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Preventing breast cancer in LMICs *via* screening and/or early detection: The real and the surreal

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Abstract

To review the present status of breast cancer (BC) screening/early detection in low- and middle-income countries (LMICs) and identify the way forward, an open focused search for articles was undertaken in PubMed, Google Scholar and Google, and using a snowball technique, further articles were obtained from the reference list of initial search results. In addition, a query was put up on ResearchGate to obtain more references and find out the general opinion of experts on the topic. Experts were also personally contacted for their opinion. Breast cancer (BC) is the most common cancer in women in the world. The rise in incidence is highest in LMICs where the incidence has often been much lower than high-income countries. In spite of more women dying of cancer than pregnancy or childbirth related causes in LMICs, most of the focus and resources are devoted to maternal health. Also, the majority of women in LMICs present at late stages to a hospital to initiate treatment. A number of trials have been conducted in various LMICs regarding the use of clinical breast examination and mammography in various combinations to understand the best ways of implementing a population level screening/early detection of BC; nevertheless, more research in this area is badly needed for different LMIC specific contexts. No-

tably, very few LMICs have national level programs for BC prevention *via* screening/early detection and even stage reduction is not on the public health agenda. This is in addition to other barriers such as lack of awareness among women regarding BC and the presence of stigma, inappropriate attitudes and lack of following proper screening behavior, such as conducting breast self-examinations. The above is mixed with the apathy and lack of awareness of policy makers regarding the fact that BC prevention is much more cost-effective and humane than BC treatment. Implementation of population level programs for screening/early detection of BC, along with use of ways to improve awareness of women regarding BC, can prove critical in stemming the increasing burden of BC in LMICs. Use of newer modalities such as ultrasonography which is more suited to LMIC populations and use of mHealth for awareness creation and increasing screening compliance are much needed extra additions to the overall agenda of LMICs in preventing BC.

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Key words: Breast cancer; Screening; Early detection; Mammography; Clinical breast examination; Breast self examination; Ultrasonography; Awareness; Developing countries; Low- and middle-income countries

Core tip: Implementation of population level breast cancer (BC) screening/early detection programs will prove to be most cost-effective for low- and middle-income countries (LMICs). Accompanying awareness creation regarding BC among women, more research and change in policy are also necessary to reduce the burden of BC in LMICs.

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INTRODUCTION

Breast cancer (BC) is the most common cancer among women in all parts of the world, be it high income countries (HICs) or low- and middle-income countries (LMICs), accounting for 1/10th of all malignancies detected in both men and women^[1]. HICs and LMICs have been defined by the World Bank as having per capita incomes of \$12616 or more and \$12615 or less respectively^[2]. In general, there is a 10-fold difference in BC incidence across the world, with HICs having a higher incidence compared to LMICs^[3]. Moreover, BC is also the primary cause of cancer death among women worldwide, accounting for about 375000 deaths in 2000^[1]. Mortality due to BC is higher in LMICs than HICs, mostly due to lack of timely detection and treatment^[3]. However, the incidence of BC is rising in all parts of the world, whether in HICs or LMICs^[3], with higher rates of increase observed in LMICs^[4].

Screening and early detection of BC has been well established in HICs due to concerted efforts through many decades. As a consequence of mammographic screening for women aged 50-69, a decrease in BC mortality has been clearly depicted^[5,6]. This is based on observations in the United Kingdom, Northern Europe and Australia of an increasing incidence of early stage and *in situ* BCs after implementation of screening programs, followed by decline in advanced BC and mortality^[7-10]. The estimates are that 10 years after screening began in the United Kingdom, about one-third of the overall 21% reduction in BC mortality was directly due to screening^[11].

