



Understanding Linkage to Biopsy and Treatment Services for Breast Cancer After a High-Risk Tele-Mammography Result in the Ministry of Health-Subsidized Population in Peru

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Citation	Errea, Renato. 2020. Understanding Linkage to Biopsy and Treatment Services for Breast Cancer After a High-Risk Tele-Mammography Result in the Ministry of Health-Subsidized Population in Peru. Master's thesis, Harvard Medical School.
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UNDERSTANDING LINKAGE TO BIOPSY AND TREATMENT SERVICES FOR BREAST
CANCER AFTER A HIGH-RISK TELE-MAMMOGRAPHY RESULT IN THE MINISTRY
OF HEALTH-SUBSIDIZED POPULATION IN PERU

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A Thesis Submitted to the Faculty of

The Harvard Medical School

in Partial Fulfillment of the Requirements

for the Degree of Master of Medical Sciences in Global Health Delivery

in the Department of Global Health and Social Medicine

Harvard University

Boston, Massachusetts.

May 13th, 2020

Understanding Linkage to Biopsy and Treatment Services for Breast Cancer after a High-Risk
Tele-Mammography Result in the Ministry of Health-Subsidized Population in Peru

Abstract

Paper 1 provides a thorough background of the situation of breast cancer in Peru and builds the hypothesis that women living in poverty in Peru face barriers to continue care after abnormal mammography results conducted through the Ministry of Health tele-mammography services. Paper 2 covers the research study conducted about such topic and is summarized as follows: **Background:** Low- and middle-income countries face difficulties in securing access to biopsy and treatment following an abnormal mammogram. Thus, we conducted a mixed-methods study to understand linkage to biopsy and treatment for breast cancer after a high-risk mammography result obtained through the national tele-mammography program of Peru. **Methods:** Data from all women who underwent tele-mammography between July 2017 and September 2018 and had a high-risk result (BIRADS 4-5) were collected. We determined completion rates (number of women who obtained a biopsy or initiated treatment, compared to the expected number for the same step) and delays (>45 days from a high-risk result to the biopsy and from the biopsy to treatment initiation; >90 days from high-risk result to treatment initiation). Also, 32 in-depth interviews were conducted with women receiving high-risk results, healthcare providers, program coordinators and policymakers to explore the factors explaining non-completion and delays. **Results:** Of 126 women with high-risk mammography results, 48.4% obtained a biopsy; of the confirmed 51 women with breast cancer, 86.37% initiated

treatment. Among those who obtained a biopsy, 37.5% had a delay from the high-risk result to the biopsy; and among those who initiated treatment, 69.2% had a delay from the biopsy to treatment and 65.9% from the high-risk result to treatment. Having to travel to and stay in major cities to seek biopsy and treatment, patients' misconceptions of the disease, and administrative and operational factors, impeded continuing care for breast cancer. **Conclusion:** Breast cancer diagnostic and treatment capacity urges to be strengthened in Peru's provinces. Better awareness of guidelines, standardized referral pathways, and robust tracking and information systems are required. Addressing these factors could help to improve the rate and time of linkage to diagnosis and treatment for breast cancer after high-risk tele-mammography results.

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Acknowledgements

First of all, I am deeply grateful for the continued support received from my thesis advisors: Dr. Molly Franke, Dr. Jerome Galea, Dr. Patricia Garcia, and Dr. Lydia Pace. I would not have been able to conduct this work without their outstanding guidance throughout all phases of the study.

I would like to express my gratitude to all the staff of Peru's Ministry of Health and hospitals who made this study possible: Dr. Diego Venegas, Dr. Mercedes Egües, and Dr. Willy Ramos were indispensable in collecting data for the study. Thanks to Dr. Isabel Cotrina and Dr. Jose Cotrina, who also played a key role during this phase.

I greatly appreciate the support of the faculty and staff of the Master's program. Thanks to Christina Lively and Bailey Merlin for their constant concerns for the students, and for being a pillar in the structure of the Master's program. I am grateful to Hannah Gilbert for her fantastic qualitative advice. I consider myself fortunate to have learned how to conduct qualitative research through Hannah's expertise.

A special thank you go to my friends and classmates of the Master's program. Their experiences in fighting for social justice in healthcare in different parts of the world have inspired me during this journey.

Finally, there are no words to express my sincere gratitude to the participants of the interviews conducted for this study, especially the patients. I learned more than I expected from listening to their stories. On their behalf, I will share the results of this study with the local and global health community.

This work was conducted with support from the Master of Medical Sciences in Global Health Delivery program of Harvard Medical School Department of Global Health and Social Medicine (MMSc-GHD). This work received financial contributions from the MMSc-GHD and the David Rockefeller Center for Latin American Studies from Harvard University, and the National Program of Scholarships and Academic Credits of Peru's Ministry of Education. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard University and its affiliated academic health care centers.

