

# Overcoming barriers in the prevention of surgical site infections

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OVERCOMING BARRIERS IN THE  
PREVENTION OF SURGICAL SITE INFECTIONS  
A MASTER PLAN EMPLOYING TASK-BASED  
INTERPROFESSIONAL TRAINING

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# Chapter 1

General introduction





# Overcoming barriers in the prevention of surgical site infections: a master plan employing task-based interprofessional training

## Introduction

### Surgical site infections and their risks

Surgical site infections (SSI) are the second most common cause of hospital-associated infections. An SSI has been defined as an ‘infection *related to an operating procedure that occurs at or near the surgical incision within 30 days of surgical procedure or within one year after surgery in case an implant is placed in a patient*’.<sup>1-3</sup> Being among the most common postoperative complications in surgical patients, SSI has consequences for individual patients' morbidity, mortality, and quality of life.<sup>1,3,4</sup> In addition to this, they also have a significant economic impact on the population and society at large. In low- and middle-income countries (LMICs), the risk of contracting SSI ranges between 4% and 30%.<sup>1,3-5</sup> However, effective infection prevention and control measures can prevent 40-60% of these infections.<sup>1,5-7</sup>

Nevertheless, such measures are not prioritized in LMICs,<sup>1,8,9</sup> meaning that existing SSI prevention guidelines are not widely followed.<sup>10-12</sup> We know that these guidelines will not be observed simply because we drafted and posted those guidelines.<sup>13</sup> Such an approach in which senior management approves guidelines and assumes they will be automatically applied is also called a top-down ‘spray and pray technique. In other words, acceptance at the highest level does not guarantee their subsequent uptake in daily clinical practice.<sup>13</sup> Hence, to implement the said guidelines effectively, we need a *bottom-up approach* that involves the active participation of health care professionals. *Minimum requirements for infection prevention and control programs*

The World Health Organization (WHO) has identified eight core components that infection prevention and control programs should encompass to ensure and initiate effective implementation of infection prevention (see Box 1.1). The first component lays the foundation for the remaining seven core components at the national, regional, and institutional levels in preventing SSI. In this dissertation, however, we will home in on the third component of education and training, which is crucial for developing the capacity of health care professionals at all these levels.<sup>11,14-16</sup> The WHO has emphasized that each country should collaborate with healthcare professionals to develop its training program on SSI prevention. Additionally, the WHO has recommended that healthcare institutions should offer task-based interprofessional training at least to all new health

professionals at the undergraduate and postgraduate levels and continue to provide this training as part of their continuous medical education.<sup>14-16</sup>

**Box 1.1 World Health Organization's core components to prevent infection.**

Core component 1: Infection prevention and control program  
 Core component 2: Infection prevention and control guidelines  
*Core component 3: Infection prevention and control education and training*  
 Core component 4: Surveillance of health-associated infection  
 Core component 5: Multimodal strategies  
 Core component 6: Monitoring and audit  
 Core component 7: Workload, staffing, and bed occupancy  
 Core component 8: Built environment, materials, and equipment for infection prevention at the facility

## Importance of education and training

To implement infection prevention guidelines effectively and thereby improve the quality and safety of healthcare, health professionals' knowledge, skills, and attitudes carry considerable weight. For this reason, many international scholars have suggested that patient safety aspects should figure prominently in healthcare education and training.<sup>16</sup> More specifically, infection prevention experts have called on healthcare institutions to focus explicitly on educational interventions that aim to improve patient care by educating, empowering, and engaging all healthcare professionals involved in the surgical care of patients and helping them learn to reduce SSIs.<sup>17</sup> Education and training together not only constitute a core component of the WHO guidelines (see Box 1.1), but they are also a prominent part of other recommendations on how to improve patient safety. Those of the European Council, for instance, have stressed the importance of implementing infection prevention education and training for health care professionals at the regional and national levels.<sup>18,19</sup>

In some parts of the world, significant efforts have already been made to implement training and education on infection prevention. The European Centre for Disease Prevention and Control, for instance, commissioned the *Training in Infection Control in Europe Project* to inventory education and training in Europe. The resulting report showed that, although education and training opportunities and qualifications differed across Europe, the number of countries with national infection prevention training for doctors and nurses was on the increase.<sup>18,19</sup> To harmonize training, the European Society of Clinical Microbiology and Infectious Diseases established a European infection-prevention certificate for healthcare professionals comparable to that provided in the USA.<sup>19</sup> Consequently, 70% of medical and 79% of nursing schools in the European Union now offer basic infection-prevention training.<sup>12</sup> As an important global problem of significant severity and magnitude, SSIs are especially problematic in LMICs. So far,

however, LMICs have shown the slightest commitment to preventing SSI. Previous studies have pointed to a lack of education and training as one of the major factors that hinder SSI prevention in LMICs including in Pakistan.<sup>2,20,21</sup>

Despite the availability of guidelines on SSI prevention, LMICs have not gone as far as to implement such guidelines to satisfactory degrees. Indeed, implementing SSI prevention measures and promoting compliance among healthcare professionals has been identified as an effective way to reduce SSI incidence.<sup>1,3-5</sup> Existing SSI prevention guidelines, however, originate essentially from high-income countries. Although they are of high quality and enjoy widespread adherence in these countries, adapting and implementing them in LMICs has proven difficult for several reasons, including a poor health care infrastructure, lack of financial and logistical assistance, and lack of sufficiently qualified healthcare professionals.<sup>11,22-24</sup> The same holds for the introduction of healthcare professional education and training to promote patient safety. Whereas in high-income countries numerous training programs have been developed to educate healthcare professionals on how to avoid SSI, these endeavors never involve healthcare experts working in the operating rooms (ORs) of an LMIC.<sup>4,24,25</sup> To complicate matters, LMICs may lack the resources to implement such a training program [4]. Consequently, there is a paucity of information regarding the method, content of education and training, and its practical implementation strategies in the specific context of LMICs. Without a master plan for education and training, any attempt to implement guidelines to prevent SSI in the ORs is bound to fail.<sup>4,24,26</sup> Therefore, the need for education and training in the medical curriculum or postgraduate training in the ORs addressing SSI prevention in LMICs is pressing. More specifically, we need to create and implement a training program aimed to prevent SSI in collaboration with policymakers, health educators, leaders/managers, and healthcare professionals working in LMICs. Only in this way can we meet the local needs and build health care professionals' competence to foster the prevention of SSI.<sup>4,24,26</sup>

## Principles for designing training to prevent SSI

According to current instructional design theories, we can enhance meaningful learning in students if our teaching approaches are underpinned by six fundamental instructional design principles. The first of these principles is to use authentic, professional tasks as a starting point for learning, as opposed to presenting knowledge, skills, and attitudes in a fragmented fashion. A second principle is to provide learners with various learning tasks to reinforce the application of what they have learned in new/different contexts.<sup>27,28</sup> These learning tasks should represent the various ways a problem can present itself in practice. Third, learning tasks should be ordered from simple to complex.<sup>27,28</sup> The fourth

instructional design principle is that, when working on learning tasks, the learner should receive guidance and feedback that ranges from a lot of guidance in the beginning to a gradual reduction of support as the learner grows more competent (scaffolding). After the learner has demonstrated that they can complete tasks of a certain level of complexity without assistance or direction, the next set of tasks can be offered at a higher level of complexity.<sup>27,28</sup> The fifth instructional design principle is that participants from different professions should learn with, from, and about each other (interprofessional learning)<sup>29,30</sup> and reflect on obstacles and contemplate potential solutions to overcome these (reflective learning).<sup>31</sup> The sixth and last instructional design principle is that regular training and repetitions/follow-up meetings should eventually lead to a community of practice where attention to SSI prevention has become part of daily practice.<sup>32</sup>

## The scientific gaps in the literature on SSI prevention in LMICs

In summary, although WHO guidelines on SSI prevention are available, they are often not sufficiently implemented in the specific clinical setting of LMICs. From a scientific point of view, we know little about the factors that inhibit the implementation of these guidelines in LMICs, which will therefore be the focus of Chapter 2. Likewise, our knowledge about how to train health care professionals in the ORs in these specific settings is scant, despite the availability of instructional design guidelines for education and training. In Chapters 3-5, we, therefore, explored stakeholders' perceptions of task-based interprofessional training on SSI prevention and its effects on behavior change in a specific LMIC setting. By addressing these two knowledge gaps, we may help develop educational training that can facilitate the implementation of SSI prevention guidelines in LMICs.

## Aims of the dissertation

The studies presented in this dissertation aim to unravel and describe:

- 1) The factors that hinder the implementation of SSI guidelines in the ORs of LMICs (Chapter 2); and
- 2) How to design a high-quality and feasible training plan for SSI prevention in LMICs (Chapters 2-5).

## Research questions

1. What factors hinder the implementation of SSI prevention guidelines from the perspective of health care workers in LMICs? (**Chapter 2**);
2. What are participants' and facilitators' perceptions and experiences of an interprofessional task-based program to prevent SSI in an LMIC? (**Chapter 3**);
3. How do participants perceive and value a revised training program to prevent SSI, and what is the impact on knowledge gain and perceived behavior change? (**Chapter 4**); and
4. How do policymakers, teachers in health care education, and managers and leaders of health care institutions perceive the outline of a master training designed to enhance sustainable awareness about SSI prevention and to induce corresponding behavior change in an LMIC? (**Chapter 5**)

## Context and research setting

We conducted this present research in two private and public sector university hospitals in Islamabad, Pakistan, which is a typical LMIC. Both university hospitals are located in the capital of Pakistan and their postgraduate medical training programs have been recognized by the College of Physicians and Surgeons of Pakistan. Their affiliated hospitals have more than 600 beds and over 20 ORs. The healthcare professionals in both hospitals have similar educational backgrounds.

## Outline of the dissertation studies

We undertook four Ph.D. dissertation studies to address the above-listed research questions. For each of these studies, Table 1.1 gives a concise overview of its contents. In **Chapter 2**, we addressed the *first research question*, by exploring the factors that hinder the implementation of SSI control guidelines in the specific context of an LMIC. To this end, we surveyed participants who worked in the ORs of an LMIC and interviewed them individually afterward.

The *second research question* was explored in **Chapter 3**. For this study, we chose design-based research approaches to design and evaluate task-based interprofessional reflective learning with a health care professional in the ORs. Designed in line with current instructional design principles, this training program was sited in an authentic educational environment. Design-based research aims to collect evidence about how

intervention and the associated design guidelines might work in a particular context, in this case, a training program on preventing infection in the ORs of Pakistan as an LMIC. We developed the training program, implemented it in practice, and investigated it using mixed methods. After this, we invited relevant stakeholders' healthcare professionals working in the ORs, and the program facilitators to evaluate the training program.

**Table 1.1** Ph.D. dissertation studies overview.

Chapter	2	3	4	5
Research question	What factors hinder the implementation of SSI prevention guidelines from the perspective of health care workers in LMICs?	What are participants' and facilitators' perceptions and experiences of an interprofessional task-based program to prevent SSI in an LMIC?	How do participants perceive and value a revised training program to prevent SSI, and what is the impact on knowledge gain and perceived behavior change?	How do policymakers, teachers in health care education, and managers and leaders of health care institutions perceive the outline of a master training designed to enhance sustainable awareness about SSI prevention and induce corresponding behavior change in an LMIC?
Methodology/design	Mixed-methods sequential, two-phase explanatory	Design-based research approach	Mixed-methods study	Qualitative study
Participants/context	Health care professionals working in the ORs of LIMCs	Health care professionals working in the ORs of LIMCs	Health care professionals working in the ORs of LIMCs	Policymakers, hospital leaders, health care teachers, managers, and leaders
Data source	1. Questionnaire 2. Individual interviews	1. Questionnaire 2. Focus-group interviews	1. Questionnaire 2. Pre- and post-test 3. Individual interviews	Individual interviews with stakeholders

**Chapter 4** focuses on participants' perceptions of and reactions to the revised task-based interprofessional reflective training. How well the training was implemented and did this training change the knowledge and behavior of healthcare professionals working in the ORs? By using a mixed-methods approach combining both qualitative and

quantitative data including multiple-choice questions, this chapter sought to address the *third research question*.

**Chapter 5** focuses on the perceptions of stakeholders from the healthcare sector to investigate the feasibility of a master plan. Central to this research was the question of whether regular training and repetitions/follow-up meetings would eventually lead to a community of practice, where attention to SSI prevention has become part of daily practice in the ORs of an LMIC. In this chapter, we addressed the *fourth research question* by conducting individual interviews with policymakers, teachers in healthcare education, and managers and leaders of healthcare institutions.



## References

1. Schaefer RL. Structured pre-operative patient education decreases the rate of surgical site infections. Grand Canyon University; 2016. (Order No. 10086213). Available from ProQuest Dissertations & Theses Global. (1778864697). Retrieved from <https://www.proquest.com/dissertations-theses/structured-pre-operative-patient-education/docview/1778864697/se-2?accountid=135034>
2. Elshami M, Bottcher B, Awadallah I, Alnaji A, Aljedaili B, Sulttan HA, Hwaihi M. Determinants of surgeons' adherence to preventive intraoperative measures of surgical site infection in Gaza Strip hospitals: a multi-centre cross-sectional study. *BMC Surg.* 2020;20(1):21.
3. Bhangu A, Ademuyiwa AO, Aguilera ML, Alexander P, Al-Saqqa SW, Borda-Luque G, Costas-Chavarri A, Drake TM, Ntirenganya F, Fitzgerald JE, Fergusson SJ. Surgical site infection after gastrointestinal surgery in high-income, middle-income, and low-income countries: a prospective, international, multicentre cohort study. *Lancet Infect Dis.* 2018;18(5):516-25.
4. Mehtar S, Wanyoro A, Ogunsola F, Ameh EA, Nthumba P, Kilpatrick C, Revathi G, Antoniadou A, Giamarelou H, Apisarnthanarak A, Ramatowski JW. Implementation of surgical site infection surveillance in low-and middle-income countries a position statement for the international society for infectious diseases: a position statement for the international society for infectious diseases. *Int J Infect Dis.* 2020;100:123-31.
5. Gentilotti E, De Nardo P, Nguhuni B, Piscini A, Damian C, Vairo F, Chaula Z, Mencarini P, Torokaa P, Zumla A, Nicastrì E. Implementing a combined infection prevention and control with antimicrobial stewardship joint program to prevent caesarean section surgical site infections and antimicrobial resistance: a Tanzanian tertiary hospital experience. *Antimicrob Resist Infect Control.* 2020;9(1):69.
6. Tanner J, Padley W, Assadian O, Leaper D, Kiernan M, Edmiston C. Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. *Surgery.* 2015;158(1):66-77.
7. de Oliveira AC, Sarmento Gama C. Surgical site infection prevention: An analysis of compliance with good practice in a teaching hospital. *J Infect Prev.* 2017;18(6):301-6.
8. Rasa K, Kilpatrick C. Implementation of World Health Organization Guidelines in the Prevention of Surgical Site Infection in Low-and Middle-Income Countries: What We Know and Do Not Know. *Surg Infect.* 2020;21(7):592-8.
9. Manchanda V, Suman U, Singh N. Implementing infection prevention and control programs when resources are limited. *Current Treatment Options in Infectious Diseases.* 2018;10(1):28-39.
10. Global guidelines for the prevention of surgical site infection, 2nd ed. World Health Organization Geneva; 2018. <https://apps.who.int/iris/handle/10665/277399>. License: CC BY-NC-SA 3.0 IGO
11. Rojas-Gutierrez E, Vilar-Compte D. An overview of surgical site infection in low-and middle-income countries: the role of recent guidelines, limitations, and possible solutions. *Current Treatment Options in Infectious Diseases.* 2019;11(3):300-16.
12. Ling ML, Apisarnthanarak A, Abbas A, Morikane K, Lee KY, Warriar A, Yamada K. APSIC guidelines for the prevention of surgical site infections. *Antimicrobial Resistance & Infection Control.* 2019;8(1):1-8.
13. Stevens PE, Tomson CR. Guidelines in the United Kingdom and how they are used. *Clin J Am Soc Nephrol.* 2009;4 (Suppl1):S23-9.
14. World Health Organization. Minimum requirements for infection prevention and control programs. 2019. <https://www.who.int/publications/i/item/9789241516945>.
15. Storr J, Twyman A, Zingg W, Damani N, Kilpatrick C, Reilly J, Price L, Egger M, Grayson ML, Kelley E, Allegranzi B. Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. *Antimicrob Resist Infect Control.* 2017; 6(1):6.
16. Ginsburg LR, Dhingra-Kumar N, Donaldson LJ. What stage are low-income and middle-income countries (LMICs) at with patient safety curriculum implementation and what are the barriers to implementation? A two-stage cross-sectional study. *BMJ Open* 2017;7:e016110.
17. Dellinger EP, Dutton RP, Guglielmi CL, CRCST A. Educate, Empower, Engage: A Collaborative Interdisciplinary Call to Action for Reducing Surgical Site Infections. [View Media \(businesswire.com\)](#)

18. Brusaferro S, Arnoldo L, Cattani G, Fabbro E, Cookson B, Gallagher R, Hartmann P, Holt J, Kalenic S, Popp W, Privitera G. Harmonizing and supporting infection control training in Europe. *J Hosp Infect.* 2015; 89(4): 351-6.
19. Zingg W, Muters NT, Harbarth S, Friedrich AW. Education in infection control: A need for European certification. *Clin Microbiol Infect.* 2015;21 (12):1052-6.
20. Punjwani R, Khatoon A, Fatima D, Ahmed A. Practices and policies of infection control and prevention, Pakistan-a review for patient safety. *Med Safety Global Health.* 2016;5:1-5.
21. Khan HA, Baig FK, Mehboob R. Nosocomial infections: Epidemiology, prevention, control, and surveillance. *Asian Pacific Journal of Tropical Biomedicine.* 2017; 7(5): 478-82.
22. Berman LR, Lang A, Gelana B, Starke S, Siraj D, Yilma D, Shirley D. Current practices and evaluation of barriers and facilitators to surgical site infection prevention measures in Jimma, Ethiopia. *Antimicrobial Stewardship & Healthcare Epidemiology.* 2021;1(1).E51.
23. Mengesha A, Tewfik N, Argaw Z, Beletew B, Wudu M. Practice of and associated factors regarding prevention of surgical site infection among nurses working in the surgical units of public hospitals in Addis Ababa city, Ethiopia: A cross-sectional study. *PloS One.* 2020 15(4):e0231270.
24. Delphi prioritization and development of global surgery guidelines for the prevention of surgical-site infection. *Br J Surg* 2020;197(8): 970-7.
24. Tsioutis C, Birgand G, Bathoorn E, Deptula A, Ten Horn L, Castro-Sánchez E, Săndulescu O, Widmer AF, Tsakris A, Pieve G, Tacconelli E. Education and training programmes for infection prevention and control professionals: mapping the current opportunities and local needs in European countries. *Antimicrob Resist Infect Control.* 2020; 9(1): 1-2.
26. Clack L, Willi U, Berenholtz S, Aiken AM, Allegranzi B, Sax H. Implementation of a surgical unit-based safety programme in African hospitals: a multicentre qualitative study. *Antimicrob Resist Infect Control.* 2019; 8(1): 1-0.
27. Van Merriënboer JJ, Kirschner PA. Ten steps to complex learning: A systematic approach to four-component instructional design. New York: Routledge; 2017 Oct 23. <https://doi.org/10.4324/9781315113210>
28. Khalil MK, Elkhider IA. Applying learning theories and instructional design models for effective instruction. *Adv Physiol Educ.* 2016;40(2):147-56.
29. Tervaskanto-Mäentausta T. Interprofessional education during undergraduate medical and health care studies. *Acta Universitatis Ouluensis. D, Medica. Oulu Finland: University of Oulu.* 2018 April.
30. Pasay DK, Guirguis MS, Shkrobot RC, Slobodan JP, Wagg AS, Sadowski CA, Conly JM, Saxinger LM, Bresee LC. Antimicrobial stewardship in rural nursing homes: impact of interprofessional education and clinical decision tool implementation on urinary tract infection treatment in a cluster randomized trial. *Infect Control Hosp Epidemiol.* 2019;40(4):432-7.
31. Burnett E, Phillips G, Ker JS. From theory to practice in learning about healthcare-associated infections: reliable assessment of final year medical student's ability to reflect. *Med Teach.* 2008;30(6):e157-60.
32. Rathakrishnan M, Raman A, Haniffa MA, Mariamdaran SD, Haron A. The drill and practice application in teaching science for lower secondary students. *International Journal of Education, Psychology, and Counseling.* 2018; 3(7): 100-8.



# Chapter 2

Factors hindering the implementation of surgical  
site infection control guidelines in the operating rooms  
of low-income countries

Ayub Khan MN, Verstegen DM, Bhatti AB, Dolmans DH, van Mook WN

*Eur J Clin Microbiol Infect Dis* 2018;37(10):1923-1929

## Abstract

The study aims to find the factors hindering the implementation of surgical site infection control guidelines in the operating rooms of low-income countries. The design of the study is a mixed-method sequential explanatory study. The setting is Shifa International Hospital and Pakistan Institute of Medical Sciences, Islamabad, Pakistan. Participants are health care workers. A questionnaire and structured key informant interviews probed the perspectives and perceptions of different stakeholders regarding the factors which hinder the implementation of surgical site infection control guidelines. Two-hundred fifty-two health care workers took part in the survey. The response rate was 90%. The majority of the participants was based in private teaching hospitals (63.9%) and 36.1% in the public sector teaching hospitals. The factors of surveillance, knowledge, education, and culture had low scores. Qualitative data analysis revealed the hindering factors in the implementation of surgical site infection control guidelines in the operating rooms of low-income country. The important ones are lack of a surveillance system, education, and culture of infection control. This study identified hindering factors regarding implementation of surgical site infection control guidelines in the operating rooms at the institutional and individual level involved in patient care. The identification of these hindering factors may help politicians, policy makers, and institutions to identify the strategies for overcoming these hindering factors. Education is the key factor for success. By offering training to health care workers, we significantly contribute to decrease the incidence of SSIs in the low-income country.

## Introduction

Establishment of high-quality clinical practice in any given health care system requires vigilance, dedication, and adherence to a strict ethical and professional code of conduct.<sup>1</sup> Especially in low-income countries challenges include, for example, weak health care systems, poor professional regulation, lack of access to evidence-based guidelines, lack of infrastructure for training, and continuing professional development.<sup>1,2</sup> However, European and North American institutes are not an exception in this regard as patients remain deprived of appropriate medical care based on evidence-based knowledge. For example, poor compliance with antibiotic prophylaxis protocol in gastrointestinal surgery has been reported across three UK hospitals.<sup>3</sup> Similarly, poor compliance with appropriate timing of prophylactic antibiotic administration<sup>4</sup> was associated with increase rate of surgical site infections (SSIs), i.e., infection of incisions, organ, and space after surgical intervention<sup>5</sup> across surgical specialties in USA. Thus, patients received suboptimal preoperative antibiotic prophylaxis is that potentially harmed the patient and contributed to the wastage of resources.