The situation in LMICs is in contrast to that of HICs. Although BC has become a health priority for most LMICs due to increasing incidence, lack of early detection and adequate treatment^[12], BC control strategies are hardly in place^[13], resulting in most women presenting with late stage disease when very little can be done^[14]. It is increasingly being realized that detecting BC early and efficiently must be the cornerstone of preventing morbidity and mortality due to BC in LMICs^[15]. In spite of this, the evidence base for implementing early detection/screening of BC in LMICs is extremely thin^[16]. This is unacceptable given the rising populations and the demographic and epidemiological shifts seen in LMICs. It is apparent that along with such changes, an accompanying increase in cancer burden is to be expected in the coming decades in LMICs^[17]. If we were to limit the impact of rising cancer burden in LMICs, it is of utmost importance that there be adequate application of existing knowledge regarding cancer prevention as well as generation of new evidence^[17]. This is also imperative in the light of strong evidence that demonstrates that diagnosing BC early can reduce BC mortality rates, mainly through initiation of appropriate and adequate treatment in the disease's natu-

ral history^[18-20].

As a part of this review, an attempt has been made to consolidate the evidence that exists regarding prevention of BC in LMICs in terms of screening and/or early detection, along with exploring ways to implement the existing evidence and identifying loopholes in research and implementation. The immediate need for prevention of BC in LMICs cannot be emphasized enough.

LITERATURE SEARCH

For the purposes of this focused review, an open search for articles was undertaken in MEDLINE (www.pubmed.com) or the PubMed database, Google Scholar and Google search using keywords like BC, prevention, control, screening, early detection, low- and middle-income countries, LMICs, developing countries, mammography, clinical breast examination (CBE), self breast examination (BSE), ultrasonography and ultrasound with their corresponding MeSH terms in combination with OR, AND where applicable. In addition, the reference list of the articles obtained from the preliminary search was used to further obtain relevant articles and so on *via* a snowball technique. The search was limited to English literature and there were no time limitations for the search. Apart from the search, a question was also put up on ResearchGate^[21] related to this topic, namely "What are the options for early detection and/or screening for BC in low- and middle-income countries (LMICs)?", to find out the opinion of various experts in the field, from both HICs and LMICs. The content of the responses was used to further obtain articles to be included in the review and also to understand the prevalent opinion regarding screening options for BC in LMICs. In addition, experts in the field were also contacted for more references and opinions.

STATUS OF BREAST CANCER PREVENTION IN LMICs-THE REAL

BC, the most common neoplasm in women worldwide, is on a fast and steady rise in LMICs^[1,22]. Mortality caused by BC is also rising quickly^[1,22]. This trend of increasing incidence and mortality due to BC is a common occurrence in LMICs in various parts of the world, be it Latin America, Asia or Africa^[19]. In most of these countries, the rising incidence is most probably due to changing lifestyle patterns, change in reproductive risk factors and increasing obesity due to improving affluence^[23-26]. The contribution of exogenous hormonal influences cannot be ruled out^[27]. It is also quite apparent that most primary risk factors of BC and the ways in which they are changing are not easily modifiable since most of them influence the long term hormonal milieu in a woman's body^[23]. Thus, beneficial impact on BC mortality can only be created *via* implementation of population level screening/early detection and continued improvements in BC treatment^[23].

Among all forms of BC prevention, screening and early detection are the most important since they can have the maximum beneficial impact in lowering the morbidity and mortality due to BC. Consequently, a number of studies have highlighted the need for BC screening/early detection in LMICs to prevent early deaths of women presenting with late stage at diagnosis^[17,28-30]. However, many complex issues crop up in the context of planning and implementation of BC screening in LMICs. One of the important issues is the occurrence of estrogen receptor negative (ER-) BC at earlier ages in LMICs^[31]. It has been suggested that the younger age of BC in LMICs is due to the age distribution of the population^[31], although there is a possibility that the aggressive ER- BC seen in younger ages in LMICs might be a different disease subtype, as has been suggested in Asia and Africa^[32,33].

