette, planning ahead via theatre lists prior to theatre, and follow-up after surgery aid students' learning.

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1 DISCUSSION.

3 The Surgical Theatre Experience

4 On visiting the surgical theatre for the first time, most medical students experience anxiety as they find it difficult
5 to fit in the coordinated teamwork set out by the surgical team.³ On stepping in the scrubbing room, a new
6 medical student will face a range of specific sterility protocols and procedures that they may have never
7 encountered before which may be daunting.

9 Sterility is defined as an object free from any micro-organisms.¹² Sterile techniques are there to reduce the rate
10 of surgical site infections (SSIs) and despite some variations among clinical institutions and situations, all try to
11 maintain an aseptic surgical theatre. Such techniques include environmental cleaning, hand hygiene, pre-
12 operative patient skin preparation, surgical gowning and general techniques of maintaining a sterile field.^{13,14}
13 Generally, every person entering the surgical theatre has to change into scrubs, wear hair caps, change shoes
14 and ensure bareness below the elbow among other sterility protocols namely, scrubbing in.^{13,14} Furthermore,
15 accommodations are made for hijab wearers among other religious variations as to maintain sterility without
16 affecting the sterility process.¹⁵

18 Preparing Medical Students for a Better Teaching Experience

19 Medical students have frequently reported that the theatre environment is an uncomfortable place mainly due
20 to aforementioned etiquette and pre-established relationships between the surgical team members.^{10,16-18}
21 Therefore, medical students may feel unsafe or awkward because of the surgical team's attitudes, which might
22 prohibit their learning and surgical interest.^{10,17} In fact, a common theme mentioned by medical students was
23 found to be the feeling of being unwelcome in a theatre.^{10,18}

25 Ensuring a positive learning experience from attending theatre sessions was attempted by many medical
26 schools. Australian universities introduced a module entitled "surgical skills" as part of their pre-clinical programs
27 with the aim to incorporate theatre experience with medical education. The program teaches medical students
28 how to scrub for a surgical operation whilst it also teaches students the theatre team's various roles. This
29 ensures that medical students acquire knowledge on sterility, scrubbing in and gowning among other theatre
30 etiquette which will enable the students to focus on surgical knowledge acquisition during the actual surgical
31 procedures.^{3,19} Moreover, a Chicago university provides students with orientation days to address topics on
32 theatre etiquette and answers any questions the students may have before attending their first surgery.²⁰
33 Notably, additional accommodations are made for all religious and cultural attitudes to prevent embarrassment
34 or humiliation due to inadequate preparation for the surgical theatre protocols.¹⁵

36 Learning Objectives and Opportunities at the Surgical Theatre

37 Setting clear learning outcomes by medical schools is vital to emphasizing the importance of teaching in the
38 theatre. However, a study conducted by a New Jersey medical school reveals that learning outcomes for the
39 surgeons and medical students differ.²¹ Namely, surgeons intend to discuss clinical application of medical
40 conditions whilst, medical students aim to learn surgical skills.^{21,22} A survey noted that surgeons were more
41 inclined to cover the importance of medical decisions and the understanding of pathology during surgical theatre

1 which contrasted with what medical students inclined to discuss during this period. Yet, surgeons and medical
2 students identified that anatomy teaching is very useful and should be discussed during surgery.²¹ Therefore,
3 the establishment of a clear outline of the learning objectives with an official curriculum by medical schools
4 ensures that important and relevant topics are discussed by the surgical team during theatre. This will also
5 provide a guide for medical students and ensures that they are well prepared before attending a surgical
6 operation.²³ Unfortunately, a survey by Lyon (2003) reports that less than half of the surveyed medical students
7 confirmed the presence of clear learning objectives in their curricula.^{10,18} Interestingly, another study noted that
8 consultants are also unsure of the learning objectives that should be covered during theatre sessions.^{10,24}