These examples illustrate the gap between what is known and what we practice. The 2004 World Report on knowledge for better health stated that scientific discoveries can improve people's health only if they are applied properly in health care systems [6]. This report emphasize on translating knowledge into action, thereby bridging the gap between knowledge and what is actually done in practice.<sup>6</sup> However, the increasing volume of evidence on how to treat patients makes it difficult for health care workers (HCWs), especially the doctors, nurses, and technologists working in operating rooms, to keep up to date. This widens the gap between what is known about best clinical practice and how medical care is actually provided. Evidence-based guidelines can be an important tool to bridge the gap between knowledge and practice.<sup>7</sup> However, the development and publishing such guidelines do not assure that they will get implemented.<sup>6</sup> The so called spray and pray approach refers to the top to bottom approach in which the top managements accept guidelines and assume that they become implemented automatically. Acceptances at top level thus do not ensure their use in daily practice.<sup>7</sup> The implementation of evidence-based guidelines needs active involvement of HCWs, thus benefits from a bottom up approach to integrate and implement guidelines at the meso- and micro-level.

To summarize, implementation of evidence-based guidelines for prevention of SSI and promoting compliance on the part of HCWs working in the operating rooms (ORs) have been suggested as an efficient means to reduce the incidence of SSIs.<sup>8</sup> However, especially low-income countries face challenges regarding the use of evidence-based guidelines. In order to design effective educational interventions regarding SSI control,

further analysis of what factors hinder the implementation guidelines to reduce SSIs in low-income countries is required.

We designed a study to explore the factors which hinder the implementation of SSI control guidelines in ORs of a low-income country, Pakistan, based on the following research questions.

### Research questions

1. To what extent are SSI control guidelines applied effectively in the ORs of low-income countries and to what extent do the different stakeholders perceive to have sufficient knowledge?
2. What are the perspectives and perceptions of different stakeholders regarding the factors which hinder the implementation of SSI guidelines in the ORs in low-income countries?

## Methods and setting

### Study design

A mixed-method sequential, two-phase explanatory study was conducted. In the first phase, a questionnaire was used to evaluate the factors that affect the effectiveness of the WHO Global Guidelines 2016 for prevention of SSIs in the ORs. In the second phase, structured interviews were conducted with leaders of HCWs working in the ORs to find out perspectives and perceptions of different stakeholders regarding the factors which hinder the implementation of SSI guidelines control guidelines in the ORs in low-income countries.

### Settings

Two teaching hospitals, Shifa International Hospital in a private sector and Pakistan Institute of Medical Sciences, Islamabad, in the public sector with anticipated deep insights in the factors which hinder the effectiveness of SSI guidelines in the ORs of low-income country were chosen for the study.

### Participants

The questionnaire was distributed to collect quantitative data from 280 HCWs working in the ORs of the two hospitals. Participants for interviews were purposefully selected from stakeholders with roles in ORs, including members of the infection control team,

operating room managers, nurses, technologist, surgeons, and anesthesiologists. Informed consent was obtained verbally before the start of interviews, and interviews were continued until saturation in analysis was reached. All interviews were digitally recorded. The participants had the option of withdrawing at any time for any reasons. Only the researchers had access to the digital recordings and the data were stored in data verse.

## Ethical approval

Approval by the ethical committee of Shifa Tameer-e-Millat University was acquired (IRB number 760–035-2017).

## Questionnaire

A questionnaire was used to explore the factors which affect the effectiveness of SSI guidelines in the ORs of a low-income country.<sup>9,10</sup> The questionnaire consisted of 51 closed items related to seven categories of barriers (items related to education and culture were added to questionnaire): factors related to surveillance (4 items), knowledge (3 items), and education (5 items); skills related to safe injections and point of care devices (11 items); and skills related to sterilization and high-level disinfection (12 items), culture (5 items), and cleaning of operating rooms (6 items). The respondents were asked to indicate their agreement using a 6-point Likert scale, ranging from strongly agree (5), agree (4), somewhat agree (3), somewhat disagree (2), disagree (1) to strongly disagree (0). The participants were approached directly by the researcher.

## Interviews

Key interviews were conducted to explore stakeholders' perspectives and perceptions. The interview guide was prepared after review of literature and analysis of the results of the questionnaire. Each semi-structured interview (Appendix 2.B) consisted of 11 questions which probed the factors which hinder the implementation of SSI control guidelines in the ORs. A sample of 12 interviews with participants was done. During the analysis, it became clear that this was enough to reach saturation.

## Data analysis

The Statistical Package for the Social Sciences software package 22.0 was used for the analysis for quantitative data. Mean and standard deviation of each item was calculated. An item's specific barrier score was calculated as mean value. A score of 3.5 or higher on a scale from 0 to 5 was considered as high. A score below 3 was considered



as insufficient, and a score in between 3 and 3½ as moderate, i.e., still needs some improvement. The item's specific score results in an overall score between 0 and 5. The qualitative data was read independently by two authors (MNA and AHB), identifying common themes through the constant comparison method; applying generally accepted principles of primary, secondary, and tertiary coding; identifying trends; and using the common opinions expressed by the participants. The identified themes were independently coded, enabling us to compare between participants' responses. The generated codes were thereafter cross-checked by WvM and DV. All discrepancies were discussed until consensus was reached. Illustrated quotes are presented.

## Results

The quantitative and qualitative results of this study are discussed consecutively.

### The quantitative results

The perception of health HCWs regarding each factor of the questionnaire will consecutively be discussed in the sections below.

### Demographic and contextual data

Two-hundred fifty-two HCWs working in ORs took part in the survey. The response rate was 90%. The majority of the participants were based in private teaching hospital (63.9%) and 36.1% in the public-sector teaching hospitals. Of the participants, 45.2% were males and 52.8% were females. The distribution of participants was doctors (43.7%), nurses (32.5%), technologists (22.6%), and perfusionist (1.2%).

### Factor and item analysis

Table 2.1 shows the mean score and the standard deviation on the main factors surveillance, knowledge and education, culture, skills for sterilization, safe injection, and cleaning of ORs. The scores on the factors varied between 4.07 standard deviation (SD=2.04) and 2.66 (SD=0.99). The highest mean scores were related to safe injection, although scores varied substantially given the high SD. The lowest mean factor scores were related to education, knowledge, and culture. Detail scores of each individual item are shown in Appendix 2.A.

**Table 2.1** Descriptive statistics per factor (n= number of items per factor).

Factors	Mean (M) (0 to5)	Standard deviation (SD)	Number of respondents (N)
Surveillance (n=4)	3.13	1.09	252
Knowledge(n=4)	2.74	1.12	252
Education(n=5)	2.66	0.99	252
Culture(n=10)	2.80	0.71	252
Sterilization(n=12)	3.64	0.72	252
Safe injection(n=11)	4.07	2.04	252
Cleaning of operating rooms (n=6)	3.70	0.83	252

## Qualitative results

Qualitative analysis resulted in identification of two categories of hindering factors in implementation of SSI guide- lines in the ORs of low-income country, namely, *the hindering factors at the institutional level* and *at the individual level*. Illustrated quotes to underscore the findings are presented where applicable. An overview is shown in Figure 2.1.

## Hindering factors in implementation of SSI guidelines at the institutional level

The following are the hindering factors in implementation of SSI guidelines at the institutional level in ORs of low-income country in order of importance based on the extent of discussion. Illustrative quotes are provided wherever applicable.

Education and training were frequently a topic of discussion, mostly in relation to implementation of guidelines to prevent SSIs. The participants in our study perceived that the administrative and financial support in public hospitals is insufficient to develop human resource to prevent SSI guidelines in ORs.

“Hospitals do not have the facility to provide training for the specific staff to prevent infection or to be sending abroad for training to acquire more knowledge that is why people are not well trained.” (P5)

The government health authorities do not have laws, policies, and rules in place to enforce guideline implementation to control SSIs.

“I think we can divide the barriers into two segments; Responsibility of the law enforcement agencies in the country and responsibility of health care institutions. I think both lack tremendously. Both do not have a clear idea what to do.” (P4)

Many participants perceived that institutions do not create a culture of evidence-based practice by a coordinated effort to bring change through the use of best evidence.

"To be honest there is no such thing or you can say no proper intentions are there and maybe institutions do not care about it, I am not directly pointing toward anybody, but you know it well." (P5)

Some of the participants said the public sector hospitals are old, and ORs do not have proper air conditioning, clean water supply, adequate scrub areas, and regulation of traffic inflow.

*"The buildings are old, have not been renovated for a long time, all the walls, structure including beds, and lights are quite old and need renovation. The buildings were not structured properly and not purpose built."* (P9)

Hindering factors in implementation of SSI guidelines at the individual level

The following are the hindering factors at the individual level in the ORs in order of importance based on the extent of discussion.

Inadequate knowledge and skills were intensively discussed as hindering factors in the implementation of SSI guidelines by all the participants. They discussed that HCWs working in the ORs do not have the education and training to prevent SSIs.

"There is a lack of knowledge, majority of the medics, have some idea about the safe surgical practice and specifically the infection control but still they might be lacking of knowledge which might be required to prevent the infection in the operating rooms."(P8)

Many participants are of the opinion that the HCWs are not aware of the importance of SSI guideline; therefore, they are not well prepared to apply the safety standards.

"People who have not seen how things are done in the West, cannot even comprehend how strict the policies are in Western countries, protecting the rights of the patient but in Pakistan that concept is not clear in the minds of the people." (P10)

In addition to the above, some of the participants consider that lack of acceptance to change as a barrier at an individual level.

"People they don't have acceptance. They don't want to change themselves. It is very hard to change mind for people in this society. So whatever their mind develops, they try to work accordingly."(P2)

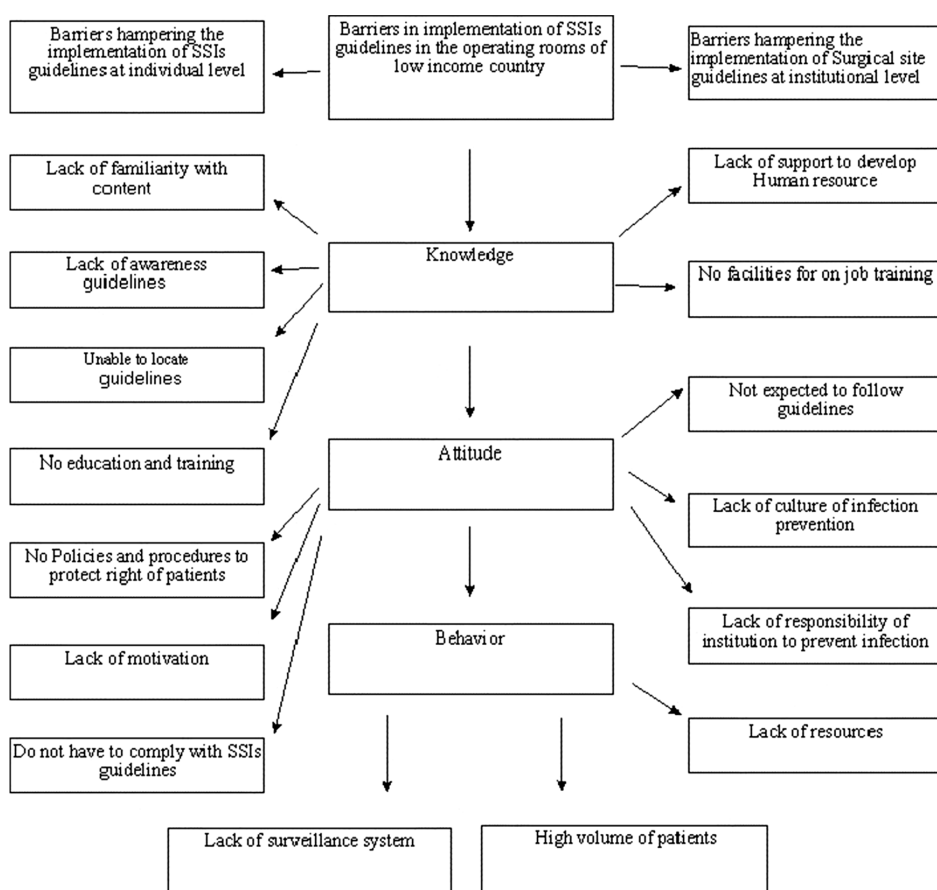


Figure 2.1 Hindering factors in implementation of SSI guidelines in the operating rooms of low-income country at the individual level and institutional level.

## Discussion

The results of this study provide an insight into the factors that hinder the implementation of SSI guidelines in the ORs of a low-income country. This mixed-method study has identified hindering factors for the implementation of SSI guidelines in the ORs at an institutional level and at an individual level of professionals involved in patient care. Both the quantitative and qualitative results show that participants believe that the lack of evidence-based culture to prevent SSIs coupled with weak education and poor surveillance system are the main hindering factors for the implementation of SSI

guidelines in a low-income country. In addition to the above, the interview data revealed that governmental and health care institutions do not prioritize proper education and training to develop a culture of evidence-based practice to prevent SSIs. There is, therefore, a need to invest more in developing resources to train and educate HCWs in order to strengthen the implementation of SSI guideline.

The absence of surveillance systems for SSIs is the perceived second key hindering factor in implementation of SSI guidelines in the ORs of a low-income country. Surveillance of infection control is present in *high-income* countries, but not in most low-income countries.<sup>11</sup> However, without a functional surveillance system, it is not feasible for the ministry of health to monitor, evaluate, and document the real burden of infection at the national level. Therefore, an institutional and national surveillance system is at the heart of infection control. It not only identifies the problem but also defines the priorities for allocating funds to develop human resources, to prevent infection, and report lessons learnt regarding prevention of SSIs in the literature.<sup>11,12</sup> Moreover, no policy exists to prevent SSIs in the ORs of low-income country at the national and institutional levels. These simple policies can decrease the incidence of SSIs. This lack of policy increases the socioeconomic burden of SSIs and pushes it in the spiral of weak health system of low-income countries.<sup>13</sup>

This study also shows the gap between the available scientific knowledge in the form of SSI guidelines and practice among the HCWs working in the ORs. HCWs either lack the knowledge of guidelines or, if they have the required knowledge, they do not apply evidence-based guidelines to prevent SSIs in their practices. On the contrary, they seem to practice according to their personal beliefs. Therefore, proper education in the form of training and refresher courses is vital. It has been recognized that the fundamentals of infection control should be taught to *all* the HCWs.<sup>14</sup> However, no institute in Pakistan exists that can take care of training on preventing SSIs in the ORs, and this is true for other countries. Similarly, the reasons behind the lack of implementation at an individual level in low-income countries are different from the developed part of the world. The individual hindering factors for instance lack of awareness, familiarity, and acceptance to follow SSI guidelines are the most common because HCWs working in ORs are usually not aware of Pakistan's national guidelines to control infection. Also, they are not familiar with the content of guidelines. Moreover, this study shows lack of organizational support for training at institutional level. The consequence is that hospitals do not have an adequate amount of trained personnel who can support implementation of SSI guidelines. This may be the reason that the participants of this study report that no culture of evidence-based practice exists. There is a general absence of policies, procedures, scientific guidelines, training material, and skills required to plan strategies to implement SSI guidelines.

Two studies from low-middle-income countries also reported the barriers in implementation of infection control practices on the individual and institutional level. The first study reported that staff turnover, time spent on training of new staff, limitations in language competence, and work-load restraints are the major barriers to practice infection control in an Indian hospital.<sup>15</sup> The second study performed a gap analysis of infection control practice in six low-middle-income countries (Nepal, India, Argentina, Hungary, South Africa, and Greece) found that infection control practices are suboptimal in these countries because of limited infection control programs, limited surveillance of health-associated infections, lack of written policies, lack of procedures for sterilization of surgical instruments, and poor antibiotics stewardship and hand hygiene.<sup>13</sup> Furthermore, an international survey on infection control practices from members of society of health care epidemiology of America outside of USA and Canada (53% members were from high, 43% members were middle, and 1% was from low-income countries) found that limited trained staff, infrastructure, and supplies were the major barriers to prevent multiple drug resistance organism transmission.<sup>16</sup> In these respects, our findings, thus in line with previous studies and barriers to implementation of infection control practice, are similar across the world.

To the best of our knowledge, this is however one of the first studies to specifically identify hindering factors behind the implementation of SSI guidelines in the OR of a *low-income* country. The strength of this study is that it includes HCWs from different professional backgrounds working in private as well as public sector hospitals with high response rate of the participants. A limitation of this study is that the majority of the participants were working in private teaching hospitals and only one third of the participants in the public sector teaching hospitals, which could have influenced the findings. Respondents from private hospital may have responded differently because their institution is a joint commissioned accredited hospital which can take more measures to control SSIs as compared to public hospitals. Despite the fact that the overall response rate was high, the results may be non-generalizable to hospitals in the more remote areas of Pakistan. In addition, participation in the interviews took place on the basis of availability and willingness, so convenience sampling can be a limitation of this study. Finally, the study was limited to Pakistan, which is presumably representative for low-income countries, although political or other reasons may also limit the study's generalizability.

The results of this study serve as the first step in identifying the hindering factors to the implementation of SSI guidelines in the ORs of low-income countries. These results will help in designing interventions to narrow the gap between knowledge and practice of preventing SSIs. The results of this study may also stimulate researchers to corroborate the findings of this study in other low-income countries and to design additional studies

addressing how to overcome these barriers in the ORs of low-income country. Based on the results of this study, the authors recommend that comprehensive low- cost educational modules on prevention of SSIs to be adopted by hospitals, which is feasible for hospitals with limited resources. Our future research will consequently focus on designing, implementing, and evaluation of such educational interventions.

## Conclusion

This mixed-method study identified hindering factors at individual and institutional level regarding implementation of SSI guidelines in the ORs of low-income country. Lack of a surveillance system, education and training programs, and culture of evidence-based clinical practice are the major hindering factors identified in both the qualitative and quantitative data. The identification of these hindering factors may help politicians, policymakers, and institutions to identify the strategies and interventions for overcoming these hindering factors. Training is the key factor for success and can increase the knowledge and skills by offering training to health care professionals, and significantly contribute to decrease the incidence of SSIs in the low-income country.

## References

1. Garner P, Kale R, Dickson R, Dans T, Salinas R. Getting research findings into practice: implementing research findings in developing countries. *Br Med J*. 1998;317:531–535.
2. Ritchie LM, Khan S, Moore JE, Timmings C, van Lettow M, Vogel JP, Khan DN, Mbaruku G, Mrisho M, Mugerwa K, Uka S. Low-and middle-income countries face many common barriers to implementation of maternal health evidence products. *J Clin Epidemiol*. 2016;76:229–237.
3. Cameron M, Jones S, Adedeji O. Antibiotic prophylaxis audit and questionnaire study: traffic light poster improves adherence to protocol in gastrointestinal surgery. *Int J Surg*. 2015;19:112–115.
4. Velanovich V, Davila M. Compliance with American College of Surgeons-NSQIP surgical site infection bundle and the occurrence of postoperative surgical site infections. *J Am Coll Surg*. 2017;225(4):e28.
5. Berrios-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, Reinke CE, Morgan S, Solomkin JS, Mazuski JE, Dellinger EP. Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surg*. 2017;152(8):784–791.
6. Thamlikitkul V (2006) Bridging the gap between knowledge and action for health: case studies. *Bulletin World Health Organization*. 2006;84(11):1040–1045.
7. World Health Organization. Global guidelines for the prevention of surgical site infection. World Health Organization, 2016.
8. Larson E. A tool to assess barriers to adherence to hand hygiene guideline. *Am J Infect Control*. 2004;32:48–51.
9. Bradley S. Strategies to fully implement infection control practices in Pennsylvania ambulatory surgical facilities. *Pennsylvania Patient Safety Authority*. 2013;10:99–106.
10. Swaminathan S, Prasad J, Dhariwal AC, Guleria R, Misra MC, Malhotra R, Mathur P, Walia K, Gupta S, Sharma A, Ohri V. Strengthening infection prevention and control and systematic surveillance of healthcare associated infections in India. *BMJ*. 2017;358:j3768.
11. Alp E, Damani N. Healthcare-associated infections in intensive care units: epidemiology and infection control in low-to-middle income countries. *J Infect Dev Ctries*. 2015;9(10):1040–1045.
12. Weinschel K, Dramowski A, Hajdu Á, Jacob S, Khanal B, Zoltán M, Mougkou K, Phukan C, Staneloni MI, Singh N. Gap analysis of infection control practices in low-and middle-income countries. *Infect Control Hosp Epidemiol*. 2015;36(10):1208–1214.
13. Zingg W, Mouton RP, Harbarth S, Friedrich AW. Education in infection control: a need for European certification. *Clin Microbiol Infect*. 2015;21(12):1052–1056.
14. Barker AK, Brown K, Siraj D, Ahsan M, Sengupta S, Safdar N. Barriers and facilitators to infection control at a hospital in northern India: a qualitative study. *Antimicrob Resist Infect Control*. 2017;6(1):35.
15. Safdar N, Sengupta S, Musuuza JS, Juthani-Mehta M, Drees M, Abbo LM, Milstone AM, Furuno JP, Varman M, Anderson DJ, Morgan DJ. Status of the prevention of multidrug-resistant organisms in international settings: a survey of the Society for Healthcare Epidemiology of America research network. *Infect Control Hosp Epidemiol* 2017;38(1):53–60.



## Appendix 2.A

The scores for items regarding surveillance, knowledge, education, culture, skills for sterilization, skills for safe injection and cleaning of operating rooms were described by using mean  $\pm$  standard deviations (SD).