Status of mammography in LMICs

Thus far, mammography has remained the main modality of BC screening throughout the world. Adequate evidence exists from some randomized controlled trials (RCTs) that mammography screening is associated with significant reductions in BC mortality^[34-36]. Also, to be most beneficial, mammographic screening programs must be of high quality, with appropriate targeting and of sufficient frequency^[37]. Mammography itself does not lead to any excess deaths^[38], although that is currently being debated, with certain researchers suggesting that for every 10000 women invited for screening, 3-4 deaths were avoided, while 1-3 deaths were from other causes for every BC death avoided^[39]. In addition, there is data emerging from HICs that apparently denotes that implementation of screening mammography at the population level has led to probable overdiagnosis while only marginally reducing the rate at which women presented with advanced cancer, consequently having only a small effect on rate of death due to BC^[40]. Similar evidence has been accumulated from multiple other studies^[41,42] and adds to the ongoing discourse regarding the usefulness of population level BC screening using mammography^[43].

Adding to the above scenario is the fact that in LMICs, BC incidence is lower and occurs more in younger age groups when breast tissue is dense. Also, there is a lack of resources for implementing any population level screening programs using mammography. Given the above, implementation of a mammographic screening program becomes quite close to impossible since the costs are too high while the benefits are negligible. There have been very few studies that have focused on cost-effectiveness of BC screening in LMICs^[44,45]. Treating Stage 1 disease and having an extensive BC screening program were found to be most cost-effective by Groot *et al*^[44], while Okonkwo *et al*^[45] suggested CBE to be as cost-effective as mammograms for India. However, maximum cost-benefit can only occur if screening is done in an age group which has a sufficiently high incidence of BC and sufficient high longevity^[46], criteria which are very difficult to fulfil in the case of LMICs. If we look at the list

of countries with any form of population level screening program involving mammography, there are hardly any LMICs, with the exception of China where such a program was begun only in 2009^[47].

Status of CBE and BSE in LMICs

In the absence of mammography as a screening option, the other options for BC screening have been CBE and BSE. Of the two, CBE is more effective than BSE with the ability to detect much smaller tumors. CBE and BSE are more important for LMICs since the screening priorities differ between LMICs and HICs. Mostly, screening programs in HICs focus on finding asymptomatic tumors, while for most LMICs the primary issue is early detection of palpable tumors^[48]. Thus, the choice of an ideal screening program for any given LMIC needs to be based on evidence generated for each of those country settings which, however, is limited due to the paucity of data being generated regarding disease burden and cost-effectiveness of screening modalities. As has been noted by Anderson *et al*^[49], it is necessary to look very closely in any given country to best direct that particular country's screening program. As a consequence, a number of attempts have been made in various LMICs for determining a BC screening solution. Numerous evaluations of such pilot studies or national programs exist in countries such as India^[50], Egypt^[51], Colombia^[52], Lebanon^[53], Palestine^[54], Philippines^[55], Taiwan^[56], Mexico^[57], Brazil^[58], Pakistan^[59] and Nepal^[60]. The results of the above pilots have been varied due to the different combinations of screening modalities and varying compliance rates, with the most effective results being observed in studies where some degree of community penetration was possible, such as in Egypt with home visits by social workers^[61] or *via* mobile units in Brazil^[62]. Results from Taiwan and Egypt were most promising with the use of a two-phase screening, starting with CBE and continuing with mammography^[56,63]. In fact some of the earliest evidence regarding combining various screening modalities come from the breast screening trial set within the Health Insurance Plan of New York where mammography was combined with CBE and almost 70% effect was estimated to be due to CBE^[64]. The Canadian Breast Screening Study among women aged 50-59 (CNBSS 2) found no benefit from adding mammography to CBE and BSE^[65], with around 20% mortality reduction achieved due to CBE and BSE^[66].

The evidence regarding the usefulness of BSE is more indirect, with evidence observed in CNBSS 2^[66]. Furthermore, a nested case-control study discovered depicted benefits from BSE among women aged 40-49 and 50-59 in CNBSS^[67]. Similar benefits were observed in Finland^[68] with randomized trials not showing any benefits of BSE^[69,70], although these trials had limitations and BSE probably would not have led to additional benefits^[61]. In fact, our studies in LMICs have clearly shown that BSE can have a significant impact on stage reduction^[71]. It has been estimated that in India, up to 55%

reduction in mortality from BC can be attained over a 5 year period by detecting tumors of 3 cm in size in the community^[72] which is possible *via* raising awareness regarding BC and BSE. In addition, studies have indicated that women can detect 95% of BCs and 65% of early minimal BCs by themselves^[73]. Along with awareness of risk factors, the health belief model (HBM) suggests that if a woman knows about BC risks, then she is more likely to practice BSE^[74]. Evidence predicts that BSE can reduce mortality up to 18%^[75] and this figure might be higher with regular BSE practice^[76]. Thus, overall it can be said that, in the absence of mammography, CBE is a good tool to begin with at the population level for early detection. In addition, knowledge of BSE among women can also be a major factor for downstaging BC tumors.

