RESEARCH ARTICLE

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Using Intervention Mapping to Develop a Theory-Based Intervention to Promote Colorectal Cancer Screening in Egypt

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Abstract

Background: Colorectal cancer (CRC) incidence and mortality rates are increasing in Egypt. Because no national screening guidelines exist, developing an effective evidence-based screening intervention could lower rates by early detection of pre-cancerous and cancerous lesions and polyps. This paper describes the development of a CRC screening intervention in Alexandria, Egypt using Intervention Mapping (IM). **Materials and Methods:** Between September 2019 and March 2020, the successive steps of the IM process were completed. Beginning with the needs assessment, we conducted a literature review, held focus groups with residents of Alexandria, and conducted interviews with local gastroenterologists and oncologists. Program objectives and target audience were determined before designing the program components and implementation plan. Using the PRECEDE-PROCEED theoretical model, predisposing, reinforcing, and enabling screening barriers were assessed. Finally, we developed a Standard Operating Procedures manual detailing aspects of the intervention and evaluation to serve as a model for an expanded screening program. **Results:** The needs assessment, e.g., literature review, seven focus groups (N=61 participants) and interviews (N=17 participants), indicated that barriers among residents included CRC knowledge deficits, fear/anxiety regarding testing, high cost, and lack of accessibility. Physicians believed CRC testing should only be performed for high risk individuals. Findings from each step of the process informed successive steps. Our final intervention consisted of training components for medical students (Health Champions) who would deliver the intervention to patients in primary care waiting rooms, providing short descriptions of CRC risks and screening, educational brochures, and distributing vouchers for no-cost guaiac fecal occult blood test kits. Health Champions would then follow up with the patients, providing results and referrals for no-cost colonoscopy testing for those with abnormal results. **Conclusion:** Utilizing the IM steps successfully led to development of a theory-based CRC screening intervention for Egypt. Next steps include the implementation of a feasibility pilot intervention.

Keywords: Intervention mapping- screening intervention- colorectal cancer- LMIC health- fecal occult blood test

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Introduction

Despite declining rates of incidence and mortality due to colorectal cancer (CRC) overall, it still ranks second globally in mortality (Sung et al., 2021) with disparities persisting in low-to-middle income countries (LMICs), such as Egypt (Arnold et al., 2017). Egyptians are diagnosed with CRC at later stages and have an overall survival of just two years (Metwally et al., 2018), in part because there are no standard practice national guidelines for CRC screening and health insurance plans lack coverage for testing. The community standard for clinical practice in Egypt is to screen only high-risk patients, e.g. a positive family history for CRC, leading to delayed symptomatic presentation (Khafagy et al., 2000). Therefore, developing an effective evidence-based screening intervention would help lay the foundation for national guidelines and subsequent policy changes.

Literature is scarce regarding CRC screening interventions in Egypt. However, a recent nurse-led CRC educational intervention examined patients' perceptions of CRC, screening, and knowledge of CRC risks and health promoting behaviors (El Sayad et al., 2021; Mohsen et al., 2020). Post-intervention, participants reported more

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positive perceptions of CRC screening (Mohsen et al., 2020) and had significant increases in knowledge and positive behavior changes, such as reducing dietary fat and increasing fiber intake (El Sayad et al., 2021).

Evidence suggests that multi-level health promotion interventions are most effective for behavior change (The Community Guide, 2020; Truman et al., 2000). It is important to follow a systematic process during the development phase of such an intervention, taking into consideration the target population's needs and assets as well as including an evaluation component (Hawe and Potvin, 2009; Moore et al., 2019). To that end, we elected to use an intervention development framework, grounded in theory and culturally-relevant, that identified multilevel barriers that could be addressed effectively through multiple components. The purpose of this paper is to describe the development of a theory-based CRC screening intervention in Alexandria, Egypt using Intervention Mapping (IM).

Materials and Methods

Overview

This CRC screening intervention was developed in Alexandria, Egypt. All focus group and interview participants were provided information regarding the study and voluntarily agreed to participate, providing signed informed consent. Each phase of the intervention development was reviewed and approved by the institutional review boards at The University of Alabama at Birmingham and The Alexandria University Faculty of Medicine.

Theoretical Framework

We developed our program within the context of the PRECEDE/PROCEED model (Crosby and Noar, 2011). The PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational/environmental Diagnosis and Evaluation) component of the model was used throughout the development steps as it examines factors on multiple levels. This component focuses on individual (predisposing), interpersonal (enabling), and structural/policy (reinforcing) factors inherent in health behaviors and interventions.