Item no	I. Items regarding surveillance	Mean $\pm$ SD
1	Postoperatively SSIs are actively identified and tracked	3.31 $\pm$ 1.29
2	There is a written documentation tracking SSIs	2.87 $\pm$ 1.45
3	The OR complies with institutional infection control policy	3.28 $\pm$ 1.29
4	SSIs tracking are shared with health care professionals working in OR	2.81 $\pm$ 1.41
Item no	II. Items regarding knowledge	Mean $\pm$ SD
5	I am familiar with SSIs guidelines	3.00 $\pm$ 1.38
6	My hospital's SSIs policies are based on SSIs guidelines	2.92 $\pm$ 1.25
7	I am aware of hospital SSIs control Policy	2.46 $\pm$ 1.28
8	I am able to locate my hospital SSIs policies	2.44 $\pm$ 1.29
Item no	III. Items regarding education	Mean $\pm$ SD
9	A designated, licensed healthcare professional directs the infections control program	3.32 $\pm$ 1.32
10	The healthcare professional directing infections control has received formal training in infection	2.90 $\pm$ 1.31
11	All operating room professionals received ongoing job-specific infection control education and training	2.36 $\pm$ 1.17
12	The infections control educational training includes all health care professionals working in OR?	2.35 $\pm$ 1.09
13	Infections control education is provided to all health care professionals on regular intervals of two years	2.23 $\pm$ 1.16
Item No	IV. Items regarding culture	Mean $\pm$ SD
14	I do not have to comply with SSIs guidelines	2.03 $\pm$ 1.49
15	SSIs guidelines are practical to use in low-income countries	2.97 $\pm$ 1.35
16	SSIs helps to reduce SSIs in low income countries	3.23 $\pm$ 1.28
17	SSIs guidelines are relevant to low income countries	3.00 $\pm$ 1.23
18	My hospital motivates me to apply SSIs	2.41 $\pm$ 1.27
19	In my hospital there are sufficient leadership support to implement SSIs guidelines	2.96 $\pm$ 1.32
20	hospital provides the essential supplies to follow SSIs guidelines	3.17 $\pm$ 1.28
21	SSIs guidelines do not contradict with my religion believes	3.53 $\pm$ 1.31
22	In this hospital, I am not expected to follow SSIs guidelines	1.98 $\pm$ 1.49
23	This hospital have a strong culture to practice evidence base guidelines to prevent SSIs	2.59 $\pm$ 1.26
Item No	V. Items regarding skills for sterilization	Mean $\pm$ SD
24	Equipment is relearned according to manufacturer's directions	3.52 $\pm$ 1.12
25	Semi critical equipment, such as laryngoscope blades and Magill's forceps that come in contact with skin or mucosa are highly disinfected	3.57 $\pm$ 1.16
26	Critical equipment that enters sterile tissue or the vascular system, such as surgical instruments implants are sterilized	4.00 $\pm$ 0.97
27	Medical device and instruments are visually inspected for residual soil and relearned	3.81 $\pm$ 1.05
28	Documentation of chemical, biological and mechanical indicators is completed	3.62 $\pm$ 1.09
29	Items are contained, handled and stored in a manner to avoid compromised sterility	3.73 $\pm$ 0.96
30	Sterile packages are inspected for integrity	3.74 $\pm$ 1.05

31	Documentation is in place that chemicals for high level disinfection are prepared , tested and replaced according to manufacturer's instruction	3.72±1.07
32	Instruments undergoing high level disinfection are disinfected for the appropriate length of time and appropriate temperature as specified by manufacturer guidelines	3.75±1.12
33	immediate use sterilization is used solely for sterilizing items that have been contaminated during a procedure	3.54±1.14
34	A rapid device is used for flash sterilization	3.59±1.20
35	Immediate use sterilization items are wrapped and covered	3.84±1.05
<b>Item NO</b>	<b>VI. Items regarding skills for safe injection</b>	<b>Mean ±SD</b>
36	Injections are prepared using aseptic technique ( including hand hygiene , use of sterile transfer device and no contact with contaminated textiles)	3.38±1.05
37	The rubber septum is scrubbed with alcohol and dried prior to puncture	3.58±1.14
38	Injections are prepared in a clean area free from contamination or contact with blood, body fluid or contaminated equipment.	3.87±1.00
39	Needles , syringes , prefilled syringes and insulin pen cartridges are used only for one patient	4.12±0.96
40	Single dose and multidose vials are always entered with a new syringe even for the same patient	4.02±0.96
41	Manufactured prefilled syringes , single dose vials, ampoules and intravenous solutions are used for only one time for one dose and for one patient	4.15±0.88
42	Medication administration tubing and connectors are used for only one patient	4.22±0.83
43	Multidose vials are dated when opened or punctured and discarded within 28 days or per manufacturer's instructions for an expiration date after opening , whichever is the first	4.00±0.97
44	Multidose vials used on multiple patients are kept in a centralized , clean medication area and do not enter the immediate patient treatment area	3.90±1.07
45	Single dose vials are discarded within one hour of opening and puncturing	3.85±1.10
46	Glucose meters are cleaned and disinfected after each patient checkup	3.30±1.32
<b>Item No</b>	<b>VII. Items regarding cleaning of operating rooms</b>	<b>Mean ±SD</b>
47	Operating room suites are cleaned and disinfected after each procedure every day	3.70±1.22
48	Operating room suites are terminally cleaned at the end of the day	3.85±1.04
49	Anesthesia and surgical items are cleaned in between use in all patients care area	3.82±1.03
50	High touch surfaces are cleaned with disinfected	3.83±1.09
51	Gross blood spills are decontaminated with DRAP registered disinfectant	3.51±1.11
52	Operating rooms are cleaned with disinfectant registered by Drugs regulation authority of Pakistan (DRAP)	3.88±1.11

## Appendix 2.B

### Interview guidelines

What do you think are the main hindering factors in the implementation of surgical site infections control guidelines with in your daily work?

- Q1. Please tells us which team you represent?
- Q2. Who is responsible for infections control in operating rooms?
- Q3. Are S.S.Is control guidelines available?
- Q4. Is there any infection control team in operating room?
- Q5. Did they receive specific training in infection control e.g certificate course?
- Q6. Do you have surveillance system to follow and track S.S.I? To whom this is communicated in operating rooms?
- Q7. What current education and training this hospital provides to health care working in operating room regarding infections control?
- Q8. What do you see as the gaps in education and training around infection control in operating rooms? How often do you receive training per year and updated regarding infections control in operating rooms?
- Q9. Within the settings in which you work, what you think are the main barriers in implementing of infections control guidelines?
- Q10. Is there an adequate 'hospital culture' to promote implementation of guidelines, e.g. communication between staff? Or with in the settings, in which you work, are there any constrain? You for applying guidelines in operating rooms?
- Q11. Can you describe how you ensure that the environment where you work is safe and clean for your patients?





# Chapter 3

## Task-based training to prevent surgical site infection: a formative evaluation

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## Abstract

### Background

Lack of evidence-based training constitutes a serious impediment to preventing surgical site infections in low-middle income countries. The purpose of this study was to design, implement an infection prevention training programme and investigate how it might work in a low-middle income country. Intended for healthcare professionals working in the operating rooms, the programme was based on current instructional design principles of interprofessional, task-based learning. The second aim was to carry out a formative evaluation exploring participants' and facilitators' perceptions and experiences of the training.

### Methods

In undertaking this design-based research, we used mixed-methods approach. The 4-session training was attended by anaesthesia and surgical trainees, registered nurses, technologists and included a video showing best practices, role plays, and peer-group reflection. We evaluated the programme through questionnaires, focus-group interviews with participants, written reflections by participants, and individual interviews with facilitators. Quantitative analysis was complemented by thematic analysis of focus-group and interview transcripts, reflections, and observer notes.

### Results

Our analysis revealed that participants had positive attitudes towards the training. They felt they had learned a lot from each other and the facilitators offered them the opportunity to interact with each other. Trainees especially valued the video presentation as it inspired them to revise old concepts and presented an excellent practical example of infection prevention in their specific setting.

### Conclusion

The training seemed to bridge the gap between knowledge and practice. However, direct observation of procedural skills and peer feedback could further reduce the gap, by enhancing the transfer of knowledge to practice.

## Introduction

A lack of evidence-based education and training constitutes a serious impediment to preventing surgical site infections (SSI) in low-middle-income countries (LMICs). Various initiatives have however been taken to reduce such infections in other countries, including educational awareness programmes, blended educational programmes, lectures, and videotaped presentations and educational meetings.<sup>1-6</sup> These initiatives, however, used educational strategies that were essentially aimed at teaching knowledge, skills, and attitudes in a rather fragmented way. Contemporary instructional design theories have recommended that learners engage in meaningful learning by performing whole, authentic learning tasks from real clinical practice that are ordered from simple to complex. More specifically, these theories have emphasised five principles that are vital when designing instruction. The first principle is that authentic professional tasks should be used as a starting point for learning.<sup>7-10</sup> Such tasks can take different forms, for instance, a video or role play shown to the learner. They should, in any case, closely resemble a professional job in real practice. Second, learners should be confronted with a variety of learning tasks so that they learn about the different varieties and situations in which a problem may present in practice. The third principle is, as mentioned, that learning tasks should be ordered from simple to complex; the simplest task should still be authentic and representative of a professional's task in real practice. Fourth, the learner must receive support and guidance while working on learning tasks, for instance in the form of reading materials or feedback from a teacher. This support should be substantial in the beginning and gradually be reduced as learners become competent (scaffolding). As soon as learners demonstrate that they can adequately complete a specific task without guidance, the next set of tasks may be offered at a higher level of complexity.<sup>7-9</sup> Finally, the fifth instructional design principle is about interprofessional learning, which occurs when participants from two or more healthcare professions (e.g. doctors, nurses, and technologists) learn to effectively collaborate, for instance, to prevent SSIs in the operating rooms (ORs) in a specific training programme.<sup>10,11</sup> This process is marked by active learning from and with each other.

The first four of these instructional design principles recall Merrill's first principles of instruction that emphasise the importance of engaging learners in solving real-world problems, activating their existing knowledge, presenting them with new knowledge, and encouraging them to apply and integrate this new knowledge.<sup>12</sup> In addition, Merrill stressed that new learning contents can be presented most efficiently by visualizing processes, demonstrating procedures, or modelling behaviours.<sup>12</sup> When all these principles are effectively applied in training, learners will acquire competencies as an



integrated set of knowledge, skills, and attitudes and be able to transfer these to professional practice.

With this knowledge in mind, we set out to design a training programme on SSI prevention that was based on the said instructional design principles of interprofessional, task-based learning (TBL). Our assumption is that this educational intervention will lead to increased knowledge, skills and attitudes regarding SSI prevention, and eventually to a decrease in SSI. Table 3.1 presents an overview of the main design principles on which the training was based. Intended for healthcare professionals (HCPs) working in the ORs, the programme was implemented in Pakistan, to see how it might work in a LIC. Finally, we formatively evaluated the programme by exploring participants' and facilitators' perceptions and experiences. With this knowledge in mind, we set out to design, implement and evaluate a training programme on SSI prevention that was based on instructional design principles using mixed methods.

### Research question

What are participants' and facilitators' perceptions and experiences of an interprofessional TBL programme aimed at supporting healthcare professionals in learning to prevent SSIs in a LMIC?

## Methods

### Study design

We conducted this design-based study in an authentic educational environment. That is to say, we first developed a training programme on SSI prevention, implemented it in a LMIC, and then investigated its outcomes using mixed methods.<sup>13</sup> This investigation consisted of a formative evaluation by relevant stakeholders, in this case, participants (HCPs) and facilitators. As explained in the Introduction and shown in Table 3.1, we designed the training programme in line with current instructional design principles or theories. With this intervention, we aimed to collect evidence about how the training might work in the specific context of a LIC, in this case, Shifa International Hospital, the teaching hospital of Shifa Tameer-e-Millat University in Islamabad, Pakistan.

**Table 3.1** Instructional design principles of a tasked- based interprofessional teaching and learning program, applied to the prevention of SSIs in ORs.

Serial Number	Instructional design principles
1	Interprofessional learning: learners from two or more health care professions, .i.e. doctors, nurses, and technologists, interactively learn about, from, and with each other to learn to collaborate effectively to prevent surgical site infection in the operating rooms.
2	Task-based training based on whole realistic tasks: learning tasks are derived from professional practice and ordered from simple to complex, e.g., starting with demonstrating best practice in a video, to practicing simplified but practical tasks, to practicing a variety of more and more challenging tasks from the daily routine of SSIs.
3	Guidance and feedback provided by the facilitators: The amount of guidance provided by the facilitators' decreases from one task to another until the learners can perform the tasks independently. The facilitators stimulate discussion rather than spoon-feeding by lecturing

## Intervention

The intervention was designed to bridge the gap between knowledge and practice in SSI prevention. The training comprised four sessions spanning two months. Every two weeks, participants gathered in a five-person interprofessional group for a two-hour session. The three sections into which the training was divided will be further discussed below.

### *Part I*

In part I, participants viewed a 10-minute video demonstrating an expert model of best practices in SSI prevention SSIs. The purpose of the expert video, which demonstrates the best practice for preventing surgical sites infection by healthcare professionals in their environment, is to give the participants an example or a situation they readily recognize as authentic in their own work setting as a starting point for discussing good practice habits. Participants compare this practice to their current practice and discuss ways to improve their current practice.

### *Part II*

Part II consisted of two role-play exercises (20 minutes each) for which participants played the role of a doctor, nurse, or patient. Role-plays were based on five case scenarios that covered the following topics: antibiotic prophylaxis, hand hygiene, use of clippers, and maintenance of normothermia. Appendix B presents an overview of the learning tasks used.

### *Part III*

Part III consisted of two facilitated peer-group reflection sessions that lasted 1.5 hours. During these sessions, participants discussed their experiences in applying what they had learned in daily practice and formulated the actions they planned to implement in their daily routine to improve site infection control.

### Participants

Participants were 20 conveniently selected HCPs who played a crucial role in improving patient safety and the quality of care: anaesthesia and surgical trainees, registered nurses, and technologists (six to seven from each group). Box 3.1 provides more detailed information about these participants. Despite their good clinical skills, participants lacked the knowledge, skills, and attitudes to prevent SSI, and consequently, integrate them inadequately into their SSI prevention practices. As they were used to collaborating in the actual OR practice, they could learn from and with each other. Therefore, this training programme was accessible to all the HCPs working in the ORs mentioned. The training was facilitated by two moderators: a nurse educator and an anaesthesia trainee with experience in conducting undergraduate-level problem-based learning at Shifa Tameer-e-Millat University.

### Data collection instruments

#### *Survey*

To evaluate participants' perceptions of the training programme, we used a questionnaire, which we administered to participants at the end of the last training session. The questionnaire consisted of 16 items to be rated on a 5-point Likert scale ranging from 4) strongly agree to 0) disagree (see Table 3.2 for the full questionnaire). Participants were directly approached by the researcher.

#### *Focus groups and individual interviews*

The principal researcher (MNA) conducted four focus-group interviews with participants (five members per group) to explore their perspectives and perceptions of the training programme. We held these focus groups for their explanatory and exploratory potential as they are commonly used to clarify, elaborate or salvage topics that are poorly understood or ill-defined in medical education. As such, they allowed us to obtain the views of various HCPs during the group discussions.<sup>14</sup> In addition to this, the principal researcher held 20-minute semi-structured individual interviews with facilitators to

probe their perceptions and experiences of the training. The six questions for facilitators are presented in the interview guide in Appendix A, as are the questions for participants. We obtained verbal informed consent before the start of the interviews; all interviews were digitally recorded.

## Reflection

We asked participants to write a brief reflection of 150 words maximum in which they contemplated the past weeks, whether the programme's intended learning goals were achieved and how the programme did or did not prepare them for SSI prevention.

## Analysis

### *Quantitative analysis*

We used Statistical Package for the Social Sciences (SPSS) software (IBM Corp, Released 2013. IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM CORP) to analyse the quantitative data, which will be reported in the form of Means (M) and Standard Deviations (SD) for each item. We flagged perceptions as 'positive' when the respective score exceeded 3.

### *Qualitative analysis*

After verbatim transcription of the focus group and facilitator's interviews. The researchers inductively analysed all transcripts, reflections, and observer notes, using the generally accepted principles of primary (open), secondary and tertiary coding. First, we identified response segments that were related to the research question (open coding). We subsequently labelled these segments to create categories (secondary coding). To reduce overlap among the categories, we read the categories that were associated with each other. In the final stage, we developed a framework to report results. Data analysis commenced when data gathering was still in progress, in an iterative process of constant comparison. The findings were discussed with participants to check for accuracy.

## Ethical approval

We obtained approval from the ethics committee of Shifa Tameer-e-Millat University (reference number IRB# 1169-445-2018). The participants could withdraw at any time for any reason. Only the researchers had access to the data, which were stored in electronic format, secured by a password, at Maastricht University.

## Results

### Quantitative results

The results presented in Table 3.2 show that participants had positive perceptions and experiences of the interprofessional TBL training. They indicated that the programme's learning environment, content, organisation, and facilitators helped them bridge the gap between knowledge and practice in SSI prevention in the ORs. The item with the highest score was *'I was allowed to reflect and discuss tasks with other participants'* ( $M=3.60$   $SD+0.60$ ). The item with the lowest score was *'The training provided me with a strong practical orientation to prevent SSIs in the OR'* ( $M=3.35$  and  $SD+0.67$ ).

**Table 3.2** Perception and experience of participants regarding the interprofessional TBL to prevent SSIs.

Items	<i>M</i>	<i>S.D</i>
The learning environment was friendly for interprofessional TBL.	3.45	0.51
The content was appropriate to prevent SSIs in ORs.	3.40	0.51
The training helps to bridge the gap between knowledge and practice to prevent SSIs in the OR.	3.50	0.51
The organization of training was good for interprofessional TBL	3.40	0.68
The training provided me with a strong practical orientation to prevent SSIs in OR.	3.35	0.67
Learners were allowed to make connections between the new and the knowledge they already had about the subject.	3.45	0.51
Facilitators encourage and motivate learners to participate actively in training.	3.45	0.60
During the training, the subject matter was discussed among the group members	3.55	0.51
The facilitator provides support in learning when needed	3.45	0.60
It is easy to initiate communication with a facilitator	3.55	0.51
The facilitator shows an interest in what participants have to say	3.45	0.51
The self-study was a central part of this TBL	3.40	0.50
Task used in the TBL was relevant to day to day clinical practice to prevent SSIs in OR	3.45	0.51
I am allowed to reflect and discuss tasks with other participants	3.60	0.60
Learners were provided with clear information about the goals and outcomes of the TBL	3.55	0.51
It is clear what was expected of me during this interprofessional TBL	3.40	0.51

### Qualitative results

Based on qualitative data analysis, we constructed the following four themes, which will be further discussed below: 1) different HCPs learn from each other, 2) the use of professional tasks enhances learning, 3) the facilitators provided scaffolding, and 4) the programme set-up could be improved. In the next paragraphs, each theme will be illustrated with quotes or reflections from participants (P) and facilitators (F).

## Theme 1: Different HCPs learn from each other

Participants' experiences of the interprofessional TBL programme were generally positive. They especially valued interacting with colleagues who had various years' experience and felt they learned from discussing and giving expertise views:

*"Not only doctors, nurses, and technologists were involved in learning together, but also people with different levels of experience were found in the same course. For instance, there were people with experience of ten years or more and some with relatively lesser experience. The point is, that everyone was learning the same thing."* (P1)

Working in teams in the ORs was central to their work, which required a firm understanding of each other's professional identity and role. Participants, therefore, deemed it beneficial if the training were offered as early as possible, as this would prepare the HCPs for their team role:

*"Interprofessional learning is effective in ORs as we work in a team. This training improves the understanding of each other's roles. Training should be provided to everyone working in the ORs at the time of the start of his job so that everyone becomes a team player."* (P1)

## Theme 2: Use of actual tasks enhances the application in practice

All participants valued the video showing best practices in SSI prevention because they saw their colleagues applying the evidence-based knowledge in their specific setting:

*"The learning format of the video was informative and captivating as per popular feedback. We saw our people practising the best evidence-based to prevent SSIs. All the sessions were admirable, but nothing could match the video session."* (F1)

Participants also noted that the tasks used in training were simple, complex, and valuable as they activated their thinking process and motivated them to understand the logic and scientific evidence behind every measure used to prevent SSIs:

*"Nothing ornamental or elaborated was imparted, but we learned the prevention of SSIs through simple tasks. This training challenged our thought process and conventional practices through challenging tasks."* (P3)

Furthermore, many participants appreciated the training for its potential to support them in applying knowledge with their colleagues, which is essential to SSI prevention:

*"This training has prepared me to practise safe and high-quality prevention of SSIs in the ORs in my country. It allows me to understand why guidelines are important and how, along with my colleagues, I can implement them."* (Reflection of P4)

### Theme 3: Facilitators provided scaffolding and support.

According to participants, the facilitators acted like guides, coaching them effectively while managing group discussions and dynamics. They created friendly learning environments that encouraged participants to discuss and actively learn from each other. Participants knew that the facilitators were there to guide them throughout the learning process when needed:

*"Facilitators provided us with reading materials and aided us during discussion sessions. They were highly unconventional and directed us at every step, yet they did not even overindulge us at all. They made sure we solved the tasks ourselves and at the same time fully assisted us." (P4)*

Interacting with an individual from a different level was often perceived as challenging in real clinical practice, however, it was not during this training. Owing to its amicable learning environment and educational climate, this interprofessional TBL programme afforded participants an excellent opportunity to interact with each other. The training not only enhanced learning but also clarified the perspectives and roles of others in the prevention of SSIs:

*"We had enough time to interact with facilitators and within the group. We brainstormed and discussed potential barriers within the group to solve tasks that not only made learning easy but also enhanced it." (P1)*

### Theme 4: Training setup could be improved by adding a workplace-based assessment and feedback.

Although perceptions were generally positive, some participants felt that the training could be improved by direct observations of procedural skills in the ORs, followed by peer feedback. Such addition could further enhance participants' learning of SSI prevention in the ORs:

*"I suggest that one more thing should be added to this course, "the practical demonstration". We tend to forget what we see, but if we do it practically within the peer groups, I think it will become a habit." (P4)*

A facilitator pointed out that the training might best be taught in a single-day workshop with protected educational time:

*"I would like to keep the training as a one-time learning experience because a clash between the timings of different healthcare professionals was observed. If the training is provided as a full day within the protective learning day, we think it will be more helpful." (F2)*

Finally, a few participants suggested that the learning materials and tasks be supplied in advance of the training, rather than on-site, to allow for preparation:

*"I would like to suggest that learning materials and tasks should be provided at least a week before the start of the training so that we read it before coming to the training, which will save us more time." (F2)*

## Discussion

In this study, we designed an interprofessional TBL programme aimed at SSI prevention in the ORs and implemented it in HCPs' real context in Pakistan to see how it might work in a LMIC. We subsequently evaluated the programme by exploring participants' and facilitators' perceptions and experiences. The programme combined a video showing best practices with case-based role plays. In the following paragraphs, we will discuss the quantitative and qualitative results of the existing literature and give suggestions on how the training might be improved.

The *quantitative results* of this study provided evidence that participants, facilitators, and observers' perceptions and experiences of the training under scrutiny were generally positive. The *qualitative results* explained why this was so: the tasks used for learning were realistic, relevant, interesting, engaging, and meaningful. Moreover, they were derived from participants' daily practice and were variegated, which facilitated the transfer of learning.<sup>7,8</sup> Participants especially valued the video session showing best practices in SSI prevention; it allowed them to discuss their current SSI prevention practices and compare them with the evidence-based best practices presented during the training. Participants also felt that the training had helped them develop the communication and speaking skills they needed when collaborating to prevent SSIs in practice.<sup>11,12</sup> Certain training parts were dedicated especially to the practising of these skills. From an educational viewpoint, this is desirable, as it may enhance transfer to practice even further. We concluded, however, that the training could gain from the addition of a fifth session where trainees discuss their experiences and ways to overcome any barriers encountered.

The previous educational intervention used to prevent surgical site infection neither utilized the instructional design principles<sup>1-6</sup> nor involved the healthcare professionals in the preparation of the planning, design, and evaluation of training to prevent surgical site infection in the operating rooms. Moreover, previous studies have not considered the context within which education and training were provided, as well as teaching strategies that actively engage the healthcare professionals in their learning and stimulate behavioral changes. Our educational intervention, on the other hand, utilized these principles and involved the healthcare professionals in the planning, design, and evaluation of training.



