Sudan Journal of Medical Sciences
Volume 18, Issue no. 2, DOI 10.18502/sjms.v18i2.13606
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Review Article

A Review of Medical Microbiology Curriculum Integration in the Integrated Modular System of Education At Medical Schools in Saudi Arabia

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Abstract

Medical or clinical microbiology has its importance in the curriculum of undergraduate degree programs of all medical colleges of the Kingdom of Saudi Arabia. This review describes the preclinical medical microbiology teaching at Prince Sattam bin Abdulaziz University as a hybrid module, it is integrated into blocks or system-based courses. Various teaching and practical approaches were discussed and elaborated. Several challenges and potential suggestions were also emphasized for innovation in an integrated system of teaching.

Keywords: curriculum medical microbiology, integration, teaching

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Received 10 May 2022
Accepted 30 December 2022
Published 30 June 2023

Production and Hosting by Knowledge E

Editor-in-Chief:
Prof. Nazik Elmalaika Obaid Seid Ahmed Husain, MD, M.Sc, MHPE, PhD.

OPEN ACCESS

1. Introduction

Medical or clinical microbiology is one of the essential parts of the medical curriculum in the Kingdom of Saudi Arabia like other nations [1, 2]. Undergraduate medical students require an understanding of bacteriology, virology, mycology, and parasitology during basic pre-clinical medical years. It often includes basic concepts such as the use of aseptic techniques, the study of the structure and physiological and molecular characteristics of a major group of medically important microorganisms (e.g., bacteria, virus, fungi, and parasites), pathogenicity and mechanisms of infection, life cycle, the mode of action of antimicrobial agents, the epidemiology and principles of laboratory diagnostic testing, and infection control and preventions.

Modern-day medical practitioners need a robust grassroot-level understanding of medical microbiology. The most commonly observed medical diagnoses in the inpatient and outpatient settings in hospitals are infections [3–5]. Medical practitioners require

general knowledge and practical skills to control the infections caused by pathogens that are multidrug-resistant against potential new antimicrobial agents [6]. Rapid globalization is resulting in local epidemics or pandemics such as Ebola and Chikungunya, SARS, COVID, etc., which necessitates the grooming of medical graduates on the emerging infectious causative organisms such as viruses and others responsible for the pandemics [7–9].

Conventionally, medical students have studied microbes mainly as disease-causing hazardous infectious agents, and very old traditional techniques were used for identifying them. However, the latest molecular diagnostic methods are rapidly becoming a dominant means for organism identification and confirmation [10]. The medical education unit of the medical college has also explored innovative education methodology that focuses on the proactive, self-reliant, or autonomous mode of instruction to teach this rapidly developing region [11–13].

Medical microbiology has gained more importance in medical education due to the emerging widespread infectious diseases growing universally and resulting in considerable human morbidity and fatality. Furthermore, the medical microbiology-oriented questions comprise a significant section for competitive medical licensing examinations for national medical boards such as Saudi Commission for Health Practitioner's Exams as well as the US Medical Licensing Examination (USMLE).

This review is the primary initial review to comprehensively describe preclinical medical student microbiology and parasitology teaching at Prince Sattam bin Abdulaziz University (PSAU), Al-Kharj, Saudi Arabia.

2. Medical Degree Program/Syllabus Format

The medical degree curriculum in the medical school of Prince Sattam bin Abdulaziz University has been organized into three different phases or blocks and each phase includes different modular courses. Formal medical microbiology teaching is included in the second and third years of medical school (Phases I & II).

In both these phases, medical students learn different modules that include basic integrated foundation modules on musculoskeletal and gastrointestinal tract, urinary system, reproductive system, cardiovascular system, endocrine, neuro and special senses, and blood immune system.

The traditional system of medical colleges teaches microbiology and parasitology as separate subjects, however, the new systems have integrated microbiology and parasitology longitudinally or horizontally [14] in the preclinical curriculum. The integration

of microbiology and parasitology is the most noteworthy or fundamental challenge for the majority of medical schools. Although many coordinators notified a productive and successful merger, others stated a broad or common concern that integration or unification has led to a significant reduction in total teaching hours.

Many different schools of thought reported the theoretical merits of curriculum integration [14], however, its benefit for enhancing or supporting medical student learning has been comprehensive [15, 16]. Nevertheless, there is a small scientific data or investigation about the unification of microbiology and parasitology and the basic fundamental sciences into a block or system-based curriculum, which needs further research.

