

Developing a theory-based behavior change intervention to improve the prescription of surgical prophylaxis in an Egyptian University Hospital.

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Research

Keywords: context-specific behaviour change strategy, prescription practices, surgical prophylaxis, Theoretical Domains Framework (TDF), Behaviour Change Wheel (BCW)

Posted Date: May 3rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-410882/v1>

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Abstract

Background: Antimicrobial resistance (AMR) is increasingly pervasive due to multiple, complex prescribing and consuming behaviours. Accordingly, behaviour change is an important component of response to AMR. Little is known about the best approaches to change antibiotic use practices and behaviours. This project aims to develop a context-specific behaviour change strategy focusing on promoting appropriate prescription practices following the World Health Organization recommendations for surgical prophylaxis in an orthopaedic surgery unit in Egypt.

Methods: The project included a formative qualitative research study was based on the Theoretical Domains Framework (TDF) to explore the determinants for inappropriate prescription of surgical antibiotic prophylaxis at an orthopaedic unit. The intervention was developed to following the Behaviour Change Wheel (BCW) in a knowledge co-production workshop with infection prevention and control experts that ensured that the theory based intervention was a culturally acceptable, practical and implementable intervention.

Results: The prescription of surgical prophylaxis was influenced by five TDF domains including, knowledge, belief in consequences (mistrust towards infection prevention and control measures), environmental factors (lack of prescription guidelines) , professional role and reinforcement (a lack of appropriate follow up actions influenced prescription of surgical prophylaxis). The appropriate set of behaviour change functions of BCW and related activities to improve the current practices included education, enablement, persuasion, environmental restructuring and restriction.

Conclusions The study showed that a theory based and context specific intervention can be created by using the TDF and BCW together with knowledge-co creation to improve the prescription of surgical prophylaxis in and Egyptian orthopaedic unit. The intervention need to piloted and scaled up.

Contributions To The Literature

- The knowledge-practice gap is well reported in the literature on antibiotic misuse indicating the need for theory-based behavior change interventions. Misuse of antibiotics major contributing factor for the growing problem of antibiotic resistance that threatens the achievements of the entire modern medicine.
- The findings of this study show evidence about factors that influence the prescription of surgical prophylaxis in an Egyptian healthcare facility, highlighting the usability of TDF and BCW tools and change theories to develop a context-specific intervention to address antibiotic prescription.
- The knowledge co-creation methodology used in this study ensures that the intervention is culturally acceptable, practical, and scalable in similar settings nationally and in the region. Large-scale interventions that address the specific triggers of behavior are needed to reduce antimicrobial resistance.

Introduction

The misuse and overuse of antibiotics are major driving forces of AMR worldwide [1–4]. New AMR mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases, resulting in prolonged illness, disability, and death. The COVID-19 pandemic has increased the use of antibiotics in the treatment of infected patients and is likely to increase AMR further worldwide [5]. About 50% of all antimicrobials prescribed globally are unnecessary [6], where antibiotic use has increased by 65% between 2000 and 2015, which is a key concern for public health [7]. The WHO AMR Global Action Plan calls for countries to improve the awareness and understanding of AMR through effective communication, education, and training. Changing behaviours of prescribers is an important piece of this puzzle. Many social and cultural factors influence antibiotic prescribing practices in acute care settings. These need to be understood in their given context in order to promote behaviour change [14–16]. Behaviour change interventions that only rely on education or policy change often have limited impact on changing behaviours [21, 22], and should be supplemented by addressing the cultural factors influencing prescribing practices.