In summary, the results of this study show that the design principles used to develop this interprofessional TBL programme based on whole tasks and guidance and feedback from facilitators produced the desired effect. They also show that the training need not be expensive, for no expensive simulators facilities were required: an educational video, case-based discussions, and role-play proved sufficient. Practising in context with colleagues, their protocols, and standards also contributed to the development of a community of practice, while it improved understanding of the various other healthcare professionals' roles and responsibilities.<sup>15-17</sup>

### Strengths and limitations

The study's strength is the triangulation of data collected, using a survey among programme participants, focus-group interviews with participants, and semi-structured interviews with facilitators. Limitations include that the training was evaluated in the ORs of one hospital in one country (with a convenience sample of 20 participants) and only addressed participants' and facilitators' perceptions.

### Implications for research

Future research should investigate not only educational outcomes but also outcomes related to SSI incidence after this TBL training in settings with more participants. We also welcome investigations into whether the training leads to behaviour changes in the workplace and reduced SSIs.

### Implications for practice

Based on this study, we recommend that all OR staff receive similar training, preferably interprofessional and task-based, with their colleagues in their hospital. The training should be task-based and led by trained facilitators who act as coaches rather than teachers. Previous studies have shown that no institution is currently offering such training.<sup>10</sup> To ensure that everyone gets trained in SSI prevention, it is therefore imperative that medical institutions and governments take responsibility for organising this training.

## Conclusion

The participants and facilitators had positive views about the tasks used in the interprofessional TBL training programme. The video presentation was valued highly because it stimulated participants, who were HCPs from different professional backgrounds (i.e. doctors, nurses, and technologists), to revise their old concepts and it offered them an excellent working example of how to prevent SSI in their specific setting. Moreover, the facilitators offered participants the opportunity to interact with each other. As such, the programme seemed to bridge the gap between knowledge and SSI prevention practices in the ORs. To further enhance this transfer of knowledge to practice, however, it might be beneficial to include direct observations of procedural skills performed in the ORs as well as peer feedback.

## References

1. Howard DP, Williams C, Sen S, et al. A simple, effective clean practice protocol significantly improves hand decontamination and infection control measures in the acute surgical setting. *Infection*. 2009; 37(1):34-8.
2. McHugh SM, Corrigan MA, Dimitrov BD, et al. Preventing infection in general surgery: improvements through education of surgeons by surgeons. *J Hosp Infect*. 2011;78 (4):312-6.
3. Savino JA, Smeland J, Flink EL, et al. Implementation of an evidence-based protocol for surgical infection prophylaxis. Agency for healthcare research and quality rockville MD; 2005.
4. Rauk PN. Educational intervention, revised instrument sterilization methods, and comprehensive preoperative skin preparation protocol reduce cesarean section surgical site infections. *Am J Infect Control*. 2010;38(4):319-23.
5. Dimopoulou A, Kourlaba G, Psarris A, et al. Perioperative antimicrobial prophylaxis in pediatric patients in Greece: Compliance with guidelines and impact of an educational intervention. *J Pediatr Surg*. 2016; 51(8):1307-11.
6. Ozgun H, Ertugrul BM, Soyder A, et al. . Peri-operative antibiotic prophylaxis: adherence to guidelines and effects of educational intervention. *Int J Surg*. 2010;8(2):159-63.
7. Costa JM, Miranda GL, Melo M. Four-component instructional design (4C/ID) model: a meta-analysis on use and effect. *Learn Environ Res*. 2021;10:1-9.
8. Frerejean J, van Geel M, Keuning T, et al. Ten steps to 4C/ID: training differentiation skills in a professional development program for teachers. *Instr Sci*. 2021;49(3):395-18.
9. Daniel, M., Stojan, J., Wolff, M. et al. Applying four-component instructional design to develop a case presentation curriculum. *Perspect Med Educ*. 2018;7:276–80.
10. Oliveira MS, Seija V, D, Vignoli R, et al. . Online continuing interprofessional education on hospital-acquired infections for Latin America. *BJID*. 2017;21(2):140-7.
11. Aucamp MC. Best practices for teaching healthcare workers about infection prevention and control: a systematic review (Doctoral dissertation, Stellenbosch: Stellenbosch University).
12. Kuba, R., Rahimi, S., Smith, G. et al. Using the first principles of instruction and multimedia learning principles to design and develop in-game learning support videos. *Education Tech Research Dev*. 2021; 69: 1201–20.
13. Dolmans DH, Tigelaar D. Building bridges between theory and practice in medical education using a design-based research approach: AMEE Guide No. 60. *Med Teach*. 2012;34(1):1-0.
14. Gammie E, Hamilton S, Gilchrist V. Focus group discussions. *The Routledge companion to qualitative accounting research methods*. 2017;31:372-86.
15. Costello M, Huddleston J, Atinaja-Faller J, et al. Simulation as an effective strategy for interprofessional education. *Clin Simul Nurs*. 2017;13(12):624-7.
16. Correia HM, Strehlow K. Mindful Care and Compassion in Higher Education: Cultivating Communities of Practice. In *Mindfulness in the Academy*. Springer, Singapore; 2018:189-202.
17. Dalinghaus, K., Regehr, G. & Nimmon, L. Intersections of power: video conferenced debriefing of a rural interprofessional simulation team by an urban interprofessional debriefing team. *Perspect Med Educ*. 2021;10:286–92.

## Appendix 3.A

### The semi-structured Focus group interview guide

#### *Questions asked to facilitators*

- How did you experience being a facilitator of the whole interprofessional TBL?
- What worked better and what worked less well, and why?
- If you are delivering the same training in the future, what would you change?
- What is your opinion about the design of this interprofessional TBL?
- Do you think interprofessional TBL is suitable to train healthcare workers, especially in the context of Pakistan?
- What is your experience with the setup and structure of this training?

#### *Questions asked to course participants*

- What are the perceptions and experiences of trainees about the interprofessional TBL?
- How do you experience the whole task based interprofessional training to prevent surgical site infection in a low-income country?
- To what extent was learning content interesting, challenging, and relevant to the day-to-day practice of preventing surgical site infection?
  - How much do you think this interprofessional training helps you understand the concepts to prevent surgical site infection in the operating rooms, especially in low income?
- Do you think that enough opportunity and time was provided to you to interact with peers to solve tasks by using different learning material to prevent a surgical site infection?
- Do you think it is good to train doctors, nurses, and technologists in one group?
- Does the facilitator provide the instructional goals?
- Which part of the training was most beneficial to you?
- Which part of the training was least helpful?
- Was there anything you would want to add to the training?
- What would you like to change about the training?
- What is your opinion about the role of the facilitator?
- Do you think this course will help you to apply knowledge to prevent a surgical site infection?
- Do you think this interprofessional training course increases the understanding among doctors, nurses and technologists?

**Box S3.1      Background of the participants.**

The anesthesia and surgical residents are doctors who have passed their preliminary fellowship exam of the college of physicians and surgeons in anesthesia and surgery. The anesthesiologist influence most of the prophylactic measures to prevent surgical site infection at the beginning in the operating room. The medical literature identifies many areas where the anesthesiologist plays an influential role in preventing surgical site infection. It included antibiotic administration, peri-operative normothermia, hyperoxia, normoglycemia, smoking cessation, and hand washing.

The registered nurses have passed a 4-years bachelor's degree in nursing and are registered with the nursing council of Pakistan. In the operating theatre, they are responsible for observing and enforcing strict standards of aseptic technique and infection control protocols, ensure compliance with aseptic techniques and hand hygiene. They also participate in quality improvement and assurance.

The technologists are registered diploma holders from the faculty of health sciences. They earn certification by attending an accredited training course of 2 years. Surgical technologists are critical members of the team who ensure safe surgical care and prevent surgical site infection. Before surgery, they prepare patients for surgery by washing, shaving, and disinfecting the surgical incision site.

## Appendix 3.B

### Examples of scenarios for role plays and task-based learning

Parts of training	Scenarios for role plays and task-based learning	Information
Part I Video Show	Video showing steps to prevent surgical site infection in the operating rooms	Supportive information
Role-play:	<p>Role-play by an actual patient</p> <p><i>A 35-year-old health care worker had a lumbar discectomy done. He was fine and discharged from the hospital on the 3<sup>rd</sup> postoperative day. On the seventh postoperative day, he developed a fever of 39° C and throbbing pain at the incision site. He called one of his colleagues who live nearby. He asked to examine his surgical wound. His colleague sees purulent drainage from the incision along with swelling, redness around the surgical incision.</i></p> <p>Discussion: What went wrong in this case?</p>	Supportive information
Role-play:	<p>Surgeon shouting and learning to speak up</p> <p><i>Thirty-two years old male has surgery. His body is full of hairs. The surgeon wants to remove his hair before surgery. You are his assistant, and you start removing the hairs with a clipper. He shouted at you why you are using damned expensive clippers, how you would handle the situation.</i></p>	Supportive information
Case Scenario	<p><i>Rebecca, a multiparous woman, gravida 2, para 1, attends your clinic. Her previous child was delivered by cesarean section. At her anomaly scan, the low-lying placenta was detected. She has just followed her repeat scan at 32 weeks, which has confirmed that the placenta is still low lying. She is planned for the elective cesarean section. She is afraid as she had a surgical site infection after her previous cesarean. She had requested to provide her with a brief commentary on measures to prevent surgical site infection in her case.</i></p> <p>Task: She had requested to provide her with a brief commentary on measures to prevent surgical site infection in her case</p>	Reading material provided
Case Scenario	<p><i>The 40-year-old male has a liver resection in progress. The patient's heart rate is 70 per minute, blood pressure 130/80 mm of hg Spo2 99%. His temperature is 34.40C. Your consultant comes into the operating room and gets annoyed after looking at the monitor. He asks you, "What is the importance of normothermia before, during, and after surgery for the prevention of SSI? How does hypothermia cause SSI?"</i></p> <p>Task: What is the importance of normothermia before, during, and after surgery to prevent SSI?</p>	Reading material provided
Case Scenario	<p><i>It is reported in a meeting of infection control that retrosternal infection is widespread in diabetic patients after open-heart surgery. It is suggested that the morning blood sugar level of these patients are not adequately monitored and controlled. What can be a possible cause? How can uncontrolled blood sugar levels cause surgical site infection?</i></p> <p>Task: You are asked to investigate and give recommendations for health care professionals and hospital services to prevent this in future</p>	Reading material provided



# Chapter 4

The impact of interprofessional task-based training on the prevention of surgical site infection in a low-income country

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## Abstract

### Background

Training is considered instrumental in reducing surgical site infection. We developed training based on authentic tasks, interprofessional learning, and reflective learning for implementation in a low-income country where such training opportunities are rare. This study evaluated the results of training in terms of participants' acceptance, participants' knowledge acquisition, and their self-perceived behavior change.

### Methods

We included 145 participants in the voluntary training program, comprising 66 technologists (45.5%), 43 nurses (29.7%), and 36 doctors (24.8%) from Shifa International Hospital, Islamabad, Pakistan. We measured "satisfaction" using a questionnaire at the end of the training, "knowledge" through pre-and post-intervention assessments, and "self-perceived behavior change" using a questionnaire and interviews eight weeks post-training.

### Results

Pre- and post-test scores showed a significant increase in knowledge. Participants were favorable to the training and eager to participate. They positively applied in practice what they had learned about preventing surgical site infection. Our qualitative data analysis revealed two categories of themes, representing the upsides of the training as it stood, and existing factors or downsides that hindered the effective transfer of learning to practice.

### Conclusion

Participants were very enthusiastic about the training format. The knowledge test showed a gain in knowledge. Moreover, participants acknowledged that their behavior toward the prevention of surgical site infection in the operating rooms had changed. The use of authentic tasks from daily clinical practice, as well as the interprofessional approach and reflection, were considered to promote the transfer of learning. Although promising, our findings also pointed to obstacles limiting the application of evidence-based knowledge, such as a shortage of supplies and conventional practices.

## Background

Surgical site infection is one of the most common hospital-associated infections. In an unfortunate turn of events, it poses a threat to patient safety because of the high incidence of morbidity and mortality associated with it.<sup>1</sup> It accounts for 20% of all health-associated infections among hospitalized patients in the developed world. In low-income countries, moreover, its incidence is even 20 times higher compared to higher-income countries.<sup>1</sup> The burden of surgical site infection in these countries can be attributed, at least in part, to a lack of knowledge and training to prevent it.<sup>1,2</sup> The World Health Organization (WHO), the Association for Professionals in Infection Control, the Center for Disease Control and Prevention, the Society for Healthcare Epidemiology of America, and the Institute of Health Improvement have emphasized the importance of training healthcare professionals working in the operating rooms to prevent surgical site infections.<sup>3</sup>

Similarly, previous research has revealed that the training of healthcare professionals is instrumental in reducing this problem.<sup>4,5</sup> We therefore designed training based on the principles of authentic tasks,<sup>6,7</sup> interprofessional training,<sup>8,9</sup> and reflective learning.<sup>10</sup> To enhance the application and transfer of knowledge to healthcare workers' practice in the operating room, we ensured that the training context was similar to the real hospital setting. Participants were presented with authentic learning tasks in an interprofessional group of trainees, such that they also worked within the practice. Reflective learning was stimulated because it helped participants evaluate and compare their actual learning with good practice to prevent surgical site infections. Task-based training has previously been successfully applied in different health professional settings, such as teaching immunohistochemistry to postgraduates in China,<sup>11</sup> continuing medical education in neurology in Pakistan [6], and in the undergraduate medical clinical years in Turkey.<sup>12</sup> As most institutions in a low-income country rely on traditional teaching methods that emphasize passive knowledge acquisition and rote memorization with limited relevance to clinical tasks and healthcare professionals,<sup>13</sup> however, implementing the said training could be challenging.

We evaluated the training on a small scale by collecting the experiences of both participants and trainers. However, we did not evaluate the impact of the training with larger groups of participants. Based on our preliminary evaluation results, we improved the training design, for instance by adding an extra session at the end of the training, as suggested by participants. The purpose of this additional session was to discuss participants' experiences of using what they had learned in practice. The key focus was on discussing what went well and what did not about preventing surgical site infection in the operating rooms. Intended to strengthen the training's design principles, the session

enhanced the transfer of learning to practice: Participants discussed their experience (authentic learning) with their colleagues (interprofessional learning) and reflected on barriers and ways to overcome these (reflective learning).

The present study aimed to evaluate this revised, task-based, interprofessional training program on the prevention of surgical site infection in a low-income country. More specifically, we used a mixed-methods concurrent approach to explore participants' satisfaction with the training, measure its effects on the acquisition of knowledge, and investigate participants' self-perceived behavior change.

## Research questions

1. What are participants' perceptions of and satisfaction with the training? How well was the intervention implemented? (Questionnaire 1, completed at the end of the last training session).
2. Does participants' knowledge about the prevention of surgical site infection increase after the training? (Pre-and post-training assessments).
3. How do participants perceive potential behavioral changes following the infection prevention training program? (Questionnaire 2 and interview with participants: completed for evaluation of self-perceived behavior eight weeks after training).

## Methods

### Study design

We conducted a mixed-methods study using a concurrent design to evaluate the perceived and measured effectiveness of a design-based, interprofessional, task-based training that had been previously described, piloted, revised, and subsequently implemented. After redesigning the original training based on participants' feedback and suggestions,<sup>14</sup> we implemented the new training on a larger scale but in the same context.

The study was set at Shifa International Hospital, a jointly commissioned, internationally accredited, private tertiary care hospital of Shifa Tameer-e-Millat University in Islamabad, Pakistan, that is home to undergraduate and postgraduate medical and nursing schools. It is a postgraduate training center for many specialties, recognized by the college of physicians and surgeons of Pakistan, with a 650-bed hospital and 24 operating rooms performing more than 1,500 surgeries per month.

## Intervention

An educational intervention based on the principles of whole task-based, interprofessional, reflective learning was designed and implemented in the operating rooms to acquired knowledge and induce change in behavior regarding the prevention of surgical site infection. The training content addressed the 2016 global guidelines for the prevention of surgical site infections by the WHO. Spanning five workshops of one hour and 30 minutes each held consecutively on Wednesdays or Thursdays, the training lasted 7.5 hours in total. The training was conducted by three experienced and trained facilitators from the nursing education department and the anesthesia department, respectively, each with extensive experience of conducting problem-based learning at the undergraduate level at Shifa Tameer-e-Millat University.

## Participants

Participants were 145 healthcare professionals from the operating rooms, including 66 technologists (45.5%), 43 nurses (29.7%), and 36 doctors (24.8%) (Box 4.1). They enrolled voluntarily after an invitation to take part in the training sent via email and Whats App groups by the operating room nurse educator. Interested respondents enrolled after providing informed, written consent. Approximately eight weeks after the training, we approached all training participants for an interview by email. The first author of this study interviewed the first 10 who accepted the invitation.

### Box 4.1 Background of the participants.

*Technologists 66 (45.5%):* The technologists were diploma holders from the Faculty of Health Sciences who had been certified after completion of an approved two-year training course. The vital members of the team were surgical technologists who ensured safe surgical treatment and avoided contamination of the surgical site. They prepared patients for surgery before the operative procedure by washing, shaving, and disinfecting the site of the surgical incision.

*Nurses 43 (29.7%):* The nurses had completed a four-year bachelor's degree in nursing and were registered with the Pakistan Nursing Council. They were responsible for following and enforcing strict standards of aseptic techniques and infection prevention procedures in operating rooms, such as ensuring compliance with hand hygiene.

*Doctors 36 (24.8%):* The doctors were anesthesia and surgical residents who had passed their primary fellowship exam of the College of Physicians and Surgeons in Anesthesia and Surgery. At the time of training, they were practicing their postgraduate training in their respective fields.

## Instruments for data collection

We wielded the following instruments to evaluate the three levels of Kirkpatrick<sup>15</sup>; level 1 satisfaction with the training, level 2 knowledge acquired, and level 3 self-perceived behavioral changes, as shown in Figure 4.1.

### *Participants' satisfaction with the training*

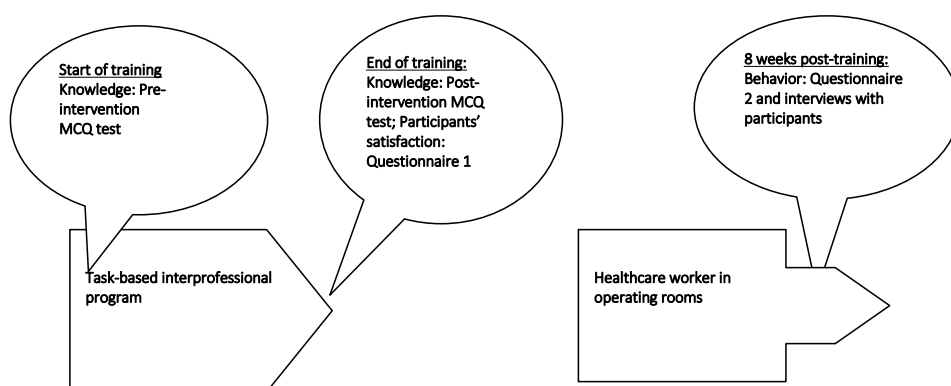
At the end of the last training session, we measured participants' satisfaction with the training using *questionnaire 1* which addressed the first research question shown in Figure 4.1. We operationalized "satisfaction" as the extent to which participants were satisfied with the training content and learning environment.<sup>15</sup> The questionnaire consisted of 16 items on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) that probed into how participants felt, what they thought, and how they experienced the training.

### *Knowledge*

We used *pre-and post-intervention knowledge assessments* to measure participants' knowledge acquisition, addressing research question 2 shown in Figure 4.1. Consisting of 14 multiple-choice questions (MCQs) about the training content, this test measured basic knowledge, the application of knowledge, as well as analytical and synthesizing skills. The MCQs were prepared by two educationalists, pilot-tested on non-participants, and reviewed by an expert panel before use in this study.

### *Self-perceived behavioral change*

We operationalized self-perceived behavioral change as the transfer of what was learned during the training to job performance. First, we administered a questionnaire (*questionnaire 2*) to collect information on self-perceived behavioral change eight weeks post-training shown in Figure 4.1.<sup>10</sup> This questionnaire consisted of 10 items on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) that probed into the extent to which participants applied in the operating rooms what they had learned during the training. Next, we held 10 *semi-structured individual interviews with participants* eight weeks following the training. Interviews lasted 15 minutes and were conducted by the primary researcher using a guide to gain insight into the changes in participants' behavior to prevent surgical site infection. The ultimate aim was to gain insight into how the training had made them change their practice or how it had not (and why). The interview guide is included in Appendix 4.A.



**Figure 4.1** The process of evaluating the implementation of task-based, interprofessional training in a low-income country: Pakistan. Knowledge was evaluated through pre-and post-intervention MCQ tests, participants' satisfaction through questionnaire 1 at the end of the training, and self-perceived behavior change through questionnaire 2 and interviews eight weeks post-training.

## Data analysis

We used Statistical Package for the Social Sciences (SPSS) software (IBM Corp, Released 2013, IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM CORP) to obtain descriptive statistics for the analysis of our quantitative data, including *means (M)* and *standard deviations (SD)* for each item. We also ran t-tests to compare the pre-and post-test results.

Two authors (MNA and AS) independently read the qualitative data, defining common patterns using a continuous comparative approach based on the commonly accepted concepts of primary, secondary, and tertiary coding, the identification of trends, and the use of participants' shared opinions.<sup>16</sup> The topics identified were coded independently to allow for a comparison of participants' responses. Before consensus was reached, all differences were addressed. These themes were presented to the second, fourth, and fifth authors during face-to-face online meetings via Skype. To test assumptions, the authors challenged the themes and illustrative codes. The Results section will feature illustrative quotes.

## Ethical approval

We obtained approval from the ethical committee of Shifa Tameer-e-Millat University (reference number IRB#329-819=2019). Participants could withdraw at any time for any reason. The data handling and storage were compatible with the law.

## Results

In the next paragraphs, we will discuss the quantitative and qualitative results of this study consecutively.

### Quantitative results

#### *Questionnaire 1: Participants' satisfaction with the training program*

Table 4.1 shows the mean scores (and standard deviations) for the factors relating to participants' satisfaction with the training. All items had high mean scores (i.e., >4) on a 1-5 scale. This holds for all the five scales, spanning goal achievement, the use of authentic tasks, how the facilitators supported the participants, the interprofessional characteristics of the training, and the organization. Hence, participants were generally very positive about all aspects of the training.