Intervention Mapping

IM systematically integrates theory, literature, and data from a target population to promote structured planning, following a 6-step progression (Bartholomew-Eldredge et al., 2016). IM has been used globally to test, revise, and refine CRC screening interventions, applying social and behavior science theories to the implementation of evidence-based health interventions (Besharati et al., 2017; Mirzaei-Alavijeh et al., 2019; Serra et al., 2017).

Figure 1 describes our intervention mapping steps. Beginning with Step 1, we completed a needs assessment, which included a literature review to identify research on CRC screening interventions in Egypt, focus groups with residents in Alexandria to identify barriers and facilitators to CRC information and screening, and one-on-one interviews with primary care physicians, gastroenterologists, and oncologists to determine their awareness of CRC screening recommendations and to identify barriers they experienced in patient care as well as assets already in place (Bateman et al., 2020). The question guides were provided by the authors to the interviewers and moderators prior to the actual interviews and focus groups after testing the components to assess appropriateness. In Step 2, we developed program objectives and identified our target population for the intervention. We based our objectives on results from our needs assessment and current assets. Step 3 required our choosing theory-based methods and applications, then, during Step 4, we designed the intervention. Next, in Step 5, we planned the adoption and implementation of our plan, during which we considered the context (location, availability of materials and personnel) of the components of the intervention. Finally, in Step 6, we created an evaluation of the intervention, designing instruments to be used, following similar steps taken by other researchers (Bartholomew-Eldredge et al., 2016; Garba and Gadanya, 2017).

Results

The intervention development began in September, 2019 and ended in March, 2020. The steps occurred in succession with the PRECEDE model guiding the direction of the multilevel components and are outlined below. The IM process led to our finalized intervention, which can be seen in Table 1.

Step 1: Needs assessment

Our assessment began with a literature review of CRC screening programs in Egypt and other Middle Eastern countries, followed by seven focus groups of residents in Alexandria (N = 61), conducted at clinic sites, and 17 one-on-one interviews with primary care physicians, gastroenterologists, and oncologists, conducted at clinics and workplace offices (Bateman et al., 2020). Interview participants were recruited within the Alexandria University primary care and specialty clinics and focus group participants were approached at clinics, specialty care clinics, and social clubs by researchers attending the events for the purpose of recruitment. All interview participants who agreed to participate completed the study. Of the focus group participants, three dropped out of the study because of refusal to agree with recording of the session. The interviews with primary care physicians, oncologists, and gastroenterologists included health care providers practicing in Alexandria, Egypt. The focus groups of residents, segmented by social class and gender, were held in various locations in Alexandria that were convenient for participants, led by trained moderators. There were no previous relationships between interviewers/moderators and study participants. Face to face interviews and focus groups were conducted by AN (male), SK (female), KA (male), IA (male), and MF (female), all either medical doctors, PhD researchers, or medical interns, trained by LB, an expert in qualitative methodology. Interviews lasted approximately 20-30 minutes while focus groups lasted an average of one

Table 1. Mapping Colorectal Cancer Screening Intervention Components to the Needs Assessment Findings within Cach PRECEDE Level

	PRECEDE Level	Needs assessment findings	Intervention components
Barriers	Individual (Predisposing)	• Socioeconomic status (MD) • Lack of preventive care (MD) • Fear of being diagnosed with cancer (MD, FG) • Invasiveness of test (colonoscopy) (MD) • Lack of knowledge about prevention in general (FG)	• Provide • Reassurance • Provide non-invasive gFOBT test. • Provide CRC information
	Interpersonal (Reinforcing)	• Health information received from media, relatives and friends, neighbors (not doctors) (MD) • Physicians' lack of knowledge about cancer risk factors and prevalence (MD) • Physicians failure to order screening tests (gFOBT and colonoscopy) (MD)	• Provide CRC information • Educate medical students on CRC risk and prevalence • Provide gFOBT tests directly to patients
	Community/ Organizational (Enabling)	• Some screening tests not available in primary health clinics (i.e. colonoscopy) (MD) • Physicians fear consequences of colonoscopy (MD) • Cost (MD, FG) • Lack of time (FG) • No specific compulsory measures for screening. (FG)	• Provide gFOBT directly to patients • Provide gFOBT tests for free • Provide convenient locations for return of gFOBT kits
Facilitators	Individual (Predisposing)	• Media campaign (MD) • Health education (MD) • Readiness to get screened based on feeling at risk (FG)	• Provide health education • Share risks of CRC and benefits of screening
	Interpersonal (Reinforcing)	• Training physicians in doctor-patient communication (MD) • Training primary physicians in CRC risk factors, screening, diagnosis and treatment (MD)	• Train medical students in doctor-patient communication and CRC risk diagnosis and treatment
	Community/ Organizational (Enabling)	• Promoting screening tests in clinics (MD) • Ensure screening tests are affordable (MD, FG) • Provide adequate equipment and training for clinic and laboratory staff (MD) • Implement compulsory screening programs (FG)	• Provide education and no cost gFOBT tests in clinics