Part 1: Background

Thesis statement

Breast cancer deaths can be reduced with a combination of early detection and timely high-quality treatment.¹ In 2017, in order to improve access to early detection of breast cancer among individuals living in poverty, the Ministry of Health (MOH) of Peru implemented a telemedicine-based mammography program. The MOH aims to strengthen the tele-mammography program progressively to increase access to screening.² However, far less attention is devoted to improving access to diagnosis and treatment services. Although the MOH has allocated funding to subsidize the elevated costs of breast cancer diagnosis and treatment among individuals living in poverty through the government-based health insurance³, in Peru, as in other low and middle-income countries, the barriers for accessing and remain linked to those services are thought to be significant for several reasons. First, these services are concentrated in major cities⁴, which entails elevated costs for transportation, accommodation and food for patients who reside outside these areas. Second, there may not be adequate tracking systems in place for individuals referred to a higher-level hospital due to abnormal mammography results.⁴ Third, stock-outs of medicines and lack of specific equipment may translate into unexpected, elevated out-of-pocket expenses by obligating individuals to pay for the medicines or procedures purchased outside the public health system.² These circumstances may impede the appropriate linkage to biopsy and treatment for breast cancer after an abnormal mammography result, undermining the effect of the tele-mammography program of Peru.

Overview of breast cancer epidemiology in Peru

Increasing incidence and stable mortality

Of the 10,650 patients diagnosed with cancer in 2017, 2/3 were female.⁵ Among cancers occurring in women, breast cancer is now the most common type in Peru per the most recent (2018) epidemiology report from the International Agency for Research on Cancer at the World Health Organization (WHO).⁶ The growing frequency of breast cancer cases in Peru follows the worldwide trend and is driven by a complex combination of higher life expectancy, behavioral factors (i.e., postponement of childbearing to a later age, having fewer children, increasing levels of obesity and physical inactivity), greater awareness and screening⁶, and potentially from environmental factors.⁷

However, unlike most countries, breast cancer mortality in Peru has not decreased. A review that extracted data on breast cancer deaths between 1987 and 2013 from WHO databases reported that breast cancer mortality decreased in 39 out of 47 countries. This downward trend was seen in most of North America, Europe, Oceania, and in a few countries of Asia and Latin America⁸; Peru was not among them.⁹ As seen in Figure 1, the adjusted mortality rate in Peru from 2000 to 2011 remained stable.

Advanced disease at diagnosis

Deaths from breast cancer have been reduced in high-income countries (HIC) due to a combination of early detection and prompt, high-quality treatment.¹ Thus, high mortality rates from breast cancer result from a lack of access to these services and from late diagnoses that occur at advanced, often incurable, stages. Peru is among the countries with the highest percentage of women diagnosed with advanced disease in Latin America¹⁰: in 2015, around 54% patients were diagnosed with advanced stage of breast cancer in Peru², compared to less than 30% in HIC.¹¹ Diagnosis rates are even worse in Peru's public health care system, where 75% of

women are diagnosed in late stages of the disease.³ Estimates predict a 70% increase in the total number of deaths due to breast cancer in Peru between 2012 and 2030¹², and a large percentage of these may stem from late diagnosis.