**Table 4.1** Evaluation of participants' satisfaction with the training program (N=145).

Serial No.	Item	Mean (1 to 5)	SD ±
<b>Theme 1: Goal achievement</b>			
1	The training helped me understand why it is essential to stick to surgical site infection guidelines related to operating rooms	4.62	0.50
2	The training helped to gain knowledge of surgical site infection prevention	4.40	0.49
3	This training helped to reflect on behavior regarding infection prevention	4.58	0.52
4	During this training, I learned to speak up to colleagues to prevent infections	4.60	0.49
<b>Theme 2: Use of authentic tasks</b>			
5	The task used was relevant to day-to-day clinical practice to prevent infections in the operating rooms	4.69	0.54
6	The video presentation was helpful to understand good practice to prevent surgical site infections	4.63	0.49
7	The video stimulated interest in infection prevention	4.61	0.51
8	The reading materials were helpful to gain a better understanding of infection prevention	4.57	0.59
9	The variety of tasks used in this training was helpful to gain a better understanding	4.69	0.46
<b>Theme 3: The facilitators</b>			
10	Facilitators encouraged learners to participate actively in training	4.62	0.53
11	The facilitators stimulated discussion among participants	4.63	0.49
12	The facilitators gave us full feedback	4.56	0.55
13	The facilitators stimulated participants to reflect on their practice	4.55	0.52

**Table 4.1** (continued)

Serial No.	Item	Mean (1 to 5)	SD ±
<b>Theme 4: Interprofessional learning</b>			
14	Discussion with professionals from different backgrounds helped to gain a better understanding of each other's perspectives	4.45	0.55
15	Discussions with professionals from different backgrounds were helpful to learn to speak up to other professionals	4.45	0.55
16	I learned to provide constructive feedback to other health professionals	4.51	0.55
17	Learning with other professionals during this training was helpful to understand that intervention requires teamwork	4.57	0.49
<b>Theme 5: Organization</b>			
18	The training was well organized	4.70	0.44

*Pre-test and post-test knowledge scores*

Table 4.2 shows a significant difference between pre-test and post-test scores with  $p < 0.00$ . The mean pre-test score was 49.10, and the mean post-test score was 86.46 (on a 1-100 scale).

**Table 4.2** Pre-test and post-test scores.

Test scores	Minimum	Maximum	Range	N	Mean	SD	P-value
Pre-test score	10	100	90	145	49.10	±8.02	<0.00
Post-test score	40	100	60	145	86.46	±14.06	

*Questionnaire 2: Participants' self-perceived change in behavior after the training*

Table 4.3 shows the mean scores (and standard deviations) for the three factors and their items relating to participants' self-perceived behavior change after the training. All items' scores were high (i.e., >4.1 on a 1-5 scale).



**Table 4.3 Self-perceived behavior change (N=145).**

Serial No.	Item	Mean (1 to 5)	SD $\pm$
<b>Theme 1: Application of knowledge</b>			
1	I applied what I learned about infection prevention during the training in my daily work	4.11	0.66
2	After the training, I became stricter in following infection prevention guidelines	4.31	0.58
3	After the training, I became better able to deal with barriers related to infection prevention	4.24	0.65
4	After the training, I became better able to speak up to others about infection prevention	4.26	0.70
<b>Theme 2: Teamwork and collaboration</b>			
5	After the training, I had a better understanding of other team members' roles in infection prevention	4.26	0.67
6	I have become more effective as a team member in infection prevention	4.33	0.62
7	Working relationships improved about playing a role in infection prevention	4.26	0.65
8	I now communicate in a better way with other healthcare professionals in the operating room	4.22	0.66
<b>Theme 3: Roles and responsibilities</b>			
9	I speak up to others about infection prevention when necessary	4.40	0.61
10	After the training, I had a better understanding of the professional role in infection prevention	4.40	0.67

## Qualitative results

Our qualitative analysis of the interviews resulted in the identification of two overarching themes that represented the upsides of the training as it stood and the downsides or factors that hindered the effective transfer of the things learned to practice.

### *Theme 1: The upsides of the current training*

The following sub-themes represent the positives of the training in its current format. Illustrative quotes are provided wherever applicable.

#### *The training produced a positive change*

Participants believed that the training increased their understanding and knowledge, which they could subsequently apply in the operating rooms to prevent infection:

*"This is the operating room; People are more considerate now about infection prevention. For instance, a few days ago, the use of razors in the operating room was met with criticism. "*

### *The training produced the will to overcome barriers*

Participants reported that the training had motivated them to follow the guidelines by making them understand the weakness of their healthcare system. Moreover, it had provided them with the will to overcome the barriers that hindered the application of knowledge to prevent surgical site infection:

*“Whenever someone tries to initiate an innovative task, there are hurdles. However, you just need to have the will and take the lead. It is because barriers are just in [your] mind. So if one overcomes them, it is a win-win situation.”*

### *The training includes relevant tasks from day-to-day practice*

Participants considered the tasks used during the training as relevant to the day-to-day practice of preventing infection. The use of these tasks during the training helped to gain a deeper understanding of how to apply good practice to prevent surgical site infection in the operating rooms:

*“The tasks assigned to us were the best part of the training as they were routine practice for us that we take to prevent surgical site infections. By solving them, we got a deeper insight, but we also learned to communicate better with other professionals about the solution. Along with this, it also gave me practical answers to my doubts and queries.”*

### *The multidisciplinary approach improved understanding of one’s role and of that of other healthcare professionals*

Many participants felt that the training had helped them to take a leading role, and to understand their responsibilities in preventing surgical site infection in the operating rooms:

*“Prevention of surgical infection is not a one-man show. It requires a multidisciplinary approach by involving the mutual coordination of healthcare professionals. Hence, working as a team helped us improve our communication and enabled us to formulate new ways to overcome the obstacles and ensure safe practice for the patients.”*

## ***Theme 2: The downsides of the current training***

The following sub-themes represent the downsides of the current training that hindered the effective implementation of the things learned in the operating rooms. Illustrative quotes are provided wherever applicable.

*Turnover of healthcare professionals complicates effective transfer of learning*

Some of the participants suggested that the frequent turnover of healthcare professionals complicated the application of the guidelines in everyday practice, often making it more “tricky.” Indeed, health professionals are continually leaving jobs to search for better financial opportunities elsewhere:

*“Health professionals leave jobs regularly because [of which] newcomers are not connected to the team; Therefore, this training should be provided more often so that they can help with the team.”*

*Shortage of supplies hinders the implementation of guidelines*

Some participants indicated that, despite the best of training, they could not follow the guidelines because the lack of medical supplies forced them to use alternative means, which, moreover, were not supported by scientific evidence:

*“Everybody says avoid razors, but because we could have clippers for five months and [then] have no clippers for a month, we are forced to go [over] to razors.”*

*Conventional practice hinders the implementation of guidelines*

Several participants noticed that some senior surgeons were guided by their personal opinion rather than by scientific evidence when engaging in clinical practice. That is, they preferred to stick to their conventional practices:

*“The infection prevention recommendations can also be difficult to use in practice as plastic surgeons also prefer to use razors to provide a hairless skin graft in plastic surgery.”*

## Discussion

This research was designed to evaluate the outcome of a task-based training aimed to prevent surgical site infection in the operating rooms that were implemented in a low-income country. In researching participants’ perceptions and acceptance of this training, we found that participants were pleased with how the training was conducted. They reported that their behavior in the operating rooms had improved at about eight weeks after the training (self-perceived behavior change). Moreover, participation in the training led to a knowledge gain, as was demonstrated by the improved scores for the post-test compared to pre-test scores. Subsequent interviews with the participants made clear that the use of tasks from daily infection control practices in the operating rooms and discussion with other healthcare professionals facilitated the transfer of

learning to practice. Similarly, the use of authentic tasks and reflection on how participants' current practice compared to recommended practices to prevent surgical site infection was perceived to promote the transfer of learning. Although the quantitative data showed positive results, the interview data pointed to some hurdles, such as the frequent turnover of professionals, a lack of supplies, and difficulties to break with conventional practices.

Participants were also positive about the fact that learning took place in small interprofessional groups. Promoting active learning, this approach stimulated them to reflect on ways to prevent surgical site infections.<sup>9,11</sup> Participants were placed in complex situations for them to analyze and learn how to solve these together. As the training differed from the conventional teaching methods often used in health institutions in Pakistan, such as lecturing,<sup>17</sup> most participants had their first experience of being actively engaged in learning tasks. More specifically, through brainstorming, self-study, and discussions, participants were actively involved in discussing the tasks assigned to them to avoid surgical site infection. These activities, combined with authentic, professionally relevant tasks, are perceived to induce behavioral changes in participants.<sup>11-13</sup>

Another reason why this interprofessional learning was perceived as beneficial for the transfer of learning was that the group composition resembled that of the teams in which participants worked in real practice. The small groups enabled participants to gain insight into the strengths and weaknesses of the healthcare system they worked in by reflecting on their current infection control practices. Videos showing good practices to prevent surgical site infection served as input for discussion. Finally, participants discussed strategies to overcome the flaws of the system and reflected on ways to reduce surgical site infection and improve patient safety. This training was perceived to improve the behavior of the participants.

## Strengths and limitations

The strength of this study is that the training was based on current instructional design principles, including the use of authentic, meaningful tasks, interprofessional teams, as well as reflection. The strength of this study is that we used various tools to evaluate the training, both at the end of and eight weeks after the training.

A few limitations also need addressing. The first limitation is that this is a single-center study. The training was implemented in a private hospital in a resource-poor setting, limiting the transferability of the results to the public sector hospitals where resources may be even scarcer than in the private hospital where this study was performed. A second limitation is that the training was of relatively short duration, which might not

have been enough to effect a sustainable change in preventing surgical site infection in the operating rooms. If such change is desired, institutions and countries should develop a master plan to ensure repeated training to prevent surgical site infections in low-income countries. A third limitation is that although changes in pre-/post- knowledge tests results have been found, this provides insufficient evidence for determining that these can primarily be attributed to the training or a re-testing effect. We have no further data about the construct validity of the test, but we ensured the content validity given that the test items were measuring four aspects we included in the training: basic knowledge about infection, application of knowledge into clinical practice of infection prevention. A fourth limitation of this study is that the positive responses might be partly caused by participants giving socially desirable answers. Participants did, however, also mention negative aspects of the training during interviews and the researchers stimulated them to take a critical view. A final limitation is that we only collected self-reported data, without observing how participants behaved in real practice.

### *Implications for research*

Future research should focus on the effect of the training on the incidence of surgical site infection at the institutional level, coupled with measurements and observations of the mid- and long-term outcome in terms of increased compliance with infection guidelines. We also invite replications of our study in other hospitals with a similar or different context. Further observational studies are needed to investigate the effects of longitudinal training on the behavioral changes in healthcare professionals to prevent surgical site infection.

### *Implications for practice*

This interprofessional task-based training should be provided to all healthcare professionals at the beginning of their job and periodically, at least every two years, to prevent surgical site infection. Periodic evaluation of the effectiveness of the training program and assessment of knowledge of preventing infection in operating rooms should be undertaken on a routine basis. As a minimum requirement for the renewal of their job contracts, healthcare professionals should be requested to participate in training to prevent surgical site infection.

## Conclusion

The training was well-received by participants and led to a significant knowledge gain as the difference between pre-test and post-test scores suggested. The discussion with other healthcare practitioners while solving authentic tasks, coupled with current, good practices to prevent surgical site infection enabled participants to practice what was taught during the training. The use of authentic tasks from daily clinical practice was considered to promote the transfer of knowledge to practice. However, although the findings from our quantitative survey were very promising, the interview results showed that there are some obstacles to the application of evidence-based knowledge to prevent surgical site infections, such as the frequent turnover of healthcare professionals, a lack of supplies, and difficulties to break with conventional practices.

## References

1. Rojas-Gutierrez E, Vilar-Compte D. An Overview of Surgical Site Infection in Low-and Middle-Income Countries: the Role of Recent Guidelines, Limitations, and Possible Solutions. *Current Treatment Options in Infectious Diseases*: 1-7.
2. Khan MN, Verstegen DM, Bhatti AB, Dolmans D.H., van Mook WN. Factors hindering the implementation of surgical site infection control guidelines in the operating rooms of low-income countries: a mixed-method study. *Eur J Clin Microbiol Infect Dis*. 2018;37(10):1923-9.
3. Aucamp MC. Best practices for teaching healthcare workers about infection prevention and control: a systematic review (Doctoral dissertation, Stellenbosch: Stellenbosch University).
4. Safdar N, Abad C. Educational interventions for the prevention of healthcare-associated infection: a systematic review. *Crit Care Med*. 2008;36(3):933-40.
5. Cherry MG, Brown JM, Neal T, Ben Shaw N. What features of educational interventions lead to competence in aseptic insertion and maintenance of CV catheters in acute care? BEME Guide No. 15. *Med Teach*. 2010;32(3):198-218.
6. Susilo A.P., van Merriënboer J, van Dalen J, Claramita M, Scherpbier A. From lecture to learning tasks: use of the 4C/4D model in a communication skills course in a continuing professional education context. *J Contin Educ Nurs*. 2013;44(6):278-84.
7. Dolmans DH, Wolfhagen IH, Van Merriënboer JJ. Twelve tips for implementing whole-task curricula: How to make it work. *Med Teach*. 2013;35(10):801-5.
8. Flood B, Smythe L, Hocking C, Jones M. Interprofessional practice: beyond competence. *Adv Health Sci Educ*. 2019;24(3):489-501.
9. Vijn TW, Wollersheim H, Faber MJ, Fluit CR, Kremer JA. Building a patient-centered and interprofessional training program with patients, students and care professionals: study protocol of a participatory design and evaluation study. *BMC Health Serv Res*. 2018;18(1):387.
10. Wang Q, Li H, Pang W, Liang S, Su Y. Developing an integrated framework of problem-based learning and coaching psychology for medical education: participatory research. *BMC Med Educ*. 2016;16(1):2.
11. Tian Y, Li C, Wang J, Cai Q, Wang H, Chen X, Liu Y, Mei F, Xiao L, Jian R, Li H. Modified task-based learning program promotes problem-solving capacity among Chinese medical postgraduates: a mixed quantitative survey. *BMC Med Educ*. 2017;17(1):153.
12. Vakani F, Jafri W, Ahmad A, Sonawalla A, Sheerani M. Task-based learning versus problem-oriented lecture in neurology continuing medical education. *JCPSP: J Coll Physicians Surg Pak*. 2014;24(1):23.
13. Ozkan H, Degirmenci B, Musal B, Itil O, Akalin E, Kilinc O, Ozkan S, Alici E. Task-based learning program for clinical years of medical education. *Educ Health ABINGDON*. 2006;19(1):32-42.
14. Dolmans DH, Tigelaar D. Building bridges between theory and practice in medical education using a design-based research approach: AMEE Guide No. 60. *Med Teach*. 2012;34(1):1-0.
15. Moldovan L. Training outcome evaluation model. *Procedia Technology*. 2016;22:1184-90.
16. Thomas DR. A general inductive approach for qualitative data analysis.
17. Tracy SJ, Hinrichs MM. Big tent criteria for qualitative quality. *The international encyclopedia of communication research methods*. 2017 Apr 24:1-0.
18. Latif Z, Nizami R, Riaz H. Faculty perceptions about continuing medical education activities. *Adv Health Prof Educ*. 2017;2(1):16-9.

## Appendix 4.A

### Semi-structured interview guide

#### *Introduction*

I would like to ask you some questions regarding the SSI training that you followed a few weeks ago. I will use your feedback to improve this training further, so please feel free to share positive and less positive experiences. What you tell me will only be reported anonymously.

#### *Opening question*

1. What do you remember most about the training?

#### *Main questions*

1. We are especially interested in whether you have been able to apply what you have learned in practice.
2. What are your experiences trying to apply what you learned during the practice course?
3. What did you or your team change? Can you give some examples? Can you explain how you introduced this change?
4. Which characteristics or aspects of the course were helpful to make this change happen? Can you give an example and explain why this was helpful?
5. What could you not do in practice? Why?
6. What are the barriers that you meet when you try to apply what you learned?
7. During the training, you worked in a group of professionals with different training backgrounds (physicians, nurses, technicians). How did this enhance you or your team to make changes?
8. What else would you like to add to the discussion?





# Chapter 5

Stakeholders' perceptions about a surgical site  
infection master training plan for  
a low-middle income country

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*Submitted*

## Abstract

### Background

Training is a critical component for improving the practice of surgical site infections (SSI). We have designed a master training plan characterized by a task-based, interprofessional and reflective approach consisting of initial training of employees and subsequent refresher training. It aims to improve the practice of SSI in hospitals. The research question was: How do policymakers, teachers and managers/leaders of health care institutions perceive the outline of a master training plan for SSI?

### Methods

Semi-structured interviews were conducted with a purposive sample of twenty-eight stakeholders from three categories.

### Results

Four key themes emerged from the interviews: Discussion of authentic tasks fosters the transfer of knowledge to the workplace; interprofessional reflective learning comes with challenges; the master training plan help to change behaviour, and is feasible with limited resources. However, the stakeholders pointed that interprofessional training creates friction among health care professionals who work together and participate in the interprofessional training sessions. To disseminate the training across healthcare facilities, stakeholders suggested developing a train-the-trainer plan. Furthermore, stakeholders suggested making health care professionals accountable for actual behaviour changes in the workplace.

### Conclusion

The stakeholders agreed with the approach that the master plan is based on. Implementing this master training plan was expected to encourage knowledge and skills to practice. Participants indicated that arranging training might be feasible in different institutions and it should be part of undergraduate, postgraduate, and continuing medical education. The stakeholders perceived the outline of the master training plan to be well suited for implementation in LMIC.

## Background

The most frequent complication in postoperative health care settings is surgical site infection (SSI). SSI has a substantial effect on morbidity and death rates. SSI negatively impacts the quality of life and increases patients’ suffering and distress. In addition, SSI has an economic impact, particularly when patients have to pay for medical costs themselves. It may contribute to personal hardship and increased healthcare costs.<sup>1-4</sup> Preventing SSI in the hospital is critical to achieve high-quality care, patient safety, and health security.

Eight core components were proposed by the WHO to enhance patient protection and promote quality in delivering healthcare services, see Table 5.1.<sup>5-7</sup> Implementing these eight components will prevent a large portion of SSI, especially in countries where infection control is limited or non-existent. The WHO recommends that relevant health care professionals be educated and trained on guideline recommendations.

**Table 5.1      WHO Core components to prevent a surgical site infection.**

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Core component 1: infection prevention and control program
Core component 2: Infection prevention and control guidelines
Core component 3: Infection prevention and control education and training
Core component 4: Surveillance of health-associated infection
Core component 5: Multimodal strategies
Core component 6: Monitoring and audit
Core component 7: Workload, staffing, and bed occupancy
Core component 8: Built environment, materials, and equipment for Infection prevention at the facility

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In a previous study, we have created and evaluated an initial training based on three principles; task-based learning,<sup>8</sup> interprofessional learning,<sup>9,10</sup> and reflective learning<sup>11</sup> see Table 5.2. We designed training for healthcare professionals working in operating rooms (ORs), provided in their hospital. In this training, they learned about SSI by discussing a set of authentic tasks encountered in their clinical practice to gain a better understanding of its challenges and possible solutions. The training was provided to an interprofessional group or participants to stimulate interactions and to encourage professionals to reflect both on themselves and the problems they face in their practice. The training was judged favorably by the participants and they reported that they learned new competencies. Involving all the (multi-disciplinary) stakeholders early in the process increased its success.<sup>12,13</sup> However; a single training will not be enough to cause sustainable awareness and behavioural change regarding infection prevention and successfully prevent SSI in the long run. Moreover, a systematic plan will be required to roll out training to all healthcare professionals, taking into account the available

resources in Low-middle-income country (LMIC). We developed a master training plan that proposes initial training of all involved healthcare professionals *plus* regular follow-up meetings and training based on task-based, interprofessional, and reflective learning [Appendix 5.A]. To implement the master training plan, the support of stakeholders: policymakers, teachers in health care education, and managers/leaders of health care institutions is essential. This study explored whether and how the master training plan for education and training can be implemented in a LMIC and whether it is likely to lead to sustainable behaviour change. We investigated the perceptions of stakeholders to gain their insights.

**Table 5.2      The principles of tasked based interprofessional reflective learning.**

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In tasked-based training a set of tasks addressed by health care professionals in clinical practice serves as the learning focus. Participants learn about a variety of tasks that instructors assign to them. The learning is organized around the tasks, and the learner attempts to comprehend not only the tasks themselves but also the concepts and mechanisms underlying the tasks.
Interprofessional learning is defined as learning that occurs as a result of interactions between members of two or more professions. This could be the result of interprofessional education or it could happen on its own in the workplace.
Reflection is a metacognitive process that occurs before, during, and after situations to gain a better understanding of both the self and the situation so that future encounters with the situation are informed by previous encounters.

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Research question

How do policymakers, teachers in health care education, and managers and leaders of health care institutions perceive the outline of a surgical site infection master training to enhance sustainable awareness and induce behavioural change about SSI prevention in a Low middle income country?

Materials and methods

Study design

A qualitative individual interview study was conducted to explore how various stakeholders perceived the outline of the SSI master training plan to enhance sustainable awareness and induce behavioural change about SSI prevention in Pakistan.

## Context

Pakistan is a LMIC where SSI is a severe problem. Most undergraduate and postgraduate medical teaching in Pakistan uses traditional teaching methods, such as lectures and studying books, with little interaction between students and teachers. In private and public sector health institutions, seventy-five percent of the curriculum content is taught by traditional lectures.<sup>14</sup> Despite some progress, most colleges continue to implement teacher-centered, traditional subject-based curricula and are managed by teachers with little formal training in teaching and learning. Currently, there is no evidence-based training on the prevention of SSI for health care professionals, neither in initial (undergraduate) education nor in continuing (postgraduate) education. For this study, we focus on post-graduate education and training in private and public hospitals in Pakistan.

## Participants

This study included three categories of participants: eight policymakers at the local, regional, and national levels, ten hospital leaders/managers of healthcare institutions, and ten teachers/educators (see Table 5.3). Sampling was purposely to include participants from Pakistan's public, private, and military health systems and with different professional backgrounds, e.g. surgeons, gynecologists, and anesthesiologists, and various training backgrounds in Pakistan and abroad. Purposive sampling was employed to have maximal diversity and gain deeper insight. In total, twenty-eight individual interviews were conducted. Three stakeholders were unable to participate due to professional obligations. The participants were personally contacted via cell phone. Interviews were held at a time and location that was convenient for them.

**Table 5.3      The participants of the study.**

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Policymakers: An individual who makes policies and is involved in education in health care institutions, i.e., members of governing bodies.

Teachers in health care education: An individual with the power to influence the opinions and behaviour of others, i.e., medical and nursing teachers. Health care professionals registered as a faculty with Pakistan medical & dental, College of Physicians & Surgeons of Pakistan and Pakistan Nursing Council,

Managers and leaders: An individual who has an interest in the decision to implement guidelines and who actively supports an innovation, i.e., managers, anesthesiologists, surgeons, infection control nurses, supervising residents, and team leaders

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## Interviews

Semi-structured interviews were conducted between January and February 2021 and lasted approximately an average of 22 to 24 minutes. Interview questions related to the components of the outline of the master training plan and its approach, i.e. the principles of interprofessional, tasked-based, and reflective learning. Furthermore, interview questions focused on the expected impact, the cost-effectiveness of the plan, and the suitability for a LMIC. The semi-structured interview guide can be found in Appendix 5.B. Participants received a copy of the information sheet detailing the process and aims two to three days before the interview. MNA conducted all interviews in English. The interviews were transcribed and pseudonymized.