The enhanced cooperation between microbiologists and clinician practitioners could be meant to accomplish an equilibrium between the two disciplines of basic science and clinics. This collaboration has effectively integrated the contents to emend medical student education in such a unified curriculum. It is potentially supported by a discipline coordinator with professionals in microbiology and parasitology along with efficient clinical infectious disease specialists to supervise the relevant subject matter inducted in all blocks.

The medical school has successfully integrated all subject disciplines in each module. The integration of microbiology and pharmacology disciplines has a specific correlation concerning its application. Depending upon the basic subject skeletal of the module, both the subjects were integrated in a manner to have a better understanding for the medical students.

The subject experts covered topics like bacterial growth and modes of action of antimicrobials as interdisciplinary lectures (IDL) together. Similarly, fungal diseases or viral diseases and antifungals or antivirals were covered together and the IDL viz. tuberculosis and antimicrobials or leprosy and its treatment to name a few.

The usage of hybrid-integrated learning as a key or central scheme applied by the medical school in PSAU throughout the curriculum for the integration is a well-thought approach for the benefit of medical students [17].

Finally, to decide which curriculum plan layout is the most efficacious for microbiology and parasitology and other similar science domains, further study of the fieldis needed.

3. The Objective of the Course Study Content

The curriculum's objectives include knowledge, cognitive skills, interpersonal skills and responsibilities, psychomotor and clinical skills, and communication and information techniques.

Every system-based module is organized in a manner to provide the medical students with the basic and applied knowledge, and the laboratory and clinical skills relevant to different subjects at the level of basic science years. Each module has credit hours of microbiology and parasitology education and contextualizes medical microbiology and parasitology within a clinical case scenario.

Each phase has been designed so that the students demonstrate professional behavior and strictly adhere to the principles of biomedical ethics in medical career; respect the principles of group dynamics and function effectively in teams; and communicate effectively with colleagues, patients, and the community using different communication methods.

4. Varied Modes of Teaching

The interactive subject lectures, IDL, small groups for problem-based learning tutorials facilitated by faculty members (PBL), as well as integrated clinical case discussions (ICCD) and team-based seminar learning were used for teaching at the medical school of PSAU. This new learning educational scheme was integrated to increase progressive education through expert support group learning, "flipped classroom," small group schooling, peer-group teaching, clinical case-based processing, and alive or simulated patient case examples. The explanation for the enhanced active study or learning program was to increase the merger or combination of the curriculum, favor more student adaptability, and conform to standard guidelines.

The subject experts delivered the lectures. The concept of an interdisciplinary lecture was designed to merge important topics like the mode of action of antibiotics on the bacterial cell wall, together and to be presented by the experts of subjects of microbiology and pharmacology.

In the problem, the faculty member facilitated learning among students in small groups (8–10) and a case scenario was presented to them. The group selected its group leader and scribed to discuss the clinical case during the first session and extract the main objectives of the case. After approximately a week, the same group would sit again

with the facilitator to debrief the second session and discuss the case. The facilitator observes the team performance evaluation and maintains the discipline of the group.

The ICCD is also conducted in a way similar to PBL, but the only difference is that the clinical case is provided to the group a week before and then discussed in one session only. The facilitator evaluates the group by having a small quiz related to the same scenario and then clarifying their doubts related to the case.

The study guide of every module provides the outline of the topics to be covered in each lecture. The recommended course resource was textbooks and online material.

Laboratory-based methods of instruction are one of the very useful tools used at medical school to assess psychomotor skills. The practicals in the laboratory were designed as per the module requirement, viz. in the foundation module, the exercises related to sterilization and types of culture medium used in microbiology and various tools application. The laboratory practicals were modular based, and similar to the digestive module, more emphasis was given on the organism causing enteric diseases and the life cycle of the different parasites causing the diseases and their identification.

The teaching society would practically conclude that a medico acquires more from a practical or experiment push approach or “hands-on” to relearning rather than from simply hearing lectures [18]. A varied form of diverse approaches or online activities were specially presented to compensate for the practical hands-on during the pandemic. These activities ranged from “demonstration of a technique” by the tutor to small student groups to experiment.

The whole class of the teaching fraternity would agree and reflect that they faced at least some hindrance to presenting practical microbiology or parasitology in the classroom.

5. Evaluation System Methodology

The medical student’s knowledge is commonly evaluated through multiple-choice exams. They are also evaluated based on their involvement and performance in small group discussions and team-based learning exercises. Other methods of assessment include assignments and small projects and quizzes.