Role of knowledge and awareness in BC prevention in LMICs

The importance of awareness when it comes to tackling cancer emerges in the quote of the title of an article in one of the recent bulletins of the World Health Organization (WHO)-“Awareness is the first step in battle against BC”^[77]. This is indeed truer for developing countries where awareness continues to be low among lay women as well as physicians and nurses. In LMICs, women present with late stage tumors which could have been detected at the primary level by physicians or nurses, but primary care physicians and nurses have not been trained to be vigilant about signs and symptoms of cancer and therefore they do not look for them^[77]. In addition, stigma and discrimination become major barriers for women who might detect a lump in their breast but hesitate in seeking medical help in time due to the fear of being abandoned by their partners or losing their jobs^[77]. It is especially important for women with cancer to have a champion or role model who has survived BC^[77]. With respect to cancer awareness interventions, there are broadly two types: one is individual-level interventions and the other community-level interventions. Evidence suggests that both individual-level and community-level interventions may increase cancer awareness. In addition, community-level interventions might increase early presentation although the evidence is limited for that^[78]. In our studies in other LMICs, we definitely found that increased individual awareness of BSE had a significant impact on early presentation^[71]. Increasing awareness also has long term impact on early presentation, as has been suggested by studies in the United Kingdom^[79].

In fact, low levels of cancer awareness have been found to be a very important risk factor for delay in presentation by the patient^[80,81]. However, studies depict that most of the research on cancer in LMICs is related to treatment with miniscule amounts of research devoted to BC prevention, awareness, early detection and palliation^[16]. Such lack of evidence on the interventions to promote cancer awareness and improve early presentation has been dampening the development of policy and action^[78], especially in LMICs.

Policy implications of BC screening in LMICs

Implementation of BC screening programs in LMICs involves complex policy implications. One of the most fundamental problems related to formulating policy making regarding BC screening in LMICs is the lack of good surveillance and monitoring systems that can provide accurate data regarding the magnitude of burden of cancer apart from cancer risk factors^[82]. Added to that is the lack of various system level factors, such as lack of trained personnel and cancer services to support screening services, which further complicates creation of effective policy^[82].

Other aspects affecting policy making includes low incidence of BC in LMICs, which means that a much larger number of women (than in HICs) need to be screened in order to find true cases of BC. Thus, implementation of screening for cancers are considered too expensive^[83]. Also, communicable diseases (CDs) are still prevalent in LMICs due to which there is reluctance to divert resources from CDs to non-communicable diseases (NCDs) like cancer, especially when there are well developed vertical programs in place in the health systems for CDs^[83]. Experts also put forth the opinion that it is unethical to screen people for cancers since treatment is unaffordable or inaccessible after screening. Thus, the final effect is that cancer screening remains accessible to a small affluent section of the population who also generally have health insurance^[83]. This situation is further aggravated by the fact that the economic evidence for implementation of BC screening strategies remains limited and of poor quality^[84]. Thus, although BC screening strategies may be economically attractive in LMICs, the evidence to create specific recommendations regarding choices such as mammography and/or CBE, frequency of screening, target population etc. remains inadequate in both quantity and quality^[84].

In general, one of the most important forces that has tried to influence policy regarding BC overall in LMICs has been the Breast Health Global Initiative (BHGI). Begun in 2002, BHGI has tried to form a global alliance for creating evidence based guidelines to improve BC outcomes according to levels of resources (basic, limited, enhanced and maximal)^[85]. Their recommendations regarding BC screening/early detection according to different resource strata are provided in Table 1^[46]. However, these recommendation need to be adapted for each country according to the various factors affecting policy in a particular country, as has been discussed before.