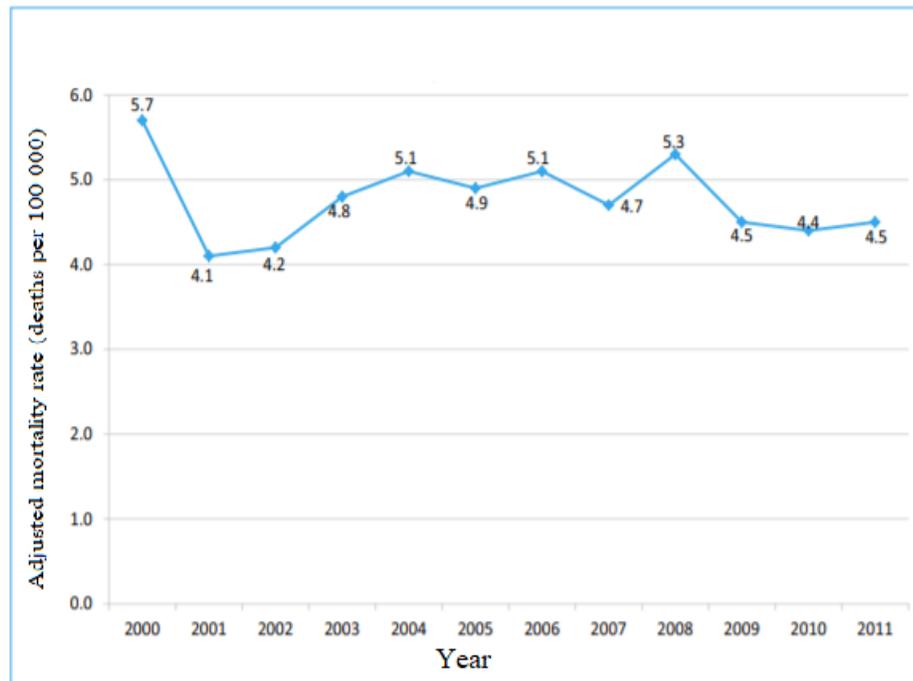


Figure 1. Adjusted mortality rate for breast cancer in Peru, 2000-2011. Source: MINSA. Análisis de la situación del cáncer en el Perú, 2013. General Direction of Epidemiology. Ministry of Health. Lima, Peru: 2013.

Mammography screening: global context and the situation in Peru

Importance of early detection and mammography screening

Early detection is one of the main pillars for decreasing breast cancer deaths. Early detection comprises screening and early diagnosis because they both contribute to the identification of early stages of breast cancer, which are associated with increased survival.¹³ Screening refers to the detection of breast cancer before the patient presents symptoms, while early diagnosis refers to the detection of breast cancer in a symptomatic patient (e.g., the

detection of a palpable nodule through clinical breast examination) at an early cancer stage.¹³ In HIC, survival rates for women diagnosed with breast cancer at early stages, either clinical stage I and II (according to the American Joint Committee on Cancer) or localized and regional disease (according to the Surveillance, Epidemiology and End Results classification), have ranged from 86% and 99.8%.¹⁴

Mammography has been used as a tool for breast cancer screening since the 1960s. Pooled results from randomized clinical trials conducted between 1972 and 2014 demonstrated a 19% reduction in breast cancer mortality associated with mammography screening.¹⁵ Nonetheless, in recent years, the public health community has raised concerns over the harm from false-positive results (e.g., a positive mammography screen which leads the women to undergo further confirmatory procedures, like a biopsy, that ultimately rule out cancer) and overdiagnosis (e.g., true cases of breast cancer that would not have led to death in the absence of detection).¹⁶ Due to these controversies, the U.S. and European countries have scaled back screening recommendations. In the U.S., to achieve a better balance between benefits and harms, the recommendation for routine breast cancer mammography screening was limited to women between ages 50 and 74 and spaced in terms of frequency (from every year to every 2 years).¹⁵ Additionally, some have stated that the older randomized trials do not accurately reflect the current impact of mammography. They predict that mammography would have a lower impact on outcomes in this era of new and more powerful treatment. Nowadays, they would attribute most of the impact to the more effective treatment options available.¹⁶ However, the randomized trials mentioned were conducted in the U.S, Canada and Europe, and the role of mammography is less well-understood in countries where the age distribution of the population is younger, such as Peru. All in all, WHO supports mammography screening as a key tool for breast cancer

control, recommending its implementation through organized, population-based programs, where all the eligible women are actively invited to get the screening and followed up accordingly, along with continuous monitoring of the screening's impact, harm and quality.¹⁷

Mammography screening in low and middle-income countries

As mentioned above, mortality rates have decreased in HIC countries due to a combination of early detection and prompt treatment. A study of European countries showed that population-based mammography screening programs, integrated within the public healthcare system, reduced breast cancer mortality by 26%.¹⁸ In low and middle-income countries (LMIC), where breast cancer is the leading cause of cancer deaths among women (except in Sub-Saharan Africa), and where high proportions of advanced disease at diagnosis exist¹⁹, early detection activities are of utmost need. For many low-income countries, implementing an organized nationwide screening program is challenging due to their fragmented health care system and limited capacity.¹⁷ For example, it has been estimated that LMIC have less than 5% of the resources required for the control of cancer.²⁰

Nonetheless, some upper-middle-income countries with enhanced health systems have already taken steps towards the implementation of screening programs. For example, in Malaysia, an opportunistic screening program incorporated into the country's health system showed higher rates of diagnosis at early stages compared to the standard of care (mammography in symptomatic women).²¹ In Colombia, a cluster-randomized trial found a higher proportion of early-stage breast cancer compared to usual care.²² Although effects on survival are not yet seen, probably because of the short time of follow-up (in the U.S it took around ten years to show an

impact on mortality)¹⁹, these efforts are good examples of feasible screening programs in countries with enhanced, but still developing, health systems.