9
10 Furthermore, medical students perceive active participation during surgical theatre sessions as an essential
11 part of their learning experience. This was termed as a “hidden curriculum”.¹⁰ In fact, studies suggest that
12 students should focus more on observing the surgeon’s behavioral attitudes when interacting with staff, patients
13 and difficult circumstances as opposed to surgical techniques.²⁵ A survey by Fernando et al. (2007) reveals that
14 medical students’ and surgeons’ opinions of how much participation should be allowed varies.²² Actively
15 participating or “scrubbing in” allows a better view of the operation and better teaching of practical skills namely,
16 suturing.¹¹ Studies recommend the level of participation is to be discussed whilst setting the learning outcomes,
17 between the surgeon and the students. This should also depend on the faculty’s curriculum and the surgical
18 case at hand.¹¹ As a result, it is important for the attending surgeon to remain updated with the academic
19 curricula and choose the right cases for his students both for observation and participation purposes.²⁰

20
21 Other studies propose that students acknowledge the surgical theatre as a holistic learning experience, which
22 will enhance students’ ability to adapt their expectations and their overall satisfaction while attending the surgical
23 theatre.⁵ On busy theatre days, when the surgeon is unable to attend to students, it would aid if the surgeon
24 was to introduce his students to the surgical team. As a result, students would be more confident to maximize
25 their learning by seeking the teaching provided by the other team members. In fact, studies have outlined how
26 a surgeon portrays that when s/he is unable to teach, the students should ask the other team members to teach
27 them during the surgery.²⁰ Moreover, the teaching contributed by the different staff members will depend on
28 their specialty. Therefore, whilst a scrub nurse can teach the students about the surgical instruments and sterility
29 procedures, an anesthetist can teach students about anesthetic choice and intraoperative monitoring.¹¹ As a
30 result, interprofessional learning is enhanced and medical students can appreciate better the multi-disciplinary
31 approach taken towards the patient’s safety and wellbeing.^{11,20} In fact, it was reported that students who were
32 taught by theatre staff found the surgical theatre experience more beneficial.²⁶ The same study suggested that
33 teaching should be the responsibility of the whole surgical team. Proper teaching delegation among staff
34 members can provide the students with a more efficient and consistent learning experience.¹¹

35 36 **Attendance to the Surgical Theatre**

37 Studies have recommended that medical student attendance to surgical theatre ought to be mandatory, yet
38 59% of medical students reported poor attendance, with less than 50% of medical students presented with
39 opportunities to go to the surgical theatre.²⁶ The hindering factors that affect the attendance rate in a surgical
40 theatre were noted to be the lack of clear learning goals, the lack of opportunity for medical students to scrub-
41 in, insufficient participation during procedures and feeling unwelcome in theatre. Interestingly, induction

1 sessions prior to the surgical theatre attachments, had no effect other than adequately preparing medical
2 students for the surgical theatre. Moreover, receiving negative comments from surgeons did not inhibit
3 attendance but nonetheless, effected their learning experience.²⁶

4 5 **What impacts learning in the Surgical Theatre?**

6 Various factors contribute to the effectivity of the surgical theatre as a learning environment. Overall, a positive
7 learning experience is enhanced if the surgeon acts as a positive role model to the students by being friendly,
8 interactive with students and explains the surgical procedure. The rest of the surgical team is recommended to
9 be helpful and supportive in the medical students' learning experience.²⁷

10 11 **Emotions and Feelings**

12 Interviews with clinical medical students by Bowrey and Kidd (2014) revealed that negative feelings around the
13 surgical theatre, namely, anxiety, fear and shame were common.²⁸ These commonly originate from students'
14 concerns of violating theatre protocols and fear of syncope.^{3,28} Although shifting positions and eating before
15 theatre prevent episodes of syncope.^{18,28}