Abbreviations: MD, data from physician interviews; FG, data from focus groups

hour. In addition, focus groups were clustered based on socioeconomic level: low, moderate, and higher social statuses. Groups were identified based on the participants' place of residency. Focus groups and interviews were conducted in Arabic, and were audio recorded. Recordings were transcribed and translated into English. Data were analyzed using NVIVO 11 (QSR International Pty Ltd, 2015) and using a framework of thematic analysis (Braun et al., 2019) with two data coders assigned to each transcript. We conducted interviews and focus groups until our team felt we reached theme saturation.

Findings from the one-on-one physician and specialist interviews (Bateman et al, 2020) examined healthcare providers' perceptions and practices of CRC screening and identified physician-level barriers and facilitators to CRC screening. Physicians felt that there was a lack of emphasis on prevention and believed that only high-risk patients should be screening. In addition, these providers were concerned about the invasiveness of colonoscopy and how patients perceived screening and their fear of a cancer diagnosis. They reported that inadequate training among laboratory providers was problematic, as well. In addition, they felt that barriers were multilevel and required a multilevel response in order to successfully lower morbidity and mortality of CRC. Some suggestions included providing screening tests at no or low cost, making tests widely available, and creating a nationwide media campaign to educate the public regarding prevention and early detection that highlights younger-age prevalence (Bateman et al, 2020).

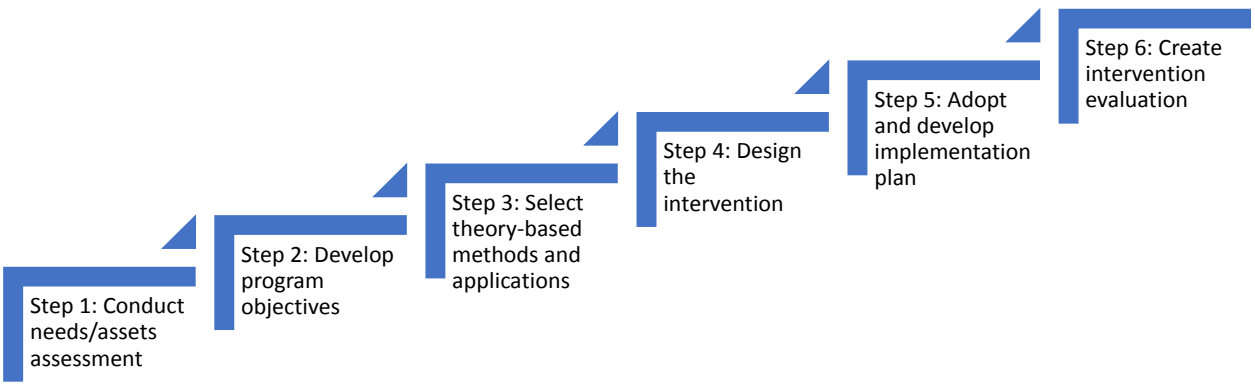

Figure 1. Intervention Mapping Steps, adapted from model by Bartholomew-Eldridge (2016)

Focus groups were held with 7-8 participants per group. Most participants knew very little about CRC in general and were unaware of the lower-age prevalence of CRC in Egypt. Participants discussed individual-level barriers to screening, which included fear and anxiety about the procedure, high cost, lack of testing availability, and the fear being diagnosed with cancer. They felt that making screening test kits convenient, low-cost or free, and obligatory would increase testing and save lives.

Results from our literature review echoed our qualitative findings regarding attitudes and behaviors; however, some studies identified in the literature review were completed in other Middle Eastern countries, rather than Egypt (Al-Dahshan et al., 2021; Qumseya et al., 2014; Tfaily et al., 2019). Other studies reported that physicians in Egypt tend to not order tests or follow recommended screening schedules, similar to other countries in the region (Mosli et al., 2017; Muliira et al., 2016).