POSSIBLE IMPROVEMENTS IN BREAST CANCER PREVENTION IN LMICs UNDER PRESENT CIRCUMSTANCES-THE ALMOST REAL

Best possible screening strategy for BC in LMICs

Based on the evidence so far, it is becoming apparent that every country needs to customize and create its own BC

Table 1 Recommendations for breast cancer screening/early detection and public education/awareness according to the resource level of a country^[45]

Level of resources	Public education and awareness	Detection methods	Evaluation goal
Basic	Developing culturally sensitive and linguistically appropriate local education programs for target populations to convey value of early detection, BC risk factors and breast health awareness (education and self examination)	Clinical history and CBEs	Breast health awareness regarding value of early detection in improving BC outcome
Limited	Culturally and linguistically appropriate targeted outreach/education encouraging CBE for age groups at higher risk administered at district level using healthcare provider in the field	Diagnostic breast USG and/or diagnostic mammography if CBE + Mammographic screening of high risk target groups	Downsizing of symptomatic disease
Enhanced	Regional awareness programs regarding breast health related to general health and women's health programs	Mammographic screening every 2 yr in women aged 50 or older Consider mammographic screening (or USG) every 12-18 mo in women aged 40-49	Downsizing and/or downstaging of asymptomatic disease in highest yield target groups
Maximal	National awareness campaigns regarding breast health using mass media	Annual mammographic screening in women aged 40 or more	Downsizing and/or downstaging of asymptomatic disease in women in all risk groups

CBE: Clinical breast examination; USG: Ultrasonography; BC: Breast cancer.

screening and/or early detection strategy. When it comes to LMICs, most of them fall in the strata of having basic or limited resources, with only a few having enhanced resources. Considering BHGI guidelines (Table 1)^[46], it can be seen that the best that LMICs can wish for with regards to BC is downstaging of the disease. Based on the how much the health system and health expenditures of a country can allow, a LMIC can aim for CBE, CBE in combination with mammography or mammography at a population level. However, the most important factor to be considered before advocating any form of population based BC screening and/or early detection is a way to identify high risk groups of women based on their life and family history. This will ensure that any population based BC control program will be cost-effective and have maximum impact. Moreover, BC screening and/or early detection must be offered at the primary care level and primary care level workers must be properly trained in conducting CBEs. Also, proper referral and diagnostic services must be available as a part of BC screening/detection programs. A BC control program targeting prevention can be viewed as a “best buy” investment opportunity for reducing health expenditures^[86]. The above also needs to be coupled with strategies for increasing the knowledge and awareness of women regarding BC and BC screening/early detection, as emphasized below.

Education and awareness enhancement for improving BC outcomes

The majority of studies from LMICs clearly indicate that the knowledge and attitude of women regarding breast screening does not correlate well with the actual screening behavior^[87-90], with regular screening behavior such as conducting BSE ranging from 10% to 80% based on ed-

ucation, occupational and socioeconomic status^[91-93]. On average, less than 50% of women aware of BSE actually practised it, with the majority of women practising incorrect techniques. Contrary to the expected view, healthcare providers were not knowledgeable about screening techniques, neither did they encourage women to implement screening behavior^[87,94]. Healthcare providers were also not at the top of the list in terms of their importance as source of information. Instead, electronic media and television (TV) was noted to be the most important source of information on BC^[95]. For less educated women, it was relatives and friends who were the most important source of information^[96]. Also, it is important to note that, despite the low levels of awareness of women in LMICs regarding BC, very few studies exist regarding evaluating methods for increasing awareness^[97-101].

However, given the importance placed by the WHO^[77] and BHGI^[49] on the importance of awareness in controlling and preventing BC, it is of utmost importance that organized methods be applied in LMICs regarding spreading awareness of BC, especially *via* the use of electronic media and TV. There must be increased public awareness regarding disease risk factors, symptoms and screening behaviors leading on to the detection of BC at earlier stages. The impact of practising breast screening behaviors on downstaging of BC has been clearly observed in our studies in LMICs^[71].