16
17 Fear is a strong emotional response to actions that can have a detrimental impact on the patient. In the surgical
18 theatre setting, medical students report fear of contaminating sterile equipment especially those unfamiliar to
19 the theatre etiquette, including where to stand during a procedure and which doors are an entrance or an exit
20 into the surgical theatre.^{5,23,25,29} Some students have also noted the fear of seeming incompetent.³⁰ Insecurity
21 towards the surgical theatre is quite a general emotion, as various studies describe how insecure medical
22 students feel regarding their own behavior in the surgical theatre.^{18,31-33} Similar feelings include embarrassment.
23 Naturally, the aforementioned feelings bring about anxiety which negatively affect the medical students'
24 performance and learning.^{5,28,29,34}

25 26 **Attitudes Towards Medical Students During Theatre**

27 Studies show that students who are made to feel welcome during surgical theatre sessions were more likely to
28 attend theatre, while enhancing their opportunities to learn.^{26,28} Yet, it was noted that only 7% of medical
29 students describe a positive, welcoming experience in theatre.²⁴ Despite such studies not emphasizing the
30 factors that define this welcoming environment, another study reports 74% of medical students rank "friendliness
31 and approachability" as the vital requirements towards a positive theatre-based teaching.²² Medical students
32 reported feeling burdensome on the surgical staff.^{22,31} Notably, this feeling may not be mutual as 55% of
33 surgeons and 66% of residents report medical students' presence as an asset.²¹ Evidently, burdensome and
34 welcoming environments can have a significant impact on learning.⁵

35 36 **Visualization and Time Expenditure**

37 Two important factors medical students value include the visibility of the surgical procedure and the time
38 management surgical theatre demands against other learning modalities. It was noted that approximately 30%
39 of students were unable to visualize "most of the operation" which significantly impacted their learning ability.²⁴
40 Indeed, it was emphasized how helpful display units through a head camera worn by the attending surgeon can
41 be. Visibility is especially a problem in open surgeries since, endoscopic procedures or those who use

1 intraoperative imaging, like orthopedics and vascular surgery, may naturally provide adequate visibility. Despite
2 their aid, such accommodations may be restricted due to costings or surgeon preferences. Nonetheless, good
3 visibility can make the surgical theatre more enjoyable, and students tend to feel more welcome.⁵

4
5 Notably, time management is of utmost importance to medical students. Knight et al. (2003) confirmed that
6 students cautiously reflect on how worthwhile it is to attend hours on end of surgeries against other modalities
7 of learning.¹⁷ Medical students' main objective throughout medical school is to ensure they pass their exams.⁵
8 Therefore, they frequently assess which learning tool is most efficient to reach their goal.^{5,18} In fact, a negative
9 correlation between longer procedures and medical student attendance was established as this was perceived
10 as "absolutely pointless".^{26,35} Croghan et al. (2019) hypothesized that shorter procedures may provide more
11 teaching per unit time since, they are associated with a less stressful environment whereby the student feels
12 more comfortable to learn and the surgeon has plenty of time to teach.⁵

13
14 Alternatively, recorded surgeries incorporated in tutorials or lectures may aid learning.^{5,36} Open communication
15 about whether or not the surgeon will be able to teach anything during surgical theatre time can also help
16 students manage their time effectively.⁵ More novel interventions include teleconferencing for medical students
17 to see a live procedure from the classroom.³⁷ Such modality will guarantee visibility and teaching without
18 disturbing the surgeon's work.³⁷

20 **Recommendations for Better Learning and Teaching**

21 A number of recommendations have been put forward as to how to enhance the medical students learning
22 outcomes during surgical theatre sessions. Medical students recommend planning ahead in accordance to the
23 scheduled theatre lists. Knowing the patients prior to the procedure can positively impact learning.^{19,32} In fact, a
24 medical student's personal reflection described not having enough time to prepare before theatre and finding
25 the whole theatre experience "demoralizing." He narrates that not knowing answers to questions left him feeling
26 "stupid" resulting in an overall negative learning experience.¹⁹ Furthermore, following the whole patient journey
27 from pre-operative assessment to the actual procedure and follow-up later on, enhances the understanding and
28 learning process for that particular surgery.¹⁹ Hence, preparation is pivotal in the medical students' learning
29 experience. An optional theatre module will enhance the understandability as well as the enjoyability of the
30 surgical experience as students will be able to engage during the sessions while enriching their learning. This
31 also aids in the students' personal growth.³³