Step 2: Develop program objectives

In our next step, we developed our program objectives and identified our target audience. To do this in a culturally-relevant way, we formed a coalition of stakeholders, including oncologists from the Alexandria University Oncology and Nuclear Medicine department, Alexandria University Faculty of Medicine (AUFM) Gastroenterology Department, medical students in the Alexandria Students' Scientific Association (ASSA), and Primary Care Community Clinic administrators who represented the Ministry of Health. Members of the coalition aided in identifying priorities in research and assets already in the community, reviewed results of our needs assessment activities, and made recommendations for intervention design.

We based our objectives on results from our needs/asset assessment and input from our coalition members. Our first broad objective was to develop, implement, and examine the feasibility of a CRC screening and promotion intervention among healthy adults in Alexandria, Egypt. Our second broad objective was to build capacity in Egyptian medical students by training them on strategies to promote behavior change and to conduct the intervention.

We determined the intervention would address barriers to CRC screening with our target audience identified as asymptomatic individuals age 30 and older. Our intervention's specific objectives included education regarding CRC risks, prevention behaviors, and screening for patients, training for medical students regarding the importance of CRC testing and early detection. We also included a component geared toward training in doctor-patient communication skills.

Step 3: Selection of theory-based methods applications

Once our objectives were identified, we made the decision to categorize the barriers and facilitators into the different components of the PRECEDE model. We concluded that each component in the program would be designed to address medical student barriers at the predisposing, reinforcing, and enabling levels to promote optimum outcomes. In particular, the interview results indicating a lack of knowledge surrounding CRC and screening among physicians prompted the realization that any effective intervention would need a significant educational component in order to address both predisposing and reinforcing levels.

Step 4: Designing the intervention

After identifying existing resources (assets), our planning team examined how those resources could address our named program objectives, adjusting current assets and discussing the application of new materials into the intervention. We elected to train medical students as "Health Champions (HCs)" to guide patients through the program, answer questions, and follow-up with patients after testing. Recruitment for HCs would be through recommendations from the ASSA. The use of medical students in this role served two purposes: (1) addressing physician-level barriers by educating future physicians about the importance of routine CRC screening, and (2) training medical students to provide education and follow-up for future patients. HCs were trained in techniques for one-on-one education regarding CRC risk factors, prevalence, prognosis, and screening benefits to patients. At the enabling (community/organizational) level, in order to address the barrier of high cost of testing, we worked with our partners to bypass the health system and clinic to provide no-cost guaiac fecal occult blood tests (gFOBT), as this kit was determined to be low cost (less than US$5) and broadly available in Egypt. In addition, we determined that, upon receipt of additional funding, we would conduct a feasibility pilot through the San Stefano Primary Health Care Center (PHCC), as it was a no-cost public health clinic in Alexandria that serves ~100,000 patients per year and provided a full range of services including laboratory testing.

Step 5: Development of an implementation plan

The implementation plan for our intervention was developed in partnership with members of the local medical community in Alexandria, Egypt. Local oncologists, ASSA, and the AUFM Cancer Center director discussed details of the developed intervention components and provided input regarding implementation and changes were made to accommodate their recommendations. For example, although we originally planned for the HCs to provide gFOBT kits directly to the participant to be returned to the clinic lab, we ultimately decided to provide a voucher for a no-cost kit to be redeemed at a laboratory chain with more than 100 locations across Egypt. This provided an added convenience to patients considering they could use a lab that was close to their home.

An additional change to our intervention regarded the age of eligibility to participate. We had planned to include patients age 30 and older; however, the clinical staff in the coalition determined that we should revise the eligibility to age 50 and above. Finally, with the help of our coalition, we were able to secure no-cost colonoscopies at the AUFM Gastroenterology Department for patients with abnormal gFOBT results.

The final intervention was approved with the following procedures. While patients were waiting for their regularly scheduled appointments, trained HCs would approach patients who appeared to look at least 45 years of age and ask if they would be willing to participate in a survey and receive information about the prevention and early detection of CRC. If the patient agreed, the HC would obtain signed consent and, using an educational brochure developed based on results from the needs assessment, explained to the patient about CRC risk and the importance of screening. The HC would then provide a voucher for the no-cost gFOBT kit, which could be redeemed at a participating laboratory convenient for the patient. Once the patient collected a sample at home, the kit would be returned to the same lab for analysis. The HC would follow-up with a phone call once each week for up to four weeks or until the kit was returned. HCs would then call patients with test results and encourage those with abnormal results to follow-up at the AUFM Gastroenterology Department for a no-cost follow-up and colonoscopy, if needed. The phone number to schedule an appointment would be provided.