The WHO Eastern Mediterranean regional office (EMRO) conducted a series of behavior change pilots in Egypt, Jordan ([15] and Sudan) between 2017 and 2019 to advance in the behaviour change programming to reduce the spread of antibiotic resistance in the region. Accordingly a theory-based behaviour change model called “Tailoring Antimicrobial Resistance Programme (TAP)” was adapted from earlier behaviour change guides (TIP; (TAP EURO) ([14]. The TAP aligns with. A regional TAP protocol was developed by the EMRO and was piloted in three countries in the region (Egypt, Jordan([15] and Sudan) between 2017 and 2019. The model focused on addressing the underlying contextual factors of behaviours related to a specific problem of antibiotic prescription identified by each country. These pilots aimed to assist WHO to implement behaviour change intervention locally and to frame generic approaches that feed into regional guidance on to use context specific and behavioural insights oriented methods to improve antibiotic prescribing related behaviours. The TAP methodology draws on the Theoretical Domains Framework (TDF) [16] to identify behaviour change domains and uses the Behaviour Change Wheel (BCW) as a theory of change [17]. TDF has proven to be a practical framework for public health professionals who are not necessarily experts in complex psychological behaviour change theories to develop an in-depth understanding of behaviours [16]. BCW represents an ideal match to TDF as the latter’s results can be merged with the BCW behaviour change functions [17]. Inappropriate antibiotic prescribing before and after surgery is widely reported worldwide [18–20], including in Egypt where prolonged post discharge treatment in particular has shown to be a major problem [21–23].

This paper describes the TAP methodology development process in Egypt that was initiated in 2018 as a collaborative activity between the Ain Shams University Hospitals (ASUH) and the WHO. The TAP aimed to modify surgical prophylaxis prescription practices in the orthopaedic surgery department of the ASUH in alignment with the WHO Guidance for surgical prophylaxis [24] The orthopaedic department was selected based on an prioritization exercise conducted by the infection prevention and control (IPC) unit of the hospital, clinical pharmacy unit and the WHO public health experts. The prescription of surgical

prophylaxis was selected as the malpractices were prevalent and multifaceted including longer courses of antibiotics and inappropriate starting time, as well as inappropriate use of antibiotic types for prophylaxis.

Methodology

This project is based on two distinct methods that comprise the TAP methodology: (1) qualitative research to explore the factors influencing the prescription for surgical prophylaxis among orthopaedic surgeons at ASUH; and (2) a workshop with select ASUH staff to develop a context specific behaviour change intervention utilizing data from global best practices drawn from the literature and local data from the qualitative study .

Qualitative Research Study:

The study used the theoretical domains framework to explore the underlying causes of the inappropriate antibiotic prescription for surgical prophylaxis amongst orthopedic surgeons at ASUH. TDF consists of 14 domains: knowledge, skills, social environment, professional role, memory and decision-making process, environmental factors, goals, intentions to change, optimism, reinforcement, behaviour regulation, beliefs in capabilities, beliefs in consequences, and emotions [25–26]. The domains were defined for the topic and context of the study. A semi-structured question guide was developed to explore which domains were relevant for the prescription of antibiotics for surgery and how they influence behaviour. The domains can be found in the Table 1.

Table 1

Behaviour domains of BCW, TDF and matching intervention functions (Mitchie et al 2013)

BCW	TDF	Intervention Function
Capability	Physical skills	Training
	Knowledge	Education
	Interpersonal skills	Training
	Memory, attention and decision process	Training
		Environmental restructuring
Behavioural regulation	Enablement	
Motivation	Professional/ social role and identity	Education
		Persuasion
		Modelling
	Beliefs about capabilities	Education
		Persuasion
		Modelling
		Enablement
	Optimism	Education
		Persuasion
		Modelling
		Enablement
	Beliefs about consequences	Education
		Persuasion
		Modelling
	Intentions	Education
Persuasion		
Incentivisation		
Coercion		
Modelling		

BCW	TDF	Intervention Function
	Goals	Education Persuasion Incentivisation Coercion Modelling Enablement
	Reinforcement	Training Incentivisation Coercion Environmental restructuring
	Emotions	Persuasion Incentivisation Coercion Modelling Enablement
Opportunity	Environmental context and resources	Training Restriction Environmental restructuring Enablement
	Social influences	Restriction Environmental restructuring Modelling Enablement

A field team of a cultural anthropologist and two IPC professionals trained in qualitative data collection conducted 35 in-depth interviews (IDI) during a period of two months in 2018. IDIs were conducted with orthopedic surgeons at ASUH. The team members conducted a maximum of two interviews per day and each interview lasted for 25–40 minutes. The study sample included one female and 30 male orthopaedic surgeons who were staff members in the ASUH. Half of the surgeons were residents whose working experience ranged from one year to three years and the other half were consultants whose work

experience ranged from 10 years to 22 years. A purposive sample was selected to gain diversity by including senior and junior surgeons representing different orthopedic subspecialties. Data saturation was the principle for obtaining an adequate sample size [27].