33 **Limitations**

34 Naturally, this review is not short of its own limitations. Firstly, the aim was to identify articles targeting the
35 perception of medical students and surgeons on the surgical theatre as a teaching tool. However, most research
36 available includes medical students' perspectives only. Thus, surgical residents' perspectives were also
37 included. Nonetheless, the surgical theatre is also an effective classroom to other health care students namely,
38 nursing and anesthesia students. However, including such health care professions was beyond the scope of
39 this review. The studies chosen occurred in different countries and included medical students across different
40 clinical years, resulting in restricted generalizability of perceptions. However, similar results were found across
41 different universities and provides a global relevance. Furthermore, most articles use students' perceptions as

1 their measure of the learning experience. Nonetheless, this qualitative factor can deem a poor objective
2 measuring tool but seems a realistic aim of attaining what inhibits and facilitates learning

3

4 **Conclusion**

5 Medical students experience unpreparedness, anxiety, lack of clear learning outcomes as part of their curricula,
6 fear and intimidation when visiting the surgical theatre. However, there are different factors that can motivate
7 and enhance the learning experience of medical students during a surgical operation including increased
8 visibility, inclusion during the procedure, among others. Surgical faculties can utilize the multi-disciplinary set-
9 up and healthcare experience to formulate plans that better accommodate medical students in their path to
10 becoming physicians. Additionally, both the faculty and students need to respect each other's perspective to
11 ensure that a teacher-student relationship is formed. Ultimately, a positive surgical theatre experience is more
12 likely to attract students to choose a surgical career.

13

14 Future research is recommended targeting the different learning and teaching quality among different surgical
15 specialties, while considering the different surgical theatre perspectives shared by both students and
16 professionals with regards to the integration of inter-professional teaching as part of the healthcare students'
17 learning experience.

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1 **SUMMARY - ACCELERATING TRANSLATION**

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3 The study entitled "Walking the Walk: A Review of Medical Students' Perspective of a Surgical Theatre as the
4 New Classroom" was conducted at the University of Malta, Msida, Malta. This was authored by Tamara Attard
5 Mallia and Dr Sarah Cuschieri to address the pivotal role the surgical theater plays in medical and surgical
6 education and the overall clinical experience for medical students. The objective is to identify what factors
7 facilitate and inhibit medical students' learning during a surgical theatre session, what opportunities may arise
8 when attending such sessions whilst identifying ways to improve medical students' experience based on the
9 readily available literature.

10

11 A critical narrative analysis was followed by undergoing systematic identification of the articles related to surgical
12 theatre learning by medical students and teaching by surgeons, while identifying factors that may facilitate or
13 hinder this interaction. Literature searches were performed through Google Scholar, PubMed and NCBI
14 databases. The keywords and terms used included 'Operating Room' or 'Operating Theatre' or 'Surgical
15 Theatre' and 'Learning' and 'Medical Students'. The latter term was switched to 'Surgeons' to assess the
16 surgeons' perspective of medical students learning in the surgical theatre. The 'Career Choice' term was used
17 to assess the effect of the theatre learning experience on medical students when choosing a specialty. The
18 'Recommendations' term was used to analyze any tips other medical students or surgeons gave to facilitate
19 learning in the surgical theatre. Inclusion criteria included research papers originating from any study design
20 published between 1990 and March 2022. The only exception was an early study done in 1908, that paved the
21 way to later studies that confirmed the main results of the study in 1908. Opinion articles written from other
22 HCW perspectives and articles targeting other health care student perspectives were excluded. Furthermore,
23 published abstracts without access to the full text were also excluded. After careful selection depending on the
24 aforementioned inclusion and exclusion criteria, 33 articles were included.