## Data analysis

Data were analyzed through a thematic approach. Data saturation was reached after 23 interviews. No new information appeared in the last five interviews. We combined inductive and deductive coding. Initially, the first and third authors (MNH and ABH) independently read the verbatim transcripts and identified general issues. Although we analysed the stakeholders' perspective, we also used several sensitising concepts, including the three principles, being authentic, interprofessional, and reflective learning to gain a better understanding of the participants' voices on a more theoretical level. All five authors participated in the discussion and refinement of themes. The generated themes were discussed and cross-checked with all authors (DV, DD & WvM). The team discussed differences in perspective among authors until consensus was reached.

## Reflexivity

The researchers' different backgrounds widened and enhanced the data analysis. MNA and ABH are well-versed in surgery and the safety of ORs in Pakistan. The same can be said for WvM in the Netherlands. DV and DD are educational scientists with a background in instructional design.

## Ethical approval

The study was granted ethical approval from the Shifa Tameer-e-Millat University Ethical Committee (reference number IRB # 435-1255-2020). The participants could withdraw from the study at any point for any reason. The data were safely stored and available only to the researchers.

## Results

The analysis of the interviews data resulted in the identification of four key themes [see Table 5.4]: Discussion of authentic tasks fosters the transfer of knowledge in the workplace; Interprofessional reflective learning comes with challenges; the master training plan will help to change and sustain behaviour; The master-training plan is feasible with limited resources. We will consecutively discuss these themes in the following sections. Illustrative quotes are presented.

**Table 5.4 Themes and subthemes related to stakeholders' perception of the master training plan.**

Themes	Sub-themes
1 Discussion of authentic tasks fosters the transfer of knowledge in the workplace.	Enhances decision-making and critical thinking skills. Participants see the potential impact of the training immediately.
2 Interprofessional reflective learning comes with challenges.	Good to include all personnel involved. The potential risk of friction was between colleagues.
3 The training master plan will help to change and sustain behaviour.	Training can have a ripple effect: knowledge and skills transfer from one health care professional to another. Health care professionals should be held accountable for SSI prevention after the training. The support of heads of the departments is a significant stimulus to reduce SSI.
4 The master plan for training is feasible with limited resources.	The plan is feasible and easily implemented, in the context of own work and the local language. Training makes use of available resources which are conducive to a LMIC. A train the trainers' plan is recommended.

### Discussion of authentic tasks fosters the transfer of knowledge in the workplace

Stakeholders agreed with the task-based approach proposed in the master plan. They thought that discussion of authentic tasks in small groups with colleagues would foster understanding. Trying to solve actual problems was perceived to stimulate critical thinking and transfer knowledge and skills to the workplace. During the training, health care professionals learned to work together to prevent infection and deliver safe, high-quality surgical care to the patients.

*"Task-based training enhances decision-making and critical thinking skills as you learn a particular situation. That's when you figure it out and find a solution."*  
(Participant 4)



Second, stakeholders believed that this master training plan would bring together health care professionals. Because the training is interactive, participants can learn what works and what does not in their specific situation.

*“Since the training is practical, professionals can see the results immediately and determine what works and what doesn’t work for them.” (Participant 10)*

#### *Interprofessional reflective learning comes with challenges*

In general, stakeholders were positive about learning with colleagues from different professions. Some even suggested expanding the training to the housekeeping staff working in the operating rooms. However, others were concerned that this kind of interprofessional training with colleagues could trigger friction since some participants may have more knowledge and experience than others. Some participants may have a higher position in the health care system than others and this might hamper interactions between participants; juniors might not feel safe to speak freely and openly.

*“Reflective learning can be challenging to implement because it involves bringing together different people, from cleaners to top surgeons, and sharing ideas on where the fault might be or improve. However, reflective learning becomes challenging to implement due to the difference in education and experience between healthcare workers.” (Participant 15)*

#### *The training master plan will help to change and sustain behaviour*

The stakeholders thought that the master training plan would lead to sustainable behaviour change in different ways.

Firstly, they expect that training will have a ripple effect. Once health care professionals are aware and equipped with skills to prevent SSI, they are expected to become ambassadors of infection prevention. The master training plan will help develop a culture of infection prevention throughout the hospital.

*“A nurse is employed in the OR and transferred to another integral unit after being taught these modules. Eventually, training and knowledge would be passed on to other healthcare staff, causing a ripple effect.” (Participant 8)*

Secondly, stakeholders agreed that the longitudinal, repetitive approach in the master training plan will cause a sustainable change in the behaviour of health care professionals. They recommend that training should also be incorporated in the medical and nursing schools to start teaching on this topic early. This might help to gain awareness of prevention measures once nurses and doctors start their clinical careers. Moreover, they agreed that there should be regular follow-up training as proposed in the master plan.

*"Training is often held, but people think it's a one-time experience and often forget it. As a result, follow-up sessions will help them recall the information and integrate it into their everyday life, which is the module's most critical element." (Participant 21)*

Thirdly, stakeholders believed that healthcare workers should be held accountable for following SSI prevention guidelines. They mentioned different ways to do so: incorporating rewards, financial rewards, and incentives, or penalties or warnings when guidelines are not applied.

*"Cultural or individual behaviour sometimes dictates the personality of the individual. However, teaching people the right way can change that. Nevertheless, if a person still chooses not to observe what they are taught, there should be some kind of penalty or warning. It also shows that they are accountable to the organization." (Participant 18)*

The interviewees initiated a lot of discussion about the organization's role in preventing surgical site infection. The stakeholders expressed that it would be vital to include the leadership of organizations in implementing the master training plan; more specifically, to ensure the support of the heads of the departments for implementing the master training plan and to create a sustainable culture of infection prevention.

*"If the head of the department understands and wants to reduce the percentage of infection, then it will be a major stimulus for the institution. After that, the practices will change, and the outcome will eventually change." (Participant 22)*

#### *The master training plan is feasible with limited resources*

Stakeholders thought that the master training plan was feasible, acceptable, and easily implementable for different reasons. Firstly, the plan is attractive because training is proposed to take place locally and interprofessionally, with colleagues that also work together in practice. During training sessions, they discuss problems they face in their daily practice and find solutions for them. In addition, they discuss with their colleagues and in their local languages, and this will stimulate dialogue and interaction among participants.

*"It is feasible and easily implemented, as we usually use the same language as local audiences when presenting videos, role plays, case scenarios, or task-based learning. So it's not only easier to understand, but it's, even more, interactive." (Participant 22)*

Secondly, stakeholders noted that the master training plan is cost-effective because it relies on resources like role-plays, case descriptions, and video fragments that are already available with limited costs.

*"It doesn't require a substantial budget. It includes activities such as role-playing, video clips, and task-based learning. These instruction methods don't require many gizmos or complex setups." (Participant 3)*

Finally, stakeholders identified that up scaling is necessary to implement the master training plan at a national level systematically. This implies that a national program manager responsible for organization and content is indispensable. In their views, teach-the-teacher programs should be put in place to recruit and train more trainers to become certified teachers.

*"You can't train everyone; you'll need more facilitators. You'll need to teach them how to conduct the interprofessional task-based training." (Participant 11)*

## Discussion

All the stakeholders agreed that a master plan for training is useful and essential to improve the prevention of SSI: repetitive training interventions were perceived necessary to induce sustainable behavioural changes. The stakeholders were positive about the educational approach proposed in the master training plan, which is based on interprofessional, task-based, and reflective learning. This approach is perceived to enhance comprehension and transfer of skills to the workplace. In addition, they judged the outline of the master training plan to be well adapted to the LMIC, given that it requires limited implementation costs. Despite the advantages of the interprofessional nature of the training program, the stakeholders pointed out that it may create friction between health care professionals who work together and participate in the same interprofessional training sessions (see below). Furthermore, stakeholders suggested making health care professionals accountable for behaviour change in the workplace, for instance by rewarding their efforts. Finally, to further disseminate the training across other healthcare facilities and health care professionals, they suggest developing a train-the-trainer plan.

Stakeholders confirmed the feasibility and cost-effectiveness of the outline of the master training plan. They noted that the role-plays, case studies, and video films herein used are inexpensive and readily available resources. Thus, implementation was considered feasible, and this master training plan was seen as a helpful alternative to the more expensive simulation-based training to prevent SSI.<sup>5,6</sup>

The master training plan relies on interprofessional training at the workplace. The stakeholders saw this as an advantage but pointed out that difference in educational level, seniority, and hierarchical positions might hamper interactions between participants. Seniors may be seen as having more knowledge, abilities, and experience

in preventing SSI than others.<sup>4</sup> We did, however, not observe this in our earlier study on interprofessional SSI training in Pakistan.<sup>12,13</sup> Hence we would propose that training should continue to be interprofessional<sup>8,9</sup> because this will result in a better understanding of roles and responsibilities, as well as other professionals' strengths and weaknesses.<sup>9,10</sup>

To improve healthcare professionals' behaviour regarding infection control, stakeholders suggested incorporating rewards, financial incentives, and penalties for noncompliance to the newly acquired knowledge and skills. This implies that accountability for infection control must be linked to clear expectations and reasonable goals, such as, e.g. providing evidence of increased compliance with infection prevention bundles and decreased infection rates. There has been some debate about whether punishment is more effective than reward,<sup>15</sup> but a recent study suggests that rewards may be the way to go if you want to boost good behavior.<sup>16</sup>

For the systematic spread of the master training plan on a national level, the stakeholders suggested developing an interprofessional train-the-trainer program with the involvement of the different stakeholders: hospital management, policymakers, and medical educators.<sup>17,18</sup> Train-the-trainer programs effectively expand the training from a single institution to a local and regional health institution. To properly expand the master training plan regionally and nationally, a surplus number of trainers is paramount, preferably both with the understanding of interprofessional task-based reflective learning and clinical practice. The outline of the master training plan used in this study could set the first stage for harmonizing infection prevention activities.

## Strengths and limitations of the study

The first strength of this study is that it was executed in a LMIC and included a wide range of stakeholders with extensive experience working, teaching, and policymaking in the public sector and private hospitals. The second strength of the study is that the master plan is based on learning theory, more specifically, the principles of task-based, interprofessional and reflective learning.

The study was limited to the participant's perception of the outline of a master training plan. We did not evaluate its actual impact in practice because the master plan is not yet fully developed and implemented. A second limitation is that we only explored perceptions of stakeholders in Pakistan. Results in other resource-constrained contexts might be different.

## Implications for practice

A consistent and systematic effort is required to prevent surgical site infection in the LMIC. It needs a well-coordinated master training plan supported by the hospital, regional, and national stakeholders, i.e. managers & leaders, teachers in health care institutions at the regional level, and policymakers at the national level. The construction of the outline of such a master training plan will necessitate a collaborative effort. Workplace-based interventions must accompany SSI prevention training, and healthcare practitioners should be held accountable to ensure long-term behavioral change. We strongly recommend that training be set up locally and interprofessionally, i.e. doctors, nurses, and technologists working in operating rooms together, if possible with colleagues from the participants' workplace, and based on authentic learning tasks from their practice. We recommend beginning with a pilot initiative in one hospital, focusing on locally educating health care professionals and building a thorough master training plan. This pilot can then be expanded to the regional and national levels.

## Implications future research

After initial education and training, several longitudinal studies using pre and post-measurements of surgical site infection would be needed to observe the effect of this master training plan on the incidence of surgical site infection. Furthermore, the number of refresher courses required to establish and maintain a surgical site infection culture in LMIC ORs must be ascertained.

## Conclusion

The task-based, reflective, and interprofessional learning components of the SSI prevention master training plan were perceived to foster understanding, transfer of knowledge, and skills to the workplace. The training plan was well adapted to the context with minimal costs to implement in a LMIC setting. Train-the-trainer programs to systematically promote long-term change to implement the master plan at the national level were considered critical to induce sustainable behavioral changes.

## References

1. Rojas-Gutierrez E, Vilar-Compte D. An overview of surgical site infection in low-and middle-income countries: the role of recent guidelines, limitations, and possible solutions. *Current Treatment Options in Infectious Diseases*. 2019;11(3):300-16.
2. Protocol for surgical site infection surveillance with a focus on settings with limited resources. Geneva: World Health Organization; 2018. License: CC BY-NC-SA 3.0 IGO.
3. Bhangu A, Ademuyiwa AO, Aguilera ML, Alexander P, Al-Saqqa SW, Borda-Luque G, Costas-Chavarri A, Drake TM, Ntirenganya F, Fitzgerald JE, Fergusson SJ. Surgical site infection after gastrointestinal surgery in high-income, middle-income, and low-income countries: a prospective, international, multicentre cohort study. *Lancet Infect Dis*. 2018;18(5):516-25.
4. Troughton R, Mariano V, Campbell A, Hettiaratchy S, Holmes A, Birgand G. Understanding determinants of infection control practices in surgery: the role of shared ownership and team hierarchy. *Antimicrob Resist Infect Control*. 2019;8(1):1-0.
5. World Health Organization. Improving infection prevention and control at the health facility: interim practical manual supporting implementation of the WHO Guidelines on Core Components of Infection Prevention and Control Programmes (No. WHO/HIS/SDS/2018.10). World Health Organization.
6. World Health Organization. Minimum requirements for infection prevention and control programs. 2019. <https://www.who.int/publications/i/item/9789241516945>.
7. Storr J, Twyman A, Zingg W, Damani N, Kilpatrick C, Reilly J, Price L, Egger M, Grayson ML, Kelley E, Allegranzi B. Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. *Antimicrob Resist Infect Control*. 2017;6(1):1-8.
8. Vandewaetere M, Manhaeve D, Aertgeerts B, Clarebout G, Van Merriënboer JJ, Roex A. 4C/ID in medical education: How to design an educational program based on whole-task learning: AMEE Guide No. 93. *Med Teach*. 2015;37(1):4-20.
9. van Diggele C, Roberts C, Burgess A, Mellis C. Interprofessional education: tips for design and implementation. *BMC Med Educ*. 2020; 20(2):1-6.
10. Coleman AJ, Finn GM, Nattress BR. Interprofessional education in dentistry. *Br Dent J*. 2018;225(3): 257-62.
11. Fragkos KC. Reflective practice in healthcare education: an umbrella review. *Education Sciences*. 2016;6(3):27.
12. Khan MN, Verstegen DM, Islam S, Dolmans DH, van Mook WN. A mixed-method evaluation of a task-based interprofessional learning program to prevent surgical site infection in the operating rooms of the low-income country. Submitted for publication
13. Khan, M.N.A., Verstegen, D.M.L., Shahid, A. *et al*. The impact of interprofessional task-based training on the prevention of surgical site infection in a low-income country. *BMC Med Educ*. 2021;21:607.
14. Gaughan AA, Walker DM, DePuccio MJ, MacEwan SR, McAlearney AS. Rewarding and recognizing frontline staff for success in infection prevention. *Am J Infect Control*. 2021;49(1):123-5.
15. Birgand G, Johansson A, Szilagyi E, Lucet JC. Overcoming the obstacles of implementing infection prevention and control guidelines. *Clin Microbiol Infect*. 2015;21(12):1067-71.
16. Tartari E, Fankhauser C, Masson-Roy S, Márquez-Villarreal H, Moreno IF, Navas ML, Sarabia O, Bellissimo-Rodrigues F, Hernández-de Mezerville M, Lee YF, Aelami MH. Train-the-Trainers in hand hygiene: a standardized approach to guide education in infection prevention and control. *Antimicrob Resist Infect Control*. 2019;8(1):1-1.

## Appendix 5.A

### Draft master plan for education and training to prevent surgical site infection in operating rooms

#### Introduction

Education and training are recommended as a core component to bridge the gaps between knowledge and practice of Surgical Site Infection (SSI) by the World Health Organization (WHO). In the past, simulation-based training in past has proved to increase hand hygiene compliance and decrease health-associated infections. Fortunately, education and training can be cheap and available. Especially in a low-income country, there is a need to bridge the gaps between knowledge and practice. This does require effort and organization, for the training of all personnel involved.

This study aims to explore how a realistic master plan can support hospitals to ensure effective implementation of their SSI interventions, implementation of an infection control system, and subsequently improve the delivery of health care services to patients. The study thus focuses on a master plan for the core component 'Education.' A draft master plan is presented that is developed for countries with low incomes, but components that also apply to countries. This study aims to get insight into the perceptions of the various stakeholders about the master plan for training in SSI prevention that we developed to enhance sustainable awareness and behavioral change in a low-income country.

#### Education as one of the eight core components

The WHO advises each hospital to set up an SSI prevention program consisting of eight components:

***Core component 1: Infection prevention and control program:*** Having a committed, qualified infection prevention team in each hospital and a national infection plan with precisely specified goals, roles, and practices to avoid infection in the operating rooms.

***Core Component 2: Infection prevention and control guidelines:*** The development and implementation of SSI evidence-based guidelines.

***Core Component 3: Education and Training:*** The establishment of the participatory training strategies. Education and training of health care professionals on the guidelines should be monitored by implementing an infection Control Program.

**Core component 4: Surveillance of infection:** Onsite facility-based surveillance to guide health care professionals for prevention and control of infection, interventions, quality assurance, and feedback to all stakeholders.

**Core component 5: Multiple strategies:** Hospitals should establish multimodal strategies to health care workers in each hospital to prevent infection in the operating rooms

**Core component 6: Monitoring and audits:** Health care institutions should have regular audits, and timely feedback should be provided to health care professionals by infection control standards to all relevant stakeholders.

**Core component 7: Workload, staffing, and bed occupancy:** Health care professionals should be assigned the following workload, with turnover time between two surgeries. In addition, the movement of health care professionals to and from the operating rooms should be clearly defined and monitored.

**Core component 8: Built environment, materials, and equipment for infection prevention control at the facility level:** a physical environment with adequate facilities and equipment to prevent SSI to ensure that patient care activities are carried out in a clean environment.

#### **Draft master plan for Core Component 3: Education and Training.**

Education and training of health care professionals in the theory and practice are essential to prevent SSI. Infection control education and training provide the knowledge base, skills, and insight into why surgical site infection is so important.

The guidelines to prevent surgical site infections are prepared in high-income countries; hence, many guidelines are challenging to implement in low-income countries. Similarly, the high-tech simulation-based training that is done in high-income countries is challenging to implement in low-income countries. In low-income countries, it is a challenge to develop education and training based on sound principles that are cost-effective, realistic, and fit in the context.

Task-based training is the most suitable strategy to help health care professionals to develop competencies essential to prevent SSI. Task-based learning using, e.g. videos and role-plays can also be done with limited resources. In task-based training, participants discuss their tasks (authentic tasks) with their colleagues (inter-professional learning) and reflect on promoting factors and barriers and ways to overcome these barriers (reflective learning). Regular training and repetitions/follow-up meetings should



eventually lead to a community of practice where attention for preventing SSI becomes part of daily practice.

### Initial training of all personnel

**Aim of the training:** To create awareness, knowledge, and skills relating to preventive measures relating to o prevent surgical SSI in the operating rooms of hospitals.

**The objective of the training:** Use of inter-professional training programs to bridge the gap between knowledge and practice to prevent SSI.

**Content:** The content of the training program addresses recommendations of the 2016 WHO global guidelines for the prevention of SSI.

**Facilitators:** The training program will be conducted by two trained facilitators with experience in conducting problem-based learning.

**Participants:** The health care professionals working in operating rooms are divided randomly into small mixed (interprofessional) groups with around five members in each group

All health care professionals involved in the prevention of surgical site infections follow an initial training, organized in their hospital. We have already developed training for this purpose, which involves 5 meetings of 2 hours each. The training has an interprofessional nature: participants are a mix of different kinds of professionals working in O.R, namely doctors (i.e., surgeons, anesthesiologists), nurses(i.e., preoperative nurses, perioperative scrub nurses, and technologists). They first come together to watch videos regarding the standard practice of preventing surgical site infections. They reflect and compare good practices with the current practices of SSI in the hospital they work in. This session is followed by an interactive lecture to consolidate the knowledge about SSI prevention. It is followed by small group sessions in groups similar to the teams they work in operating rooms. In these sessions, trainees are presented with authentic learning tasks: video showing good practice to prevent SSI, role-plays, case scenarios, and task analysis. The participants solve tasks by collaborative learning and discussion. When they have concluded, participants present their solutions to the rest of the participants. Eight weeks after these sessions, participants get together and discuss their experiences in the workplace and the barriers they perceive for the ideal practice of preventing SSI in their hospital. They discuss what they learned in

training and give suggestions on how to overcome the barriers. Along with that, they discuss tips to increase compliance with good practice in preventing SSI.

### Short training to maintain awareness, knowledge, and skills

The initial training will not be sufficient to achieve long-term behaviour change. Regular repeated discussion and training are necessary to maintain awareness, knowledge, and skills regarding preventing surgical site infections and foster a culture change in the workplace. It is also necessary to observe procedural skills because if these are not practiced regularly, they can deteriorate over time. They require mandatory repetitive training and collaborative practice. Moreover, there might be changes in the hospital that require different ways to prevent surgical site infection and overcome new barriers. There may be a need for intervention after incidents or near incidents and a need for training the team leaders to organize their intervention sessions. Based on what we know from our clinical experience, we can say that there is a need for follow-up training and meetings because a single short training is not enough to cause long-lasting changes in behavior.

### Learning outcomes of Task-based learning

#### **The students are expected to achieve the following learning outcomes at the end of the course**

1. Acquire in-depth knowledge of the principles of surgical site infection prevention.
2. Identify the links between suboptimal surgical site infection prevention practices and increased rates of surgical site infection affecting patient safety.
3. Understand types of hand hygiene, hand washing, and use of alcohol hand rub to promote best practice of hand hygiene in operating rooms.
4. Achieve an understanding of the importance of preoperative antibiotics in the prevention of surgical site infection. Illustrate the appropriate antibiotic timing and dosing for general, gynecologic, orthopedic, and colorectal surgeries.
5. Achieve an understanding of hair removal before surgery. Understand current recommendations for preoperative hair removal. Understand advancement in device technology that improves the safety of hair removal before surgery.
6. Understand intraoperative thermoregulation and its impact on surgical site infection.
7. Achieve an understanding of surveillance of surgical site infection, audit, and quality assurance to establish validity and utilization of surgical site infection prevention guidelines. Learn from feedback and audit results appropriately and effectively.
8. Understand the importance of glycemic control and its importance in preventing surgical site infection.

9. Be able to speak up when surgical site infection guidelines are not being followed.
10. Collaborate with other healthcare professionals within their clinical team to achieve their goals of preventing surgical site infection. Acquired skills of communication, teamwork, and interprofessional collaboration were enhanced.
11. Learn the application of knowledge into practice to prevent surgical site infection in their settings by developing checklists and tailoring surgical site infection prevention guidelines according to the need of their settings.