Informed verbal consent was obtained from participants. Interviews were recorded and conducted in a private space in the hospital selected by the participant, and no identifiers were obtained to ensure confidentiality. Audio recordings of the interviews were transcribed verbatim and translated from Arabic to English by the team members. Debriefing sessions were conducted weekly for the team to share key findings and to discuss modification of interview techniques and questions as necessary.

The first author of this paper (AL) conducted thematic data analysis according to the TDF domains [16]. Thematic analysis included familiarization of the data by reading the transcripts several times to gain an initial understanding of the data followed by manual coding that lead to the development of a code book that was shared by other field team members to get a consensus of the final set of codes. AL developed a chart where the codes were organized based on TDF domains and continued the analysis process by identifying categories and patterned meanings across the dataset [28]. The final interpretation of the data included a set of overarching themes used as a base for developing a behaviour change intervention [16].

Knowledge co-production workshop

A three-day knowledge co-production workshop was held with 10 public health experts from ASUH and the WHO to design an intervention that is acceptable, practical and implementable utilizing the findings from both the qualitative study and literature on global best practices to improve antibiotic prescription practices [29–32].

The workshop used the Behaviour Change Wheel as a framework to develop the behaviour change intervention. The BCW is based on three domains which interact to explain behaviour: capability, opportunity, and motivation. They further link with the domains of TDF. Capability includes the TDF domains of knowledge, skills, memory and habits, and behavioural regulations. Opportunity includes the TDF domains of social and environmental factors, whereas motivation will include the remaining TDF domains. Each BCW domain is matched with a set of intervention functions and policy that are expected to be effective for bringing about desired changes in behaviour. The BCW and TDF domains as well as the matching intervention functions can be found in Table 1 below.

The workshop resulted in development of a behaviour change strategy including selected behaviour domains and linked intervention functions and activities to be piloted. This strategy aimed to promote prescription practices for surgical prophylaxis in the orthopaedic surgery department at ASUH.

Results

In this section we describe the findings of (1) the qualitative research study and (2) the multi-disciplinary knowledge co-production workshop .

Qualitative study results

Behavioural domains of TDF

The factors identified during the interviews that influence the prescription of surgical prophylaxis were linked to eight out of fourteen domains of the TDF framework, including knowledge, beliefs in consequences, communication skills, professional role, psychological reactions, environmental context, optimism, and reinforcement.

Domain: Knowledge

Respondents discussed how their limited knowledge influenced the prescription of antibiotics for surgical prophylaxis. Most respondents discussed having learned how to prescribe antibiotics for surgical prophylaxis from senior physicians during their residency, *"This is what I learned during my residency by observing others and my superiors. This is what we all do"- Orthopaedic surgeon, resident.*

Several respondents highlighted that they did not know enough about appropriate antibiotic prescribing. Likewise, several respondents mentioned that they were not clear about how to prescribe antibiotics appropriately, *"I was not trained to prescribe antibiotics. I do what I have to do, but it is not based on any knowledge. I would need to Google if I want to prescribe correctly. I don't have time for it." - Orthopaedic surgeon, consultant.*

Domain: Belief in consequences of prescribing antibiotics without following guidelines

Respondents discussed AMR as a consequence of improper prescription of antibiotics for surgical prophylaxis. All respondents were aware of antibiotic resistance as a global phenomenon. Many of them were also convinced that AMR was more common in Egypt. However, respondents had given little thought to their own antibiotic prescription practices as a contributing factor to AMR. Instead they blamed community pharmacists and patients for the overuse. For example, one Orthopaedic surgeon, consultant said *"All I can say is that this is a big problem in Egypt. People and pharmacists use antibiotics without any control whatsoever."*

Domain: Belief in the consequences of prescribing antibiotics by following international guidelines

Many respondents were aware about the international guidelines for antibiotic prescription ; however, they did not believe that these guidelines were applicable in the Egyptian context because they believed that international guidelines were developed in the context of western countries where AMR was less of a problem than in Egypt.