25

26 These articles under-went full text analysis and thematic review to identify the relevant information provided by
27 every article included in the review. Literature reports medical students perceive the theatre as uncomfortable
28 and anxiety-provoking due to surgical etiquette and pre-established relationships between the surgical team
29 members. The poor attendance to theatre reported by several studies was mainly due to lack of clear learning
30 outcomes, opportunities, feeling unwelcome and insufficient preparedness. Medical students experience
31 unpreparedness, anxiety, fear and intimidation when visiting the surgical theatre, all of which inhibit medical
32 education. Factors facilitating learning during surgical theatre sessions include increased visibility, inclusion
33 during the procedure, feeling welcome and previously set learning objectives. A number of recommendations
34 have been put forward as to how to enhance the medical students learning outcomes during surgical theatre
35 sessions. These include planning ahead using theatre lists, assessing the patient pre-operatively and following
36 up post-operatively and sufficient preparation beforehand.

37

38 In conclusion, surgical faculties can utilize the multi-disciplinary set-up and healthcare experience to formulate
39 plans that better accommodate medical students in their path to becoming physicians. Additionally, both the
40 faculty and students need to respect each other's perspective to ensure that a teacher-student relationship is

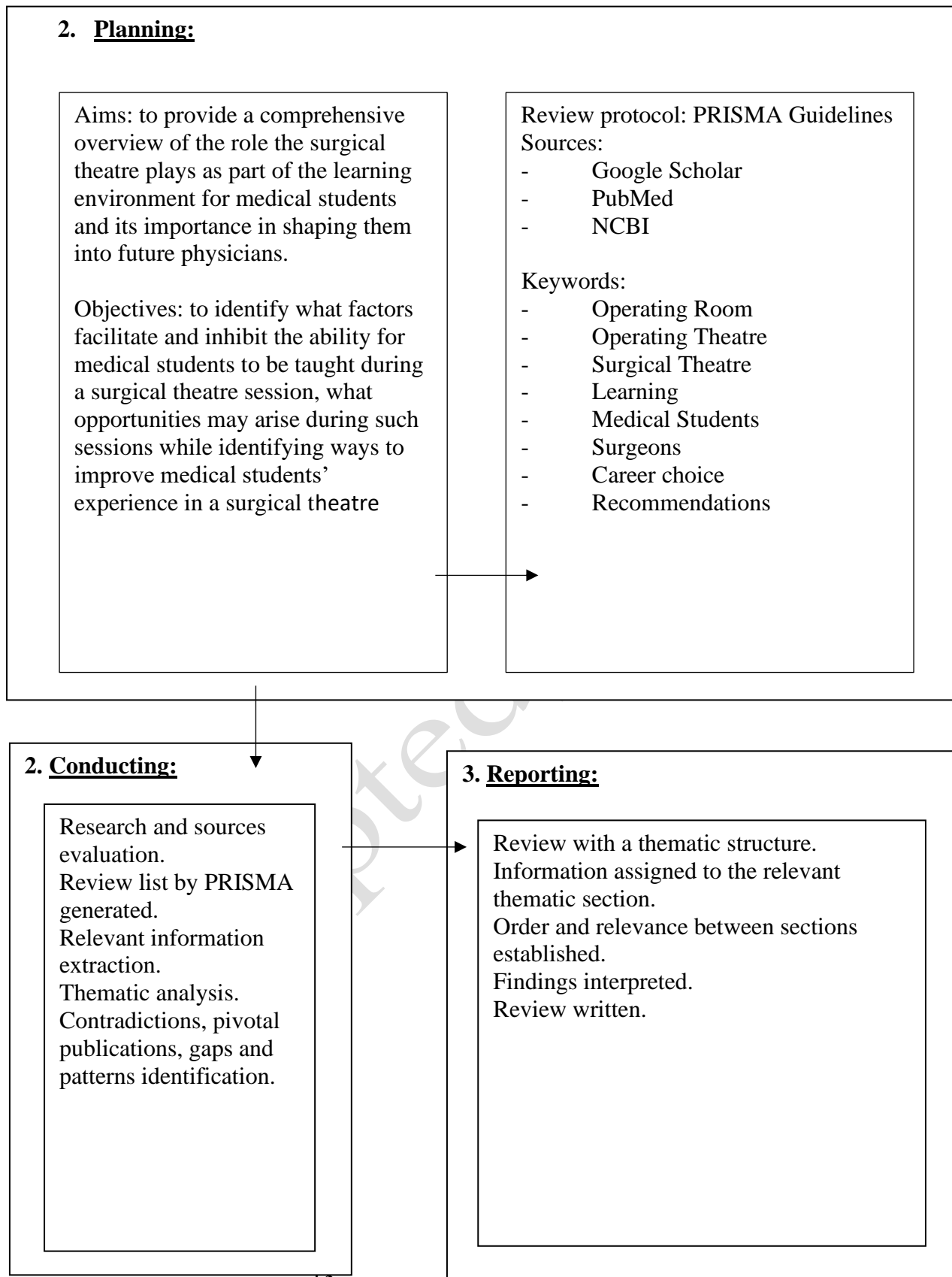
1 formed. Ultimately, a positive surgical theatre experience is more likely to attract students to choose a surgical
2 career.