Need for more research regarding BC prevention

As has been stressed before in this work, research on BC prevention remains highly inadequate and significant improvement is required in both quantity and quality in order to reduce morbidity and mortality due to BC. A recent review of the literature suggests a very significant

role of research in adapting the findings and experience of HICs in LMICs^[102]. A most important need in LMICs is to study “structural violence” as defined by Paul Farmer: the diffuse and indirect oppressive societal forces that routinely limit the choices that individuals have to make in LMICs^[103]. Another important area of research is to clearly define the varying etiology of BC in various LMICs, as has been delineated in some of our studies with regards to hormone receptor status^[31,104]. In fact, significant differences have been observed with respect to hormone receptor status in populations of various LMICs, such as Bangladesh, Taiwan, Philippines, Vietnam and India, relative to HIC populations^[105-107]. Similarly, differences between LMICs and HICs exist when it comes to host metabolism of systemic treatment agents, one of the cases in point being tamoxifen^[108,109]. Other differences lie in mediating effects of social and cultural factors on impact of BC interventions in LMICs, including personal representations^[110,111]. Another important area of research in LMICs is health systems which can be highly complex and thus, interventions and strategies developed for HICs may be inappropriate for LMICs with competing interests such as communicable diseases^[112] and affordability gaps^[113,114]. Overall, more research is required in various LMICs to provide the evidence base required to develop customized BC prevention strategy for each LMIC, as has also been reiterated by BHGI^[49].

Policy changes required for implementing BC screening in LMICs

It is quite apparent by now that cancer screening/early detection is not a high priority in terms of policy for LMICs. In fact, most LMICs are focused on maternal health policies based on Millennium Development Goals (MDGs). This is in spite of the fact that 200000 more women die each year due to breast and cervical cancer than from complications due to pregnancy and childbirth^[115-117]. The rising incidence of cancer in women in LMICs is quite in line with “cancer transition” described by Bray *et al*^[118]. According to these projections of cancer trends until 2030, it is plausible that cancers caused due to infections (*e.g.*, cervical cancer) will be offset due to a rise in cancers associated with NCD risks (*e.g.*, breast cancer)^[118]. Thus, overall the burden of women’s cancer will continue unabated unless the right policies are made to counteract such trends by building capacity for basic cancer services, especially screening/early detection.

Premature death and disability from cancer has maximum economic impact compared to other causes of death worldwide. Despite this, only 5% of global resources are being spent in LMICs on cancer, while 80% of the cancer burden is being borne by LMICs^[119]. With such low spending in LMICs and even without direct medical expenditures, cancer still costs approximately 895 million USD, or 1.5% of global GDP, which is 20% higher than that for cardiovascular disease^[120]. According to Knaul *et al*^[121], much of this spending can be reduced. Especially for breast and cervical cancer, the cost savings by the

“prevention/early detection and treatment approach” are much greater than by the “treatment only” approach followed currently by LMICs. The scenario is changing gradually, although with few and far between examples of implementation of cancer screening/early detection in LMICs. For example, the state of Tamil Nadu in India is the first state to launch cervical cancer screening using the VIA/VILI method^[122]. However, what is still lacking in India and most other LMICs is an overarching nationwide policy that implements screening, early detection and prevention of cancer. Thus, the need of the hour for most LMICs is the formation of a national cancer control policy which also has inbuilt strategies for increasing knowledge and awareness of people regarding cancer.