Step 6: Evaluation of the intervention

After our intervention and implementation plans were approved by coalition representatives, we developed a Standard Operating Procedures manual that detailed all aspects of the intervention including our evaluation plan. This manual would be the guide for when a feasibility pilot was approved. Process evaluations (treatment fidelity) would assess study design, staff training, delivery of treatment, receipt of treatment, and enactment of treatment skills (Bellg et al., 2004). HCs would complete a tracking sheet documenting each patient encounter, including the initial visit and follow-up phone calls. Challenges and other notable issues would be documented on the tracking sheet for each interaction. Quality assurance related to the intervention delivery would be checked through unannounced clinic visits and assessments by the program manager. Results and feedback would be shared with HCs to ensure congruence.

Discussion

Using the IM methodology (Bartholomew-Eldredge et al., 2016), we developed an intervention to provide CRC screening to healthy adult persons 50 years of age and older in Alexandria, Egypt. To secure buy-in and address sustainability and scalability, our engagement of a coalition of stakeholders in the research process was critical, as we have found from our previous work (Fouad et al., 2004; Morales-Aleman et al., 2018; Wynn et al., 2006). Our coalition worked with us to clarify program objectives, determine an implementation plan, and to provide invaluable input in several aspects of patient and physician engagement. Because of the close working relationship between the researchers and the coalition, we were able to pivot when necessary and identify additional resources to help our intervention be more successful.

One of our earliest challenges was the scarce literature on CRC screening interventions in LMIC middle-eastern countries generally and in Egypt specifically. Due to the decision to utilize IM methodology through the theoretical framework of the PRECEDE model, we were able to address multilevel barriers to CRC education and testing. Our findings corroborated results from the literature review and indicated that the most significant gaps were the lack of awareness regarding health screening in general and CRC specifically among both physicians and Alexandria residents (Soliman et al., 1997). As such, our intervention focused on health education. One-on-one education by health care professionals about the benefits of screening, accompanied by motivation and encouragement, has been shown to be particularly effective with the gFOBT test (The Community Guide, 2020). Therefore, we trained HCs in basic CRC knowledge and patient engagement and behavior change methods.

Our approach included providing awareness of risk factors, mortality rates, and how to prevent CRC with healthy lifestyle choices. Utilizing medical students in this role not only provided a source of eager health educators, it also served the purpose of educating the next generation of physicians on the importance of CRC screening to help with sustainability. By addressing cost, availability of screening tests, and time spent on the process, which were the next most important barriers for individuals with regard CRC screening tests, the barriers were no longer insurmountable. This is in line with other studies in LMICs which found that cost and convenience are often barriers in accessing cancer screening services (Koo et al., 2012; Lim and Ojo, 2017; Sharma et al., 2021). In the development of the training for the HCs, we also ensured that we addressed obstacles identified in the needs assessment, such as the Egyptian cultural practices of only visiting a physician when feeling sick and gaining basic medical knowledge from either the television or the internet (Bateman et al., 2020).

Strengths and limitations

There are a few limitations to note. Despite being an effective method for educating future physicians, utilizing HCs to conduct the education, awareness, and recommendations components for the intervention does not address the current physician-level barrier of physicians' knowledge gap regarding CRC risks and screening. In addition, limiting the focus groups and interviews to include only participants in the city of Alexandria, Egypt may have impacted the replicability of the study in other areas of the country.

Regardless of these limitations, the successful utilization of IM in the intervention development and having a strong coalition of stakeholders provided foundational first steps towards developing an effective nationwide CRC screening program that will impact rising rates of advanced-stage CRC in Egypt. Our future research plans include pilot testing of the intervention for feasibility. Then, using the results of that pilot study and lessons learned during the intervention development process, we can then conduct a randomized trial to test the intervention on a larger-scale that would expand testing throughout Egypt and, hopefully, lead to a national standard for CRC screening and education.

Author Contribution Statement

AN, LB, SK, MF, WA, SA, SB, KA, LR, IS - contributed to the design of the intervention. AN, LB, SK, MF, WA, KA, IS - contributed to the qualitative data collection. AN, LB, SK, KA, EA, AK, IS - contributed to thematic analysis of qualitative results. AN, LB, SK, BH, KF, IS, contributed to the writing of original manuscript All authors contributed to revisions of manuscript. All authors reviewed the manuscript and approved the final version.

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Ethical considerations

This work was approved by the Institutional Review Boards at The University of Alabama at Birmingham and the Alexandria University Faculty of Medicine. Written informed consent was obtained by all participants. No ethical issues arose during the course of this study.

Conflicts of interest

The authors report no conflicts of interest.

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