"In Egypt AMR is a big problem. For that reason we have to prescribe more stronger antibiotics and for longer periods of time than elsewhere." (Orthopaedic consultant)

Domain: Communication skills

Respondents discussed the critical role communication skills could play when answering patient demand for receiving antibiotics following hospital discharge. They acknowledged that the practice was unnecessary nor supported by any evidence, but also thought that halting the prescription of antibiotics after hospital discharge would not be readily accepted by patients. An orthopaedic surgeon consultant said *"Patients tell me what they want. Yes, I discuss with them, but they don't always listen to me. They may not consider my advice about antibiotics."*

Domain: Professional role

Junior doctors highlighted that senior physicians were always the decision makers if they were involved in the prescription for surgical prophylaxis, as indicated by a resident orthopaedic surgeon. *"We follow what senior doctors are recommending."* It was also highlighted that clinical pharmacists had no role to play in the prescription of antibiotics unless there was a patient with resistant infections. *"We do not benefit from the pharmacological knowledge of clinical pharmacists. We don't have them."* - Orthopaedic surgeon, consultant.

However, many residents cited that communication between senior and junior doctors was often limited and, as such, they were left with limited guidance on how to prescribe antibiotics. *"Sometimes we don't see our consultant at all. He may not follow the case much. I can go back to him if I have a problem"* - Orthopaedic surgeon, resident. Respondents also highlighted that different orthopaedic surgery specialties had different undocumented group rules for surgical prophylaxis, however, there is no group pressure to follow them. *"There is nobody checking if we follow the rules or not, but most do what we all do"* - Orthopaedic surgeon, resident. The undocumented rules mentioned included the type of antibiotic and the duration of the antibiotic course.

Domain: Psychological reactions

Respondents discussed the fear of patient acquisition of infection due to ineffective IPC programmes as a factor that influenced their prescription of antibiotics for surgical prophylaxis. This fear of infections encouraged prescribers to prolong the duration of antibiotics and to use broad spectrum antibiotics which are not recommended by international guidelines. The limited confidence in the effectiveness of the hospital's IPC programme contributed to the practice of antibiotic prescribing. *"Here in the hospital there are no IPC measures implemented. Doctors and nurses practice as they wish. There is no follow up. Where is the IPC team?"*-Orthopaedic surgeon, consultant. Some of the respondents referred to breaches of IPC practices they witnessed, such as entering the operating theatre multiple times with the same personal protective equipment, not using masks or gloves as per guidelines, insufficient sterilization of surgical equipment, breaches in environmental cleaning, as well as overall crowding in the wards, construction work, and a lack of nursing staff.

The patients were another source of fear of infection as most are from low socio-economic backgrounds and respondents believe they tend to be prone to infection due to poor general health conditions, nutritional status, and unhygienic living conditions. One resident orthopaedic surgeon explained, *"Our*

patients are so fragile. It is easy for them to acquire an infection. That's why we cannot comply with any international guidelines. We are different."

Many respondents noted that inadequate hospital infrastructure might be a contributing factor to the acquisition of hospital-acquired infections. Examples are: overcrowded wards with lots of visitors who stayed for extended periods of time at bedsides, continuous construction work, and limited air conditioning in different areas of the hospital. Another orthopaedic surgeon, resident noted, *"In a private hospital we have one patient per room, and we have nice furniture and surroundings. But here in the government hospital we have to use antibiotics to kill any germs in the environment."*

Domain: Environmental context

Respondents also explained that their selection of certain types of antibiotics is influenced by availability within the hospital. On many occasions, certain types of antibiotics are out of stock and sometimes broad-spectrum antibiotics are also unavailable.