3 **FIGURES AND TABLES.**

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1 **Figure1.** The Study Description



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1 **Table 1.** The Primary Sources

Author	Year	Country	Themes Identified
Yerkes RM. <i>et al</i> ⁽²⁹⁾	1908	USA	Students report fear of contaminating sterile equipment especially those unfamiliar to theatre etiquette.
Lewis L. <i>et al</i> ⁽³⁶⁾	2000	USA	Recorded surgeries incorporated in tutorials or lecture may aid learning.
Taylor I. ⁽¹¹⁾	2003	UK	Medical students focus on generic clinical skills. Active participation aids visibility during theatre hence, is to be discussed by the surgeon and students. Topics taught by other staff members will depend on their specialty; this aids students' learning.
Lyon PM. <i>et al</i> ⁽¹⁶⁾	2003	Australia	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members.
Lyon PM. ⁽¹⁸⁾	2003	Australia	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members. Medical students commonly feel unwelcome in theatre. Clear learning objectives are commonly absent. Shifting positions and eating before theatre are preventive of syncope.
Stark P. ⁽³⁵⁾	2003	UK	Longer procedures negatively correlate with medical student attendance.
Schwind CJ. <i>et al</i> ⁽²⁷⁾	2004	USA	A positive learning experience is enhanced if the surgeon acts as a positive role model and the staff supportive in teaching medical students.
Agha RA. <i>et al</i> ⁽⁹⁾	2005	UK	The surgical theatre is perceived by students as a poor "teacher" in their medical education. Medical students focus on generic clinical skills.
Fernando N. <i>et al</i> ⁽²²⁾	2007	UK	Surgeons' and students' opinions of their learning objectives and the level of student participation in theatre are differs. "Friendliness and approachability" were ranked vital towards a positive learning experience whilst, most students report feeling burdensome in theatre.
Fernando N. <i>et al</i> ⁽²⁴⁾	2007	UK	Consultants are unsure of the learning objectives to be covered during theatre. A minority of students describe a positive theatre experience. Unable to visualize the procedure negatively impacted students' learning.