## Appendix 5.B

### Interview guide

What are your designation and organizational affiliation?

Did you read the master plan? What is your general first impression?

*The master plan proposes initial training of all involved healthcare professionals plus regular follow-up meetings and short training based on task-based, Interprofessional, and reflective learning.*

Which elements did you like most?

Which element did you dislike or perhaps have some doubts about? Please explain.

How do you think this master plan can help to improve SSI prevention? Why will it help, and why not?

Will it enhance awareness of SSI? Why? Why not?

Will participants reach the objectives and goals? Why yes? Why not?

Will it lead to behaviour change in the short term and the longer term?

Will it lead to a change in SSI culture?

What else could be offered to stimulate long-term and sustainable behaviour change?

Is the master plan suitable for the context? Explain why yes, or why not.

Is the master plan doable/realistic/can it be implemented? Explain why yes or why not? Give example

Does it fit with the context of a low-income country? Why? Give an example?

Is it cost-effective? Explain why yes or why not?

What changes should we make in this training to make it more feasible to use?

Which aspects of the master plan are most positive and why?

Which adaptations are needed and why?

Or there any other issues you would like to discuss?



# Chapter 6

General discussion



## General discussion

In low- and middle-income countries (LMICs), surgical site infections (SSIs) are the most common postoperative surgical complication. Up to 60% of such infections, however, can be avoided if evidence-based infection prevention guidelines are properly followed.<sup>1,2,3</sup> Although World Health Organization (WHO) guidelines on SSIs are available, LMICs have not gone as far as to implement these in the operating rooms (ORs) to satisfactory degrees.

We identified two gaps in the existing research on the implementation of evidence-based guidelines to prevent SSIs in the ORs of these countries. First, we know little about the factors that inhibit the implementation of such guidelines. Second, healthcare professionals are not adequately prepared, and knowledge about how to effectively educate and train them to prevent SSIs in the ORs is scant. The purpose of the present dissertation was therefore to address the following research questions:

- What factors hinder the implementation of surgical site infection prevention guidelines in the ORs of LMICs? (Chapter 2); and
- How can we design a high-quality and feasible training plan for surgical site infection prevention in LMICs? (Chapters 3, 4, and -5).

In this discussion chapter, we will first report the main findings that flow from the different studies in this dissertation and subsequently discuss how they relate to the existing literature.

### Main findings

In **Chapter 2**, we conducted a mixed-methods sequential explanatory study among doctors, nurses, and technologists who worked in the ORs of two hospitals: Shifa International Hospital and the Pakistan Institute of Medical Sciences, Islamabad, Pakistan. We first collected quantitative data first inviting these healthcare professionals to complete a questionnaire. This phase was followed by key informant interviews to further probe participants' perspectives and perceptions of the factors that inhibit the implementation of SSI control guidelines.

Two hundred fifty-two health care professionals took part in the survey, with a response rate totalling 90%. The majority of the participants (63.9%) were based in private teaching hospitals and a smaller proportion (36.1%) were active in public sector teaching hospitals. We purposively selected interview participants to include stakeholders with



roles in ORs, members of the infection control team, operating room managers, as well as nurses, technologists, surgeons, and anaesthesiologists.

We found that the barriers identified were either related to the individual healthcare professionals or associated with the institution where these health professionals worked. Individual factors that were perceived to hinder the implementation of the guidelines included a lack of awareness, knowledge, and skills, a reluctance to change current practices, and a lack of motivation to follow the most recent SSI prevention guidelines. Factors at the institutional level that were perceived to inhibit the implementation were: the absence of a surveillance system, a lack of support for human resource development, a lack of institutional responsibility for infection prevention, and the absence of a culture of practicing evidence-based guidelines.

We concluded that both individual and institutional factors influenced the application of SSI control guidelines in the ORs of LMICs. The focus of our next study was, therefore, on designing training to prevent SSIs in LMICs.

In **Chapter 3**, we conducted a design-based study in an authentic educational setting. More specifically, we designed a task-based interprofessional training in SSI prevention and implemented it in a healthcare centre in an LMIC, namely Shifa International Hospital, the teaching hospital of Shifa Tameer-e-Millat University in Islamabad, Pakistan. The design of this training program was based on contemporary instructional design principles of authentic, interprofessional, and reflective learning that was prompted by a coherent set of learning tasks. Spanning two months, the training comprised four sessions. In the first session, 20 participants viewed a 10-minute video demonstrating an expert model of best practices in SSI prevention. They subsequently discussed this video and compared it with their SSI prevention practices. In the second session, participants conducted role-play exercises for which they played the role of a doctor, nurse, or patient. The five case scenarios used (20 minutes each) covered the following topics: antibiotic prophylaxis, hand hygiene, use of clippers, and maintenance of normothermia. Finally, in the last two sessions, participants took part in facilitated peer-group reflection activities in which they discussed their experiences in applying what they had learned in daily practice and formulated the actions they planned to implement in their daily routine to improve SSI prevention.

Next, we evaluated participants' perceptions of the training used, inviting six to seven participants from each target group - anesthesia and surgical trainees, registered nurses, and technologists - to complete a questionnaire. We subsequently held four semi-

structured focus-group interviews with five participants each and individual interviews with two facilitators about their perceptions of the training program. We found that participants and facilitators had positive perceptions and experiences of the training. In their view, learning tasks were realistic and derived from trainees' daily practice, which facilitated the transfer of learning to practice. The different healthcare professionals felt that the joint learning experience had helped them to develop the communication skills they needed when collaborating to prevent SSIs. Indeed, certain training parts were specifically dedicated to practicing these skills, for instance how to speak up. The training did not, however, explore which barriers trainees met when trying to apply what they had learned in practice.

We concluded that participants had positive perceptions of and experiences with this particular training in SSI prevention. To stimulate further reflection and discussion, we recommended the inclusion of an additional training session in which trainees can discuss their experiences of trying to improve their practices and ways to overcome barriers encountered when applying what they had learned.

In **Chapter 4**, we again conducted a mixed-methods study, but this time to assess the perceived and measured effectiveness of an improved version of the interprofessional, task-based training. Based on the results reported in the previous chapter, we implemented the training on a larger scale, whilst including an additional session at the end of the training. In this additional session, participants discussed their experiences of applying what they had learned in practice and reflected on ways to overcome the barriers encountered when doing so. The main focus was on discussing what did and what did not work in terms of reducing SSIs in their specific OR context.

We included 145 participants in the training program on a voluntary basis. To measure their perceived 'satisfaction', we administered a questionnaire at the end of the training; we used pre-and post-intervention assessments to gauge their 'knowledge' and a questionnaire and interviews eight weeks post-training to measure their 'self-perceived behavior change'. Participants valued the training and were eager to participate. Pre-and post-test scores showed a significant increase in knowledge. Moreover, participants reported that they had applied in practice what they had learned about SSI prevention. Our qualitative data analysis confirmed that participants were enthusiastic about the training format. The use of authentic tasks representative of daily clinical practice, as well as the interprofessional approach and reflection sessions, were considered to promote the transfer of learning. However, they also pointed to practical obstacles limiting the application of evidence-based knowledge, such as a shortage of supplies and

conventional practices. Although the training encouraged them to reflect on barriers in practice and to apply what they had learned, participants also felt that without structural embedment in the organization and at a national level it was unlikely to affect sustainable change.

In **Chapter 5**, we developed a master training plan to raise awareness of SSIs and produce long-term behavioral changes with the ultimate aim to support hospitals in the effective implementation of SSI control interventions, thereby improving the delivery of healthcare services to patients. Taking up the suggestions info from Next, we conducted a qualitative, individual interview study to investigate how various stakeholders - policymakers, educators in the healthcare professions, and healthcare leaders - perceived the master training plan.

We found that stakeholders considered the training plan suitable and felt it matched resource-constrained situations well. They judged implementation costs to be low, for example when compared to advanced technological simulators. They were also positive about the task-based, reflective, and interprofessional learning components of the training and thought these would increase understanding, transfer of knowledge, and workplace skills. In order to implement the master plan at a national level, train-the-trainer programs were deemed necessary to allow large-scale implementation and induce long-term behavioral changes. Although stakeholders considered the interprofessional character of the training sessions to be positive, they also warned that collaboration among different health care professionals could create friction.

## Main discussion points

The main findings of this dissertation outlined above complement existing research in the field of education and training by offering new insights into how to bridge the gaps between knowledge and the practice of infection control in an LMIC setting. These insights can be summarised as follows:

- Training alone is not enough
- The challenges of interprofessional training identified must be addressed
- Engage leaders in the master training plan.

### *Training alone is not enough*

In this dissertation, we designed and evaluated training in SSI prevention. In doing so, however, we only focused on education and training as one of the core components prescribed by the WHO (see Chapter 1, Box 1.1).<sup>4,7,8,9</sup> We also know from our study in

Chapter 2 that, although promising, training interventions alone are unlikely to be sufficient. Infection surveillance, for instance, is an essential component of SSI prevention; without it, the results of SSI prevention training will quickly fade. We therefore also need a surveillance system to monitor SSI rates on both hospital and national level. Frequent monitoring, auditing, and reporting to health care professionals about SSI rates is known to reduce infections because it encourages adherence to good prevention practices.<sup>4,5,6</sup> In LMICs, however, such surveillance is weak because health care personnel who are appropriately trained to perform and maintain organized surveillance systems are lacking on the hospital, regional, and national levels. This situation creates a need for training on how to set up a surveillance system.<sup>5,6</sup> To prevent frustration and reduced motivation to contribute to SSI prevention, however, these surveillance systems should only be introduced when health care personnel have received proper training.

*The challenges of interprofessional training identified must be addressed*

Aiming to reproduce the interprofessional teamwork setting of the OR, we designed training in which different professionals learned, from, with, and about each other. Although participants valued this set-up, some were also concerned that such an approach might contribute to conflict regarding the roles and responsibilities in SSI prevention and/or that participants' differences in training level, hierarchy, roles, and responsibilities in the ORs could complicate interprofessional learning [Chapter 5].

The results of Chapter 5 showed that participants valued the interprofessional training but also saw potential challenges related to the power differentials and hierarchy typical of health care institutions. We, therefore, concluded that having a team of skilled facilitators was critical to the success of interprofessional training. These facilitators could encourage professionals to appreciate each team member's contribution, ask questions to stimulate critical thinking and discussion for a deeper understanding, draw conclusions from participants' discussions, provide feedback, and manage any potential conflicts among training participants sparked by differences in educational backgrounds and health care hierarchy.<sup>10</sup>

*Engage leaders in the master training plan*

The results of Chapter 5 also underscored the importance of engaging leaders in the implementation of a master training plan. Introducing training along with procedures and monitoring systems is a good start to help enforce the implementation of SSI prevention guidelines. However, we must also transition to a safety culture in which

leaders demonstrate that they value efforts to increase safety, offer training opportunities and reward good practices. Hence, to improve practice, a culture change is paramount and leaders should strongly support the initiation of such a master training plan and encourage their staff to participate. Hospital leaders could play an important role in facilitating the implementation of the training program and overcoming local barriers.<sup>11</sup>

## Strengths and limitations

In this dissertation, we investigated the barriers to implementing SSI prevention in the specific OR setting of an LMIC. As such, it was the first attempt to address the gaps between knowledge and the practice of SSI control in this setting. Another strength is that we mostly used mixed methods, surveys, and interviews, whilst seeking the active participation of various stakeholders from the Pakistani public and private health care systems. The third strength of this dissertation is that we based education and training on current principles of learning and instructional design, including task-based, interprofessional and reflective learning.

Nevertheless, to ensure a nuanced perspective on the consequences for practice and future research, it is important to interpret the findings with a few limitations in mind. First, the fact that we conducted the research in university hospitals of the Pakistani capital does not necessarily imply that the results are generalizable to other LMIC settings. As resources are not evenly distributed in LMICs, hospitals in rural areas may have even fewer resources. The second limitation is that although we demonstrated that participants learned from the training, we did not investigate its actual impact on long-term behavior change regarding SSI prevention. Finally, we did not study whether the intervention led to a reduced incidence of SSIs in the short and long run.

## Directions for future research

The results of the studies in this dissertation allow us to provide several directions for future research. First, it will be worth investigating how the training we designed is perceived in other contexts, such as other Pakistani hospitals and other LMIC settings. Second, we welcome additional studies into the impact of this training on health care professionals' behavior in clinical practice. These could be observational studies that observe their compliance with SSI prevention guidelines. Finally, we invite researchers to conduct longitudinal studies with pre-and post-measurements of SSI rates to determine the impact of initial education and training on the incidence of these infections in their respective institutions.

## Implications for practice

This dissertation has demonstrated that in order to bridge the gap between knowledge and the practice of SSI control in a particular setting, it is important to first identify and prioritize the most critical knowledge gaps. The next crucial step is to research the factors that facilitate and inhibit the successful implementation of guidelines in the respective context. Hospital educators should ask themselves the following questions to make the training relevant to their specific circumstances:

*What factors inhibit the prevention of SSIs in my context?*

When it comes to implementing SSI prevention guidelines, each health institution faces different challenges. An important prerequisite for overcoming these barriers to implementation is to have adequate knowledge of the organizational structures, educational and health care systems, and of institutional and societal culture.

*Who is involved in SSI prevention in my specific OR context?*

Our training is interprofessional and includes all the OR personnel involved in SSI prevention. Hence, to be able to decide who should be invited to participate, it is imperative to first identify the professions responsible for the various aspects related to SSI prevention in the respective context. In a Pakistani OR, for instance, nursing staff and technologists are typically responsible for preparing patients in terms of skin disinfection and patient draping. In such cases, these individuals should therefore be invited. Other key players in the fight against SSIs may be anaesthesiologists, for they often play a crucial role in optimizing perioperative conditions. Considering that the first few hours after bacterial contamination present a critical window for infection, the reduction of SSIs depends in large part on their actions. Similarly, SSI prevention will be difficult if surgeons are not actively engaged as well. Consequently, their active participation, engagement, and involvement in SSI prevention training are critical.

*What are the specific needs of individual health care professionals in my context?*

Training facilitators must consider specific needs related to both the training and clinical contexts, such as the entry-level of their training participants, specific SSI risks or barriers to guideline implementation, and the interaction between trainees from various professional backgrounds.

*What are participants' specific tasks? What are the risks and problems in my context?*

Our training format is based on authentic learning tasks that represent the daily work of participants. Hence, to ensure that the training functions well and meets the demands of healthcare professionals in each context and setting, it is necessary to adapt the tasks accordingly, for instance by using different examples and scenarios.

*Who are suitable facilitators for this kind of training?*

In our training set-up, the trainer is a facilitator rather than a teacher and needs to be comfortable in that role. As the training is interprofessional, the facilitator is also responsible for cultivating an atmosphere that is conducive to collaborative, interprofessional learning. It is therefore recommended to involve facilitators from various disciplines with experience in interprofessional training facilitation.

*Whose support do I need to get the training implemented?*

Setting up education and training programs in an institutional setting can be daunting. Any such endeavors typically involve different hospital disciplines, which calls for good collaboration, coordination, communication, teamwork, and efficient planning. Hospital leaders and managers can play a key role in making sure that education and training programs are valued and implemented. Likewise, senior leaders can provide resources and support to set up the training program, including the running of day-to-day activities.

*How can we ensure follow-up?*

One initial training will not suffice. To reduce the risk of SSIs in the ORs, a master training plan with repeated training is indicated. Continuous task-based, interprofessional training for healthcare professionals is critical to ensure that infection prevention policies and procedures are and continue to be understood and implemented. In our studies, stakeholders also stressed the importance of a surveillance system to monitor SSI rates at the hospital and national levels. This is consistent with WHO recommendations that propose eight components to prevent infection in an institution, including education to build up the skills of health care workers at a national, regional, and institutional level.<sup>7,8</sup> To prevent SSIs at the specific institutional level, it is imperative to educate and train health care workers as well as to monitor infection rates.

## Lessons learned from the present research

From previous and our own research, we learned that education and training activities alone will not lead to improvements in the implementation of SSI prevention guidelines. For education and training approaches to have a long-lasting effect on behavior and practice, they should not only be based on instructional design and learning theory, but also on insights from implementation science, and on a strong understanding of the local context, as adaptations to the specific setting are required needed to render these interventions effective. Only by referring to a variety of resources and literature reviews, conducting interviews with important stakeholders, monitoring and evaluating the training program as well as infection rates, and effecting a culture change will such efforts eventually lead to improvements in health care settings.<sup>4,7</sup>



## References

1. Rojas-Gutierrez E, Vilar-Compte D. An overview of surgical site infection in low-and middle-income countries: the role of recent guidelines, limitations, and possible solutions. *Curr Treat Options Infect Dis*. 2019;11(3):300-16.
2. Berman LR, Lang A, Gelana B, Starke S, Siraj D, Yilma D, Shirley D. Current practices and evaluation of barriers and facilitators to surgical site infection prevention measures in Jimma, Ethiopia. *Antimicrob Steward Healthc Epidemiol*. 2021;1 (1)E51.
3. Mengesha A, Tewfik N, Argaw Z, Beletew B, Wudu M. Practice of and associated factors regarding prevention of surgical site infection among nurses working in the surgical units of public hospitals in Addis Ababa city, Ethiopia: A cross-sectional study. *PLoS One*. 2020;15(4):e0231270.
4. Storr J, Twyman A, Zingg W, Damani N, Kilpatrick C, Reilly J, Price L, Egger M, Grayson ML, Kelley E, Allegranzi B. Core components for effective infection prevention and control programmes: new WHO evidence-based recommendations. *Antimicrob Resist Infect Control*. 2017; 6(1):1-8.
5. Mehtar S, Wanyoro A, Ogunsola F, Ameh EA, Nthumba P, Kilpatrick C, Revathi G, Antoniadou A, Giamarelou H, Apisarnthanarak A, Ramatowski JW. Implementation of surgical site infection surveillance in low-and middle-income countries a position statement for the international society for infectious diseases: a position statement for the international society for infectious diseases. *Int J Infect Dis*. 2020; 100:123-31.
6. Russo PL, Saguil E, Chakravarthy M, Lee KY, Ling ML, Morikane K, Spencer M, Danker W, Yu NY, Edmiston Jr CE. Improving surgical site infection prevention in Asia-Pacific through appropriate surveillance programs: Challenges and recommendation. *Infect Dis Health*. 2021;26(3):198-207.
7. World Health Organization. Minimum requirements for infection prevention and control programs. 2019. <https://www.who.int/publications/i/item/9789241516945>.
8. Rasa K, Kilpatrick C. Implementation of World Health Organization Guidelines in the Prevention of Surgical Site Infection in Low-and Middle-Income Countries: What We Know and Do Not Know. *Surg Infect*. 2020;21(7):592-8.
9. Deryabina A, Lyman M, Yee D, Gelieshvili M, Sanodze L, Madzgarashvili L, Weiss J, Kilpatrick C, Rabkin M, Skaggs B, Kolwaite A. Core components of infection prevention and control programs at the facility level in Georgia: key challenges and opportunities. *Antimicrob Resist Infect Control*. 2021;10(1):1-20.
10. El-Awaisi A, Sheikh Ali S, Abu Nada A, Rainkie D, Awaisu A. Insights from healthcare academics on facilitating interprofessional education activities. *J Interprof Care*. 2021;35(5):760-70.
11. Birgand G, Johansson A, Szilagyi E, Lucet JC. Overcoming the obstacles of implementing infection prevention and control guidelines. *Clin Microbiol Infect*. 2015;21(12):1067-71.
12. Cianciolo AT, Regehr G. Learning theory and educational intervention: producing meaningful evidence of impact through layered analysis. *Acad Med*. 2019;94(6):789-94.





# Addendum

Impact paragraph



## Impact paragraph

In this section, we will reflect on the studies reported in this dissertation and, in doing so, address the following questions:

1. (Research) What is the main objective of the research described in the dissertation at hand and what are its most important results and conclusions?
2. (Relevance) How do these research results contribute to science and, if applicable, to social sectors and social challenges?
3. (Target group) To whom are the research results of interest and/or relevance and why?
4. (Activity) In what way can these target groups be involved in and informed about the research results, so that the knowledge gained can be used in the future?

### The main objective, results, and conclusions of the research

We aimed to bridge the gap between knowledge and the practice of surgical site infection (SSI) control in the operating rooms (ORs) of a low- and middle-income country (LMIC), that is, Pakistan. To this end, we conducted four empirical studies. In the first study, we found amongst others that the country lacked education and training in SSI prevention in the ORs, which inspired the development of a training program. The second and third studies, focused on developing, evaluating, and implementing a task-based, interprofessional, reflective training program to prevent infections in the ORs. Finally, in the fourth study, we developed a master training plan to raise awareness of SSIs and produce lasting behavioral changes.

The results from the first study (Chapter 2) showed that the factors that inhibited the implementation of SSI control measures in the ORs originated at either the individual or institutional level. The lack of a surveillance system, education, and training, as well as the absence of a culture of embracing the evidence-based clinical practice, were identified as major hindering factors related to the institution. We, therefore, shifted our focus towards raising awareness among healthcare workers about how to reduce the rate of SSIs in LMICs, by developing adequate education and training. Consistent with instructional design guidelines, this training emphasized the importance of authentic, interprofessional, and reflective learning that was organized around a coherent set of learning tasks relevant to SSI prevention in the ORs. Participants, who were healthcare workers from different professions, viewed a video on good SSI prevention practices, took part in role-play exercises, and discussed case scenarios.

Together, they reflected on these scenarios and on their daily care practice in the hospital.

The evaluation of this training (Chapters 3 and 4) revealed that participants perceived the learning tasks as realistic. They also felt that the joint learning experience had helped them to develop the communication skills they needed when collaborating to prevent SSIs. According to participants, they were able to apply in practice what they had learned about preventing infections. The use of authentic tasks representative of daily clinical practice, as well as the interprofessional approach and reflection sessions, were considered to promote the transfer of learning to the workplace. Finally, in Chapter 5, we evaluated stakeholder perspectives of a master training plan designed to enhance long-term sustainability and produce lasting behavioral change regarding SSI prevention. Stakeholders held the view that the training plan was well-designed, improved their understanding, and facilitated the transfer of skills to the workplace. Because implementation costs were low, they considered it particularly practicable in and suited to their resource-constrained context.

## Research contribution to science and society

In conducting the present research, we took a design-based research approach by first developing an educational and training program and consequently evaluating it. During this process, we applied insights from our theoretical analysis in practice, for instance by using instructional design principles of authentic, interprofessional, and reflective learning as the foundation for the training design. The outcomes suggest that the instructional strategies we used are suitable for teaching infection prevention in ORs located in LMICs in a manner that is both effective and efficient. Moreover, those who work in ORs place a high value on real-world experience and collaboration among professionals. Participants confirmed that they were able to use what they had learned from this training about infection prevention in their specific LMIC context.