Respondents explained that they did not have guidelines for surgical prophylaxis based on their Egyptian context, *"We don't follow any guidelines as we don't have guidelines"- Orthopaedic surgeon, consultant.*

Domain: Optimism

Responses regarding the belief in changes to prescribing practices varied significantly, but most respondents did not believe that change in prescribing behaviour can happen, *"This is our practice. Changes are not possible."*- Orthopaedic surgeon, consultant. Many explained that senior staff and eminent surgeons in particular will not change their current prescribing practices. Some believed that over time change could be introduced but that would require everyone in the department to follow a specific policy. Others cited that changes could be introduced when IPC practices were improved, *"Sure, sometime later when our hospital is in better shape and infection control practices are well institutionalized"- Orthopaedic surgeon, consultant.*

Domain: Reinforcement

All respondents agreed that there was no follow up or feedback on their antibiotic prescribing practices including surgical prophylaxis. There is no follow up or peer control, *"Nobody follows how we prescribe antibiotics. There is no positive or negative feedback"- Orthopaedic surgeon, consultant.*

Workshop of knowledge co-production

The workshop resulted in the selection of five behavioural domains to be addressed in the behaviour change intervention based on the qualitative research study, followed by selecting five intervention functions which correspond with the BCW framework and are in line with global best practices. Workshop participants selected the interventions which were evaluated based on their acceptability, practicality and how well they can be implemented on a large-scale basis. The intervention functions and activities can be found in Table 2.

Table 2
Suggested behaviour change functions and activities

Behavioural Domain	BCW intervention function	Activities
Knowledge	Education	<ul style="list-style-type: none"> • Educational sessions • Advocacy meetings
Beliefs in capabilities	Enablement	Infection Prevention and Control improvements and training
Professional role	Persuasion	<ul style="list-style-type: none"> • Advocacy to engage senior physicians • Promotion of positive self-images of physicians
Environmental factors	Environmental restructuring	Guidelines for surgical prophylaxis
Reinforcement	Restriction	Feedback system with restrictions

Domain: Knowledge

The qualitative research study indicated that there is lack of knowledge about antibiotic prescription among orthopaedic surgeons, thus highlighting the relevant TDF theme of ‘knowledge’. The BCW intervention which corresponds with ‘knowledge’ is ‘education’. The rapid literature review indicated that educational interventions alone have little impact on behaviour change [33–35]. However, many interventions that use several elements including an educational component provided evidence that education together with other interventions can have a positive impact on behaviour change [36–40].

The workshop participants discussed how educational sessions in general are perceived as culturally acceptable interventions, but also how inviting senior staff to an education session is believed to be a sensitive issue because it could be interpreted by senior staff as undermining their knowledge and skills. This was not believed to be a problem among junior staff who may find educational opportunities appealing. The workshop participants highlighted that the composition of educational session participants must be planned carefully and introduced in a way that follows the hierarchies of Egyptian hospitals.

From a practical point of view, organizing educational sessions was considered difficult because doctors were generally busy. Incorporating educational components into existing hospital staff meetings and continuous educational trainings was therefore considered more feasible. Workshop participants agreed that educational sessions are easily approved by the hospital management. Therefore, such sessions were considered easily implementable even on a larger scale within the hospital. Workshop participants also agreed that the behaviour change intervention should include educational sessions for residents. In addition, educational messages in the form of advocacy for AMR could be incorporated into regular unit meetings where senior staff meet.

Domain: Beliefs in capabilities

The qualitative research study pointed out that one of the major drivers of current misuse of antibiotics was a fear of the acquisition of hospital acquired infections, linked to beliefs about insufficient infection control measures as well as the poor general health and unhygienic living environments of patients.

Literature shows that multi-faceted antibiotic stewardship programs including structural adjustments to improve IPC measures showed positive results in changing prescription practices [41–43].

The BCW intervention concerning reducing the fear of patient acquisition of hospital acquired infections through improvements in IPC corresponds with the TDF theme of 'enablement,' which itself refers to modifications in the enabling environment. Accordingly, respondents discussed the need to improve IPC programmes, which is a concrete, visible and measurable action that is likely to be strongly welcomed by all healthcare workers. Workshop participants also believed that enhancing IPC measures would provide an opportunity for the IPC team to become more visible and appreciated. An IPC related intervention was considered practical as ASUH has a large and well-trained IPC staff that can incorporate additional IPC measures to support the orthopaedic surgeons. However, the intervention is likely to require some advocacy as IPC related measures are not prioritized by the hospital administration.