Lupien SJ. <i>et al</i> ⁽³⁴⁾	2007	Canada	Anxiety negatively impacts students' performance and learning.
McIntyre TP. <i>et al</i> ⁽³⁷⁾	2008	USA	Teleconferencing guarantees visibility and students' learning without disturbing the surgeon's work.
Karle H. ⁽¹⁾	2010	Denmark	Medical degree (MD) program organization.
Wilhelmsson B. ⁽⁴⁾	2012	Sweden	Outdoor environment reinforces learning.
Knight WR. <i>et al</i> ⁽¹⁷⁾	2013	UK	Surgical theatre is perceived as uncomfortable due to pre-established relationships between team members. Feeling unsafe or awkward prohibits learning. Students cautiously reflect on how worthwhile it is to attend long periods of surgery in comparison to other methods of learning.
Ravindra P. <i>et al</i> ⁽²⁶⁾	2013	UK	Students taught by theatre staff found the surgical theatre more beneficial. Teaching should be delegated among all team members. Surgical theatre attendance was reported as poor and mainly hindered by absent learning objectives, absent participation opportunities, insufficient preparation during procedures and feeling unwelcome. Longer procedures negatively correlate with medical student attendance.
Chapman SJ. <i>et al</i> ⁽³¹⁾	2013	UK	Students report feeling insecure about their behavior in theatre. Most students report feeling burdensome on theatre staff.
Nagji A. <i>et al</i> ⁽³³⁾	2013	Canada	Students report feeling insecure about their behavior in theatre. An optional theatre module can positively impact students' learning experience and personal development.
Bowrey DJ. <i>et al</i> ⁽²⁸⁾	2014	UK	Anxiety, fear and shame are commonly felt by students in theatre mainly due to concerns of violating theatre protocols or fear of syncope. Students who felt welcome in theatre were more likely to attend and learn.
Stone JP. <i>et al</i> ⁽³⁰⁾	2015	Canada	Students report fear of seeming incompetent.
Zundel S. <i>et al</i> ⁽³²⁾	2015	Germany	Students report feeling insecure about their behavior in theatre. Knowing patients prior to surgery can positively impact learning.

Hartmann EK. ⁽³⁾	2016	Australia	Student's perspective of the first surgical theatre experience. Australian universities introduced a "surgical skills" module to prepare students prior to surgery.
Gaines S. <i>et al</i> ⁽¹³⁾	2017	USA	Sterility protocols.
Barnum TJ. <i>et al</i> ⁽²⁰⁾	2017	USA	A Chicago university organizes orientation days to prepare students prior to theatre. The surgeon should remain updated with academic curricula. The surgeon introducing the students to the staff, aids their multi-disciplinary learning.
O'Neill R. <i>et al</i> ⁽²¹⁾	2018	USA	Surgeons' and students' opinions of their learning objectives in theatre are differs. A significant number of surgeons and residents report students' presence in theatre as an asset.
Hexter AT. <i>et al</i> ⁽²³⁾	2018	UK	A curriculum ensures adequate preparation of students prior to theatre and discussion of relevant topics by surgeons.
Jensen RD. <i>et al</i> ⁽²⁵⁾	2018	Germany	Students ought to focus more on learning the surgeon's behavioral attitudes rather than surgical technique.
Croghan SM. <i>et al</i> ⁽⁵⁾	2019	UK	Students' surgical theatre experience; lack of clear learning objectives, fear, anxiety, humiliation, intimidation, lack of participation and visibility hinder their learning experience. The experience is perceived as multi-disciplinary. Burdensome and welcoming environments significantly impact learning. Display units can aid visibility of procedures, enhancing learning. Shorter surgeries may provide more teaching per unit time.
Twig V. <i>et al</i> ⁽⁸⁾	2020	UK	Medical education is perceived by students as less likely to teach suturing skills.
Kent F. <i>et al</i> ⁽¹⁰⁾	2021	Scotland	The surgical theatre is perceived by students as a poor "teacher" in their medical education. It is perceived as an uncomfortable environment. Feeling unsafe or awkward prohibits learning. Medical students commonly feel unwelcome in theatre. Clear learning objectives are commonly absent.

			Participation aids learning during theatre.
Abdelwahab R. <i>et al</i> (15)	2021	USA	Sterility accommodations for students of various religions to prevent embarrassment due to inadequate preparation.
Hunukumbure AD. <i>et al</i> ⁽¹⁹⁾	2022	UK	Acquiring knowledge on sterility and theatre etiquette, planning ahead via theatre lists prior to theatre, and follow-up after surgery aid students' learning.

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