SSIs being the most common postoperative complication in these countries, it is of utmost importance that they are prevented to ensure that surgical patients receive safe medical care. Naturally, avoiding such infections is a fundamental component of standard medical care, and all OR personnel must therefore acquire the appropriate knowledge and skills. This dissertation has demonstrated which innovative training strategies can be used to reduce the risk of such infections and how they can be used in a resource-constrained context. To prevent and control infections, the World Health Organization has placed a strong emphasis on task-based interprofessional training. In

doing so, however, the organization did not provide explicit guidelines as to how professionals should be educated and trained to accomplish this goal. Hence, other healthcare institutions might use our training and master training plan as an example, especially those in LMICs as the training programs are both comprehensive and cost-effective compared to other interventions that use expensive equipment (e.g. for simulation). By improving education on infection prevention, the proposed strategy will help to produce better-educated medical professionals in the surgical domain, thereby diminishing the incidence of SSIs in LMICs and improving patient care in the process.

### To whom the results might be of interest and relevance

The findings of this dissertation are significant for hospital leaders and managers, regulatory bodies, academic institutions, and healthcare workers in LMICs who are seeking to implement a training program for healthcare workers to prevent infections and who wish to provide patients with safe, high-quality, compassionate care within local health systems. Not only do our findings demonstrate the value of applying the educational tenets of authentic task-based, interprofessional and reflective learning in practice, but they may also serve educators and researchers in the field of health professions educators who are interested in developing, implementing, and evaluating educational interventions in LMICs to raise awareness of infection prevention among healthcare workers.

### Ways to involve the target groups and inform them about the research

There are many different ways to involve the diverse target groups (hospital leaders and managers, regulatory bodies, academic institutions, and health care workers) in the research and to disseminate the lessons learned from the research at hand. The first step is to incorporate training into the orientation program for newly hired staff members and to include it as part of the continuing education of medical professionals. The second and third steps are to publish the findings in peer-reviewed journals and to present them at scientific conferences, both domestically and internationally, which we have done and will continue to do. Our final suggestion is to persuade key people and regulatory authorities to support or lead a program; working with national and international organizations that focus on infection control and prevention as well as with groups that are seeking to improve patient safety is another way to increase the prevention of SSIs in LMICs and to make a societal difference.





# Addendum

Summary



## Summary

Surgical site infections (SSIs) occur when a patient is receiving surgical treatment for a medical problem. As these infections can have severe physical, emotional, and financial consequences, their prevention has become an important point of focus in patient safety. Robust prevention guidelines do exist that, when properly implemented, can help reduce their incidence. To strengthen and build the capacity of health care organizations, the World Health Organization (WHO) has, therefore, defined core components for infection prevention and control that specify how national authorities, as well as institutions/hospitals, can prevent infections in the long term. More specifically, to prevent SSIs it is imperative to have an infection control program in place that incorporates relevant, evidence-based recommendations, targeted surveillance, process monitoring and feedback, education and training, and an enabling environment, as well as proven practice and behavior change measures. Although the WHO recommends that all of these components be implemented, it also specifically points to the adaptation/adoption of evidence-based guidelines, monitoring and feedback, the use of multi-modal improvement initiatives, and active surveillance in particular for making a difference in reducing SSI rates. Essential is a focus on educating and training healthcare professionals who work in the operating rooms (ORs). Even though the global surgical societies are well aware of the harmful impact SSIs have on patient outcomes, there is a paucity of scientific information about the factors that inhibit the adoption of the said guidelines. Furthermore, knowledge about training healthcare personnel in preventing SSIs in the ORs in low- and middle-income countries (LMICs) is scant. In this dissertation we, therefore, addressed the following two main questions:

- *What factors hinder the implementation of surgical site infection guidelines in the operating rooms of low-middle income countries?*
- *How can we design a high-quality and feasible training plan to prevent surgical site infection prevention in low-middle income countries?*

After introducing the reader to SSIs in general and LMICs in particular, as well as to existing guidelines and the role of education and training, **Chapter 1** presents the research questions and gives an overview of the studies reported in this dissertation.

The aim of **Chapter 2** was to gain insight into the factors that inhibit the implementation of SSI prevention guidelines in LMICs. For this study, we surveyed healthcare professionals and interviewed healthcare leaders from two university hospitals in Pakistan. We found that the barriers identified were either related to the individual

healthcare professionals or associated with the institution where these healthcare professionals worked. Individual factors that were perceived to inhibit the implementation of the guidelines included a lack of awareness, knowledge, and skills, a reluctance to change current practices, and a lack of motivation to follow the most recent SSI prevention guidelines. Factors at the institutional level that were perceived to inhibit the implementation were the absence of a surveillance system, a lack of support for human resource development, a lack of institutional responsibility for infection prevention, and the absence of a culture of practicing evidence-based guidelines.

In **Chapter 3**, we developed and evaluated a task-based interprofessional training program to prevent SSIs in the ORs. Designed in line with contemporary instructional design principles of whole-task and interprofessional learning, the training was delivered in four sessions spanning two months. Participants met in a five-person interprofessional group every two weeks for a two-hour session. To evaluate their perceptions of the training program, we used a questionnaire and held semi-structured focus-group interviews with participants, and also conducted individual interviews with two facilitators. We found that participants and facilitators had positive perceptions of and experiences with the training. In their view, learning tasks are realistic and derived from trainees' daily practice. The different healthcare professionals felt that the joint learning experience had helped them develop the communication skills they needed when collaborating to prevent SSIs. Indeed, certain training parts were specifically dedicated to practicing these skills. The training did not, however, explore which barriers trainees met when trying to apply what they have learned in practice.

In **Chapter 4**, we used a mixed-methods study to assess the perceived and measured effectiveness of an improved version of the interprofessional, task-based training. Based on the evaluation outcomes reported in the previous chapter, we implemented the training on a larger scale, whilst including an additional session at the end of the training. In this additional session, participants discussed their experiences of applying what they had learned in practice and reflected on ways to overcome the barriers encountered. The aim of the study was to assess participants' perceptions, as well as their knowledge gains and perceived behavioral changes following the training. To measure their perceived 'satisfaction', we administered a questionnaire at the end of the training. We used pre-and post-intervention assessments to gauge their knowledge and a questionnaire and interviews eight weeks post-training to measure their self-perceived behavior change'. Participants were positive about the training and were eager to participate. Pre- and post-test scores showed a significant increase in knowledge. Moreover, Participants reported that they had applied in practice what they had learned

about SSI prevention. The use of authentic tasks representative of daily clinical practice, as well as the interprofessional approach and reflection sessions, were considered to promote the transfer of learning. However, they also pointed out practical obstacles limiting the application of evidence-based knowledge, such as a shortage of supplies and conventional practices.

In **Chapter 5**, we developed a master training plan to raise awareness of SSIs and produce lasting behavioral changes in SSIs. Taking up the suggestions from Chapter 4, the master training plan proposed basic, institution-based training in combination with repeated training interventions to effect lasting behavioral change. We conducted a qualitative, individual interview study to investigate how various stakeholders - policymakers, medical educators, and healthcare leaders - perceived the newly developed master training plan. We found that stakeholders deemed the plan necessary to term spread knowledge of SSIs and produce behavior change. In their view, repeated training was essential to make sure that such changes would last. They also felt that the instructional design principles of interprofessional, task-based, and reflective learning included in the master plan improved understanding and transfer of skills to the workplace. Finally, because implementation costs were low, they considered the master training plan as particularly practicable and suited to their specific resource-constrained LMIC context.

In **Chapter 6**, we looked back and reflected on the research questions presented in the Introduction.

1. *What factors hinder the implementation of surgical site infection guidelines in the operating rooms of low-middle income countries?*

Healthcare professionals and their leaders classified the factors that they perceived as inhibiting the implementation of SSI control measures into two groups, namely individual factors and factors that were associated with the institution. A lack of education and training, absence of a culture of following guidelines, and absence of a surveillance system were found to be important barriers to SSI control implementation.

2. *How can we design and implement a high-quality and feasible master training plan for surgical site infection prevention in low-middle income countries?*

We concluded that training in which authentic, whole learning tasks are used in an interprofessional and reflective learning approach was perceived to enhance learning about SSI prevention by participants. The training also resulted in a significant knowledge

gain. We also learned, however, that a short stand-alone training is unlikely to affect sustainable behavioral change in practice. To promote further reflection and discussion, we recommended the inclusion of an additional training session in which trainees can discuss their experiences and ways to overcome the barriers encountered when applying in practice what they had learned. We also developed an outline of a master training plan to raise awareness of SSIs and induce lasting behavioral changes. This training plan proposed basic, institution-based training in combination with repeated training interventions to make sure that such changes would last. Stakeholders, who were policymakers, medical educators, and healthcare leaders, felt this master training plan matched their resource-constrained context well. They judged implementation costs to be low, for example when compared to advanced technological simulators. They were also positive about the task-based, reflective, and interprofessional learning components of the training and thought these would increase participants' understanding, transfer of knowledge, and workplace skills. To implement the master plan at a national level, train-the-trainer programs were deemed necessary. Finally, in Chapter 6, we presented practical implications, strengths, and weaknesses of the research and offered possible directions for future research.







# Addendum

Samenvatting



## Samenvatting

Postoperatieve wondinfecties treden op wanneer een patiënt een chirurgische ingreep ondergaat voor een medisch probleem. Aangezien deze infecties ernstige fysieke, emotionele en financiële gevolgen kunnen hebben, is er op het gebied van patiëntveiligheid veel aandacht gekomen voor de preventie ervan. Inmiddels bestaan er degelijke preventierichtlijnen die, mits correct toegepast, de incidentie ervan kunnen helpen verminderen. Om de capaciteit van zorginstellingen w.b. infectiepreventie te versterken en op te bouwen, heeft de Wereldgezondheidsorganisatie (WHO) daarom kerncomponenten voor infectie-preventie (en -bestrijding) vastgesteld waarin wordt aangegeven hoe overheden evenals instellingen/ziekenhuizen infecties op de lange termijn kunnen voorkomen. Om postoperatieve wondinfecties te voorkomen is het met name noodzakelijk dat er infectiebestrijdingsbeleid wordt toegepast dat zich baseert op relevante, wetenschappelijk onderbouwde aanbevelingen met gericht toezicht, procesbewaking en feedback, onderwijs en opleiding, een faciliterende omgeving en beproefde maatregelen ter bevordering van praktijk- en gedragsverandering. Hoewel de WHO de invoering van al deze aspecten aanbeveelt, wijst zij er ook op dat, om het verschil te maken bij het terugdringen van postoperatieve wondinfectie-percentages, met name de aanpassing/ter handneming van *evidence-based* richtlijnen, bewaking en feedback, het gebruik van multimodale verbeterings-initiatieven en vooral actief toezicht van belang zijn. Daarbij is aandacht voor het onderwijzen en opleiden van zorgprofessionals die in de operatiekamers (OK's) werkzaam zijn essentieel. Hoewel de wereldwijde chirurgische gemeenschap zich terdege bewust is van de schadelijke gevolgen van postoperatieve wondinfecties voor de patiënt, is er onvoldoende wetenschappelijke kennis over de factoren die de terhandneming van voornoemde richtlijnen belemmeren. Voorts beschikken we over slechts geringe kennis over hoe we het zorgpersoneel in lage- en middeninkomenslanden het beste kunnen opleiden om postoperatieve wondinfecties in de OK's te voorkomen.

In dit proefschrift gingen we daarom in op de volgende twee hoofdvragen:

- *Welke factoren belemmeren de invoering van richtlijnen ter bestrijding van postoperatieve wondinfecties in de operatiekamers van lage- en midden-inkomenslanden?*
- *Hoe kunnen we een kwalitatief hoogwaardig en uitvoerbaar opleidingsplan ontwerpen ter preventie van postoperatieve wondinfecties in lage- en midden-inkomenslanden?*

Na een inleiding over postoperatieve wondinfecties in het algemeen, en lage- en middeninkomenslanden in het bijzonder, alsmede over bestaande richtlijnen en de rol van onderwijs en opleiding, worden in **Hoofdstuk 1** de onderzoeksvragen gepresenteerd en de in dit proefschrift beschreven studies kort samengevat.

**Hoofdstuk 2** had ten doel meer inzicht te verkrijgen in de factoren die de invoering van richtlijnen ter preventie van postoperatieve wondinfecties in lage- en middeninkomenslanden belemmeren. Hiertoe bevroegen we zorgprofessionals en interviewden we zorgmanagers uit twee academische ziekenhuizen in Pakistan. Onze bevinding was dat belemmerende factoren ofwel te maken hadden met de zorgprofessionals afzonderlijk, dan wel met de instelling waar deze zorgprofessionals werkzaam waren. Tot de *persoonsgebonden factoren* die de invoering van de richtlijnen in de weg stonden, behoorden onder meer een gebrek aan bewustzijn, kennis en vaardigheden, bereidheid om huidige praktijken om te buigen en een gebrek aan motivatie om zich aan de meest recente postoperatieve wondinfectiepreventierichtlijnen te conformeren. *Instellingsgebonden factoren* die volgens de participanten de betreffende invoering belemmerden, waren de afwezigheid van een toezichtstelsel, een gebrek aan steun/middelen voor personeelsontwikkeling, een gebrek aan verantwoordelijkheid vanuit de instelling voor infectiepreventie en het ontbreken van een cultuur waarbinnen de *evidence-based* richtlijnen effectief worden toegepast.

In **Hoofdstuk 3** hebben we een taakgerichte interprofessionele training gericht op het voorkomen van postoperatieve wondinfecties in de OK's ontwikkeld en geëvalueerd. De training werd ontworpen volgens actuele onderwijsontwerpprincipes als authentieke taken (*whole-task learning*) en interprofessioneel leren. De training besloeg vier sessies die verspreid over twee maanden plaatsvonden. De deelnemers kwamen elke twee weken in interprofessionele groepen van vijf bijeen voor een twee uur durende sessie. Om hun percepties van de training te meten, lieten we hen een vragenlijst invullen en hielden we behalve semigestructureerde focusgroepinterviews met de deelnemers ook individuele interviews met twee docenten. Onze bevinding was dat zowel de deelnemers als de docenten positieve percepties en ervaringen hadden van/met de training. Volgens hen waren de leertaken realistisch en afkomstig uit de dagelijkse praktijk zoals de deelnemers die kennen. De verschillende zorgprofessionals vonden bovendien dat de gezamenlijke leerervaring hen geholpen had om de communicatieve vaardigheden te ontwikkelen die zij nodig hadden om goed te kunnen samenwerken op het gebied van postoperatieve wondinfectiepreventie. Bepaalde onderdelen van de training waren immers specifiek gericht op het oefenen van deze

vaardigheden. De training ging echter verder niet in op de vraag welke obstakels de deelnemers tegenkwamen bij hun pogingen om het geleerde in de praktijk toe te passen.

In **Hoofdstuk 4** hebben we een multimethodisch onderzoek verricht met als doel de ervaren en gemeten effectiviteit van een verbeterde versie van de interprofessionele, taakgerichte training te beoordelen. Op basis van de evaluatiebevindingen uit het vorige hoofdstuk voerden we de training nogmaals uit, maar dit keer op grotere schaal en met toevoeging van een extra sessie aan het einde van de training. Tijdens deze extra sessie kregen de deelnemers de gelegenheid om hun ervaringen met het in de praktijk brengen van het geleerde te bespreken en om na te denken over manieren om de ervaren obstakels het hoofd te bieden. Het doel van het onderzoek was om deelnemers' percepties te meten, evenals hun verworven kennis en ervaren gedragsverandering na afloop van de training. Om hun "tevredenheid" te meten, gaven we na afloop van de training een vragenlijst. Verder gebruikten we voor het meten van hun "kennis" een voor- en nameting. We vroegen deelnemers in hoeverre zij hun gedrag veranderd hadden door middel van een vragenlijst in combinatie met interviews acht weken na de training. De deelnemers waren positief over de training en wilden graag deelnemen. De cijfers uit de voor- en nameting toonden een significante toename van hun kennis op gebied van infectiepreventie. Daarbij gaven de deelnemers aan dat zij hetgeen zij over postoperatieve wondinfectie-preventie geleerd hadden in de praktijk hadden gebracht. Ook vonden zij dat het gebruik van authentieke taken die een getrouwe weerspiegeling waren van de dagelijkse klinische praktijk, alsmede de interprofessionele benadering en de reflectiesessies, de overdracht van kennis naar de praktijk te bevorderden. Zij wezen echter ook op praktische obstakels die de toepassing van *evidence-based* kennis in de weg stonden, zoals een tekort aan voorzieningen en materialen.

In **Hoofdstuk 5** hebben we een masteropleidingsplan ontwikkeld met als doel om meer bewustzijn van postoperatieve wondinfecties te creëren en blijvende gedragsveranderingen ten aanzien van postoperatieve wondinfecties teweeg te brengen. Voortbouwend op de in Hoofdstuk 4 gedane suggesties, werd in dit masteropleidingsplan een basistraining op de werkplek voorgesteld in combinatie met herhaalde trainingsinterventies met als doel om zo blijvende gedragsverandering teweeg te brengen. Om erachter te komen hoe verschillende stakeholders zoals beleidsmakers, medische opleiders en zorgmanagers tegen dit nieuwe masteropleidingsplan aankeken, hebben we een kwalitatieve studie verricht op basis van individuele interviews. We constateerden dat de stakeholders het plan noodzakelijk

achtten voor de verspreiding van kennis over postoperatieve wondinfecties en voor het aandrijven van gedragsverandering. Volgens hen was herhaalde training essentieel om ervoor te zorgen dat zulke veranderingen blijvend zouden zijn. Daarbij vonden zij dat de in het masterplan opgenomen onderwijsontwerpprincipes als interprofessioneel, taakgericht en reflectief leren voor een beter inzicht in infectiepreventie en een betere overdracht van vaardigheden naar de werkplek zorgden. Tot slot gaven zij aan dat zij het masteropleidingsplan gezien de lage implementatiekosten als bijzonder uitvoerbaar beschouwden en zeer geschikt voor hun specifieke lage- en middeninkomenscontext waar middelen niet rijkelijk voorhanden waren.

In **Hoofdstuk 6** werd teruggeblikt en gereflecteerd op de in de Inleiding gepresenteerde onderzoeksvragen.

- 1. Welke factoren belemmeren de invoering van richtlijnen ter bestrijding van postoperatieve wondinfecties in de operatiekamers van lage- en midden-inkomenslanden?*

De zorgprofessionals en hun managers verdeelden de factoren die volgens hen de invoering van postoperatieve wondinfectie-bestrijdingsrichtlijnen in de weg stonden in twee groepen, te weten persoonsgebonden factoren en instellingsgebonden factoren. Een gebrek aan onderwijs en opleiding, het ontbreken van een cultuur waarbinnen de richtlijnen effectief werden opgevolgd en de afwezigheid van een toezichtstelsel bleken belangrijke obstakels te zijn voor de invoering van deze richtlijnen.

- 2. Hoe kunnen we een kwalitatief hoogwaardig en uitvoerbaar masteropleidingsplan gericht op de preventie van postoperatieve wondinfecties ontwerpen en in lage- en midden-inkomenslanden implementeren?*

We concludeerden dat een training op basis van principes van authentiek, interprofessioneel en reflectief volgens de deelnemers het leren over postoperatieve wondinfectie-preventie bevorderde. De training zorgde ook voor een significante toename van kennis. We hebben echter ook geleerd dat het niet waarschijnlijk is dat een korte, op zichzelf staande training tot structurele gedragsverandering in de praktijk zal leiden. Om reflectie en discussie nog meer te bevorderen, raden wij aan een extra trainingssessie in te lassen, zodat de deelnemers de gelegenheid krijgen om hun ervaringen te bespreken, alsmede te bespreken hoe zij de obstakels die zich bij de toepassing van het geleerde voordeden, het hoofd kunnen bieden. Daarnaast hebben we de contouren geschetst van een masteropleidingsplan met als doel om meer bewustzijn van postoperatieve wondinfecties te creëren en blijvende gedrags-

veranderingen teweeg te brengen. In dit opleidingsplan werd een basistraining op de werkplek voorgesteld gecombineerd met herhaalde trainingsinterventies om ervoor te zorgen dat deze veranderingen blijvend zouden zijn. De stakeholders (dit waren beleidsmakers, medische opleiders en zorgmanagers) vonden dat dit masteropleidingsplan goed paste bij hun middel- en lage inkomenscontext waar middelen niet rijkelijk voorhanden waren. Zij gingen ervan uit dat de implementatiekosten laag waren, bijvoorbeeld in vergelijking met geavanceerde technologische simulatoren. Ook waren zij positief over de taakgerichte, reflectieve en interprofessionele leeraspecten van de training en waren zij van mening dat deze het begrip, de kennisoverdracht en de werkplek-vaardigheden van de deelnemers zouden vergroten. Om het masterplan op nationaal niveau in te voeren, werd het noodzakelijk geacht om docenten via zogenaamde train-the-trainer-programma's op te leiden. Tot slot presenteerden we in **Hoofdstuk 6** de implicaties voor de praktijk, alsmede de sterke en zwakke punten van het onderhavige onderzoek en zetten wij potentiële lijnen uit voor toekomstig onderzoek.





# Addendum

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# Addendum

About the author



## About the author

Muhammad Nasir Ayub Khan was born on March 19, 1970 in Rawalpindi, Pakistan. He began his education in his native village in Azad Jammu and Kashmir. Muhammad began his medical studies at the Allama Iqbal Medical College Punjab University in Lahore, where he earned his MBBS in 1995. Muhammad completed internships in medicine and anesthesia at the Services Hospital in Lahore. After passing his primary anesthesia exam, he enrolled in the anesthesia residency program at Aga Khan University Hospital in 1998. In March 2003, he received his fellowship in anesthesia from the College of Physicians and Surgeons of Pakistan. He traveled to the United Kingdom to gain international anesthesia experience. He became a consultant in cardiac anesthesia at Shifa International Hospital. He later traveled to Kings College London and Global Hospital Chennai, India to gain experience with liver transplant anesthesia. He established the first training unit to produce liver anesthetists to meet Pakistan's growing demand. Furthermore, he serves as a mentor and examiner for postgraduate anesthesia students at the College of Physicians and Surgeons Pakistan.

He was deeply committed to medical education. He earned a postgraduate diploma in medical education from the University of Dundee in Scotland and an MPhil in health professions science from Stellenbosch University in South Africa. He also held multiple teaching positions at Shifa Tameer e Millet University Islamabad and served as a mentor for undergraduate students. Muhammad began his Ph.D. studies at Maastricht University's School of Health Professions Education (SHE) in 2015. During his Ph.D., he supervised students pursuing a Master's degree in health professions education at Islamabad's Shifa Tameer-e- Millet University and gained university teaching experience. Muhammad is currently a consultant anesthesiologist in the department of anesthesia at Shifa International Hospital and an assistant professor at Shifa School of Health Professions Education. His long-term goal is to combine patient care, education, and research.





# Addendum

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