Domain: Professional role

The qualitative research study illustrated that the role of senior doctors was critical in many ways. Accordingly, the workshop participants highlighted the importance of paying special attention to the senior staff. They agreed that getting senior staff on board would ensure the intervention's acceptability to all staff working in the hospital, and it's approval by the hospital administration which tends to align with senior doctors in decision making. Workshop participants also discussed that doctors could be encouraged to change their prescription practices through promotion of positive professional images as Egyptian doctors take great pride in being reputable doctors. The BCW intervention function corresponding with professional role was the TDF theme of 'persuasion,' and workshop participants agreed to include persuasion by developing appropriate activities such as reminders that address senior staff to emphasize their role in the intervention.

Domain: Environmental factors

The qualitative study revealed that neither the hospital nor the orthopaedic department had guidelines or policies for antibiotic prescription in general, including surgical prophylaxis. Although the literature on AMR suggests that introducing antibiotic guidelines and policies alone does not always result in behaviour change, when including guidelines as a part of an intervention bundle there seems to have been a positive impact on improving prescription practices [44–49].

The workshop participants indicated that guidelines can be acceptable if the introduction of them takes place gradually, starting from the senior staff first. Ideally, the senior staff should be involved in the development of the guidelines to ensure they are accepted and applied by all. The workshop participants

also agreed that training and orientation on the guidelines is important to ensure implementation. The scaling up of guidelines was also seen as feasible even on a national scale. The workshop participants therefore agreed to include the TDF theme of 'environmental restructuring' as a BCW intervention function that included developing and disseminating hospital-based guidelines for surgical prophylaxis as a part of the intervention.

Domain: Reinforcement

The qualitative findings showed that, currently, there is no follow up of prescription of surgical prophylaxis or prescription of antibiotics in general. The surgeons did not receive any feedback from their peers or the management regarding their antibiotic prescription practices. Yet, the rapid review pointed out that multi-component interventions that includes follow up, audits, or feedback systems were generally effective in changing prescription [36–39, 40].

The workshop participants discussed how implementing a feedback or audit system would not be easily accepted by the doctors who are used to making decisions about antibiotics independently. They believed that senior staff would be the most difficult, if not impossible, to convince them on the importance of such systems – given their view that senior doctors believe they know what works best based on their vast experience. Therefore, workshop participants suggested that the feedback system include 'restrictions' that will require surgeons to comply even if they were not in agreement. Restriction systems as part of antibiotic stewardship programs were also used successfully in other international settings [50–52].

Workshop participants also discussed including a clinical pharmacist in the follow up system as the rapid literature review showed that the involvement of clinical pharmacists is highly beneficial [53–56].

In addition, the workshop participants highlighted the need to include the hospital management in the feedback system to make it practical. The workshop participants also highlighted that as university hospital in general have similar structures and staffing, the same system can be easily adjusted for other settings.

Discussion

TAP is an effective method to understand the underlying factors behind antibiotic prescription practices and in developing sound evidence-based behaviour change intervention in the Egyptian context. The TDF used in the qualitative study proved to be a practical framework for collecting qualitative data to understand the prescription practices for surgical prophylaxis in the Egyptian healthcare setting where respondents appreciated the structured way of exploring behaviours.

The qualitative study highlighted that there was a lack of knowledge about proper antibiotic prescription. Number of studies highlights that sufficient knowledge about antibiotics and antimicrobial resistance is a prerequisite for proper prescription practices [57]. However the qualitative study also identified

misconceptions that must be taken into consideration when aiming at improving the prescription of surgical prophylaxis. Firstly prescribers did not think that their prescription practices were contributing to the AMR problem of the country, which has been found as a misconception also in other countries [58]. Secondly they believed that international guidelines were not applicable to the Egyptian context where antibiotic consumption was believed to be higher than elsewhere with higher rates of resistant bacteria. It is not uncommon that international guidelines are seen inappropriate in a local context as the definitions of improper antibiotic use differ across various settings and they are often linked with local understanding of uncertainties and moral judgments [59].