FUTURE REQUIREMENTS AND POSSIBILITIES FOR BREAST CANCER PREVENTION IN LMICS-THE SURREAL

New inventions of the future for BC screening

Although the main modalities of BC screening/early detection are still a trio of mammography, CBE and BSE, new modalities are emerging for BC prevention that may become the cornerstone of BC screening/early detection in future with greater benefits and cost-effectiveness for LMICs. One such method for BC screening/early detection has been the use of ultrasonography (USG) and there have been limited trials in LMICs^[123,124] that have proven their utility, especially when dealing with small or dense breasts, as is common with BC occurring in younger premenopausal women in LMICs^[124]. Similar trials of USG as a screening modality are required in other LMICs to evaluate its benefits as a more cost-effective and easily available way of conducting BC screening/early detection. A number of other modalities are also gradually becoming available apart from mammography and USG, such as low-dose mammography, contract-enhanced mammography, tomosynthesis, molecular imaging and magnetic resonance imaging (MRI)^[125]. MRIs are more sensitive than mammograms in picking up tumors in asymptomatic women^[46]. However, once again more trials are necessary in LMIC specific contexts to decide the best suitable technologies according to age, risk and breast density^[125]. The main issue when it comes to widespread use of better imaging technologies such as MRI is to bring down the costs to levels that can be afforded by health systems of LMICs^[126].

Use of mobile health (mHealth) for better spread of education and awareness

It will also be ideal in future if the full potential of mHealth is utilized for enhancing knowledge and changing the attitudes of women in LMICs regarding cancer and screening behaviors to limit the impact of “structural violence”^[103]. Technological interventions have gained much popularity ever since the phenomenal growth observed in Asia, Africa and Latin America in the use of

new information and communication technologies (ICTs), especially the cell phone and internet^[127]. If we look at the most recent figures, 41% of the world's households were using the internet, ranging from 7% in Africa to 77% in Europe^[127,128]. More astounding is the number of global mobile phone users which has grown to 6.8 billion, or 96% of the world's population, with the greatest growth occurring in Asia, Middle East and Africa^[127,129]. All this has become the bedrock for the growth of ICTs in health, eHealth systems or mHealth.

Mobile phone based ICTs have been used in multiple ways globally in the context of LMICs. Also termed mHealth, individuals around the world are increasingly integrating mobile technologies to access health care services and information while health professionals are integrating mobile technologies into public health and clinical activities^[130]. The main advantages of a mobile or cell phone platform has been its capability of transferring information quickly for both literate and illiterate populations. With relatively low start-up cost and flexible payment plans, mobile technology is accessible by most strata of the population^[131]. Various uses of mobile phones in health have included using SMS or even voice-recorded messages for things like reminders to take medication or dates for appointments. With further development of health-related software in mobile phones, such platforms can provide real-time feedback, pre-programmed automated message services and support an increasingly decentralized health system^[132]. Several studies from LMICs, such as Bangladesh, Laos and Egypt, have shown that introduction of mobile phones led to a more direct link between clients and health care workers, causing an increase in demand for health services and health-related information^[131,133]. Such mHealth strategies can be made a part of the cancer control programs in various LMICs for easy dissemination of information, for reminding women about appropriate screening behavior, and for scheduling appointments for screenings.

CONCLUSION

In conclusion, it can be pointed out that in spite of more women dying from cancer than from pregnancy or childbirth related complications, most LMICs are focused mainly on maternal health in terms of resources, while cancer overall and BC takes a backseat. That apart, policy maker awareness remains low in LMICs regarding BC screening/early detection being cost-effective and the "best buy" opportunity to reduce health costs. This coupled with a lack of research regarding cost-effective screening/early detection methods and little community awareness about BC being a treatable disease results in most LMICs losing a large number of women at an early age, a situation that is unfair from a human rights perspective while also creating "cancer orphans"^[86]. While creating new options for pathological diagnosis and treatment, the main focus of LMICs must be on developing national level programs that emphasize screening/early

detection of BC along with effective use of ICT for changing knowledge, attitudes and practices of women. In addition, greater encouragement for research in various aspects of public health ranging from use of newer screening methods and improving health systems cannot be emphasized enough. For the moment, the best option ahead for LMICs is to begin with ways of opportunistic screening after assessing a woman's risk using a combination of CBE followed by mammography at select centers. As a next step, such methods must be rolled out for the larger population with guidelines developed regarding frequency of screening based on the BC epidemiology in a particular LMIC. Further research regarding use of USG and development of screening guidelines regarding use of USG as a screening modality in LMICs is eagerly awaited.

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