6. Acceptance Toward Collaboration

Integration of microbiology and parasitology into organ system modules or blocks was also a big task for the medical education unit of the medical college. The reported reasons for the change in the curriculum planning include enhancing clinical relevance, reducing preclinical timing, and meeting accreditation standards. The theme enclosing the integrated curriculum improvements includes new latest technological education modalities to exploit the maximum clinical applicability or curriculum relevance.

Although it has reduced the total allotted teaching time in microbiology and parasitology, for medicos, the special concentration is the pathogenic aspect of medical microbiology, diagnostics, and prevention. Medical colleges have been dragged toward a more centrally structured or unified curriculum in which microbiology and parasitology are not the particular focus of separate coursework. Burton [19] pointed out that these improved changes have lessened the content of information on pathogenic aspects required by medicos.

7. Recent Innovation Suggestions (New Inventions)

The use of videos and animated pictures and digital demonstrations as an important portion of a flipped lecture room and current online modules are the most frequently described technological innovations. The smart, interactive electronic White Board [20] is one of the more advanced technological inventions that can help medical students.

These boards find their first usage in corporate boardroom services and are staged for teacher training [21]. The electronic whiteboards can function independently as a projector to exhibit visual images or as a touchscreen computer. However, it is common in present modern-day lecture rooms and experimental laboratories at some universities [22] and their usage in academic settings will undoubtedly expand. For medical microbiology education, McCarthy *et al.* [23] described the usage of smart interactive technology to develop “virtual patients.” They pointed out the emergent indication that the integration of this kind of computer technology into microbiology education may improve a lot of education strategies as compared to conventional lecture formulations.

8. Realized Achieved Outcomes

The effective integration of all disciplines in module-based teaching is important. These disciplines include anatomy, histology, physiology, pharmacology, biochemistry immunology, pathology, and microbiology and parasitology. Medical students perceive the course integration success as a tool that helps them to prepare for Saudi Commission for Health Practitioner Exams as well as the US Medical Licensing Examination (USMLE).

9. Objections or Dissent

The main struggle referred to by the correspondent was to successfully incorporate microbiology and parasitology into modules in the preclinical curriculum to keep an equilibrium between basic fundamental sciences and clinical information. The second concern by the correspondent was the time allocation for teaching microbiology and parasitology during the preclinical curriculum has been considerably reduced. The medical student also overwhelmingly reported that there is a shortage of time to effectively learn the course material.

10. Conclusion

It has been identified that microbiology is a predominant course and microbiologists have leadership and teaching roles. The relevant medical microbiology basic science content in the preclinical curriculum helps to develop a foundation for the post-clinical years. This can facilitate the improvement of the medicos understanding of the practice of infectious communicable diseases while concentrating on specific fields or regions such as the mechanism of antimicrobial resistance, sepsis, and immune deficiency that make them susceptible to infection.

An understanding of these topics will support the academician's possibilities to demonstrate the linkage between basic fundamental science, insurance, and clinical medicine especially applicable in the present-day modern age.

The lack of medical microbiology exposure during the undergraduate degree program may probably present a challenge to medico foreign with this integrated theme and perhaps impart to the stressful academic workload for their postgraduate program.

The author also believes that antimicrobial stewardship must be stressed strongly concurrently with the basic fundamental learning of microorganisms and agents rather than waiting till the practitioner's career stages later, taking into consideration the

increase in resistance to antimicrobials and frequency of prescribing antibiotics in almost all medical fields [24]. This knowledge at the preliminary stage will establish stewardship into medico's core understanding of diagnosis and treatment of infections. These incorporated principles will help them in future prescribing medical practices [25].

The majority of the academicians supported communication and enhanced collaboration with other course coordinators to meet these needs. The elaboration of a multidisciplinary organization of preclinical microbiology professionals could enable sharing of teaching materials and group participation in necessary scientific research work [26, 27].

A similar issue of reduced teaching hours of the subject has been elucidated from the study of medical schools from Albaha University, Al-Azhar and Cairo University by Ihab Shafek Atta *et al.* [28].

Finally, the Association of Saudi Medical Colleges should consider establishing a consortium of experts to enable the exchange of best practices and also to establish resources to support innovations and research in the area of medical microbiology.

Acknowledgements

The authors are grateful to the Deanship of Scientific Research, Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia for its support and encouragement in publishing this review.

Competing interests

The authors declare no conflict of interest.

Availability of Data and Material

All data and materials used in this study are available from the corresponding author on reasonable request.

Funding

None.

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