The qualitative data also highlighted that mistrust towards infection prevention and control (IPC) programmes were driving fear of infection that made prescribers reluctant to make modifications to their current surgical prophylaxis practices. Breaches in IPC have been commonly identified as a barrier for improving the prescription for surgical prophylaxis in middle and low income countries where prescribers tend to prescribe antibiotics for longer periods of time [60]. A study in Egypt indicates that treating physicians are motivated to prescribe antibiotics to avoid potential secondary bacterial infections caused by lack of IPC measures or due to unhygienic living conditions of the patients [61].

Interventions that aim to change practices must fit to the organizational culture to be accepted and sustained [62]. The data also showed that in the Egyptian context, a top bottom approach is appropriate to drive a change; meaning that engaging senior physicians and department directors is essential for any change in the practices of younger physicians. Trust in the perceptions of senior practitioners have been shown to be powerful reasons for the inappropriate prescription of antibiotics in several countries in the world [8,11, 63–64].

The knowledge co- production workshop ensured that the selected intervention functions were context appropriate. For example, an intervention was suggested to reduce the fear of physicians for patient acquisition of infection due to limited IPC. This was addressed by enhancing the IPC programme activities to ensure patient safety. This was supplemented by updating the hospital guidance on surgical prophylaxis addressing the needs of the orthopaedic surgeons. Knowledge co-production demonstrated also efficacy in identifying local solutions for activities. [17]. For example, as a result of co-production, the intervention activities were merged into existing hospital activities such as incorporating educational sessions on antibiotics and AMR during the regular department meetings that made the intervention low cost. Co-production interventions are known to be valuable in behaviour change programming as they stimulate participation in the design development including co-identification of problems, co-development of alternatives, and co-implementation of solutions that promote mutual learning and co-realization in all stages of the process. to participate in the design process [65–67].

The study has some limitations that must be acknowledged. The practices reported in interviews might have been influenced by socially desirable answers given the potentially sensitive nature of subjects discussed. As the study is based on qualitative data, there is a need to evaluate critically the applicability of the findings in larger scale implementation.

Conclusions

This project showed that qualitative methods can be used to develop a theory-based behaviour change intervention that aims to change the prescription of surgical prophylaxis in an Egyptian orthopaedic surgery unit in Egypt. The impact of the intervention will be piloted, evaluated, and based on the results the of the evaluation, similar interventions could be rolled out in Egypt and in other socio-culturally similar settings. In other settings that may differ, use of similar qualitative methods may help designing adapted behaviour change interventions that may have a different focus towards the same aims. Consolidated experience from such projects in different setting will ultimately contribute to a WHO regional guidance for behavioural insights in antibiotic prescription. This would build capacity of public health experts in social and behavioural change communication to design adapted behaviour change strategies and reduce the spread of AMR.

Declarations

Ethics approval and consent to participate

The project and TAP methodology received ethical approval by the Ain Shams University ethical review board in February 2018, followed by the approval of the WHO Eastern Mediterranean Regional Office ethical board. In addition, the London School of Tropical Medicine and Hygiene (LSTMH) MSc Research Ethics Committee approved the protocol for MSc in Public Health program. All participants signed consent to participate.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interest

Funding

The study was funded by a German Fund to the WHO Eastern Mediterranean Regional office.

Author Contributions

1. Conceptualization AL, IH, SA, AO, CA
2. Formal analysis AL

3. Funding acquisition MT
4. Investigation- AL, IH, SA, SS
5. Methodology AL, IH, CA
6. Project administration SA, AK, EH, SS
7. Resources AL, IH, SS
8. Supervision MT, SA, AK, EH, CA
9. Writing- original draft preparation AL
10. Writing- review and editing IH, MT, CA

Acknowledgements

The authors wish to thank the team of Central Unit of Infection Control, Ain Shams University Hospital for their support in data collection and planning of a behaviour change interventions. Additionally, we would like to thank the staff members of the Orthopaedic Surgery Department, Faculty of Medicine, Ain Sham University Hospital who participated in the interviews, discussions and technical dialogues for their commitment and generous cooperation.

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