Peru's Tele-mammography Program for women living in poverty

Peru, an upper-middle-income country, has also started to strengthen its mammography capacity. In 2017, the breast cancer screening coverage in Peru for women between 50 and 69 years old was below 1%², very far from the standard recommendation of 70%.¹⁷ Around that time, only 19 of the country's 25 regions had functioning mammography equipment, and only 32 of the 113 radiologists participating in mammography reading throughout the country were appropriately trained for the role.² Also, the majority of the equipment and human resources were (and still are) centralized in the capital city, Lima.² A recent study with data from the 2018 Demographic and Health Survey in Peru showed that among all mammography tests taken in the previous two years, 26.9% were in women living in major cities, while only 3.8% in women living in the countryside. Similarly, 53.2% of the women belonged to the highest two wealth quintiles compared to 9.3% belonging to the lowest two.²³ This shows that a vast population outside of Lima, especially the poor living in rural or remote urban areas, were left without access to screening.

For this reason, in July 2017, the MOH implemented telemedicine-based mammography services for women aged 50 years or over and who benefit from the government-based insurance.² This insurance, named SIS (from the Spanish abbreviation of Comprehensive Health Insurance), subsidizes care for individuals living in poverty and without access to employment benefits: around 75% of individuals living in poverty are subsidized by SIS.²⁴ The tele-mammography effort entailed progressively placing more mammography equipment in

provinces outside Lima (the capital city) and installation of tele-digital systems that allow for mammograms taken remotely to be sent virtually to a reading center in Lima, where trained radiologists could provide the mammography result within a few days.² Within 18 months of program creation, 8,993 women around the country had undergone tele-mammography.

Although the tele-mammography strategy helped to reduce the screening gap, there were barriers to its implementation, as reported by a recent study.²⁵ First, the tele-mammography strategy seemed to have operated more as an opportunistic program, where the chances of undergoing mammography depended on the healthcare provider's rather than as part of an organized, population-based program where all eligible women are invited to participate as recommended by the WHO¹⁷. Concurrently, there was low community awareness of the mammography services, and the primary care centers failed to refer patients to the tele-mammography teams at the hospitals, leading to low demand and productivity. Also, once the mammography image was reported, there were difficulties in contacting women to inform them of their results. Besides, there were frequent technical breakdowns of the machines and limited coordination between the reading center in Lima and the regional hospitals. Some of the staff also showed concerns about the capacity of the tele-mammography service if more patients started to demand it. Despite the limitations and needed improvements, the tele-mammography program has the potential to increase screening coverage among disadvantaged women living in the provinces of Peru, where trained radiologists, equipment and infrastructure resources are scarce.⁴ Through the Tele-mammography Program, the Peruvian government has committed to increasing the screening coverage progressively throughout the country. The MOH goal is to increase screening coverage from 0.9% described for the year 2015, to 80% for the year 2021.²

After an abnormal mammography-result: global context and situation in Peru

For mammography screening to effectively contribute to the reduction of mortality from breast cancer, high-quality treatment must follow.¹ Peru's MOH target is to reduce mortality by 1.5% by the year 2021, thanks to mammography screening.² To accomplish this goal, Peru must widen its tele-mammography screening program, and at the same time, increase access to biopsy (for confirming the disease) and to high-quality treatment.

Delays for initiating treatment in LMIC

As mentioned before, LMIC characteristically have fewer resources for the control of cancer.²⁰ Their weak healthcare systems, comprised of an insufficient number of healthcare facilities, equipment and trained healthcare providers, may not secure access to adequate treatment of breast cancer.²⁶ One reflection of this is the high number of deaths from breast cancer occurring at LMIC. In HIC, the percentage of death related to the incidence cases of breast cancer is 24%, compared to around 45% in LMIC.²⁷ Nonetheless, elevated mortality is also the result of the high frequency of late-stage disease at diagnosis that occurs in LMIC. The number of breast cancer cases reported at late stage is 50-80% in LMIC and only around 30% in HIC.¹¹ A complementary way of determining how a healthcare system may be facing difficulties for allowing access to diagnosis and treatment is the calculation of time delays for initiating treatment. A review study showed that the time between the presentation of symptoms and the initiation of treatment was 3-8 months in LMIC, while in HIC, it was between 30 and 48 days.¹¹ Moreover, the most prolonged delays were seen after the patient had already presented to the hospital; thus suggesting that the delays encountered could be attributable to deficiencies in the healthcare system, rather than being the responsibility of the patient. In Peru, there have not been

studies evaluating delays in cancer treatment, but in the following section, we provide reasons for why delays and non-linkage to care after an abnormal tele-mammography result could be occurring with high frequency in the country.

Limited and centralized diagnostic and treatment capacity

In Peru, some breast cancer treatment resources are available, but these resources are unequally distributed and not sufficient to meet the needs of the population. Most of the equipment and human resources for the diagnosis and treatment of cancer (around 70%) are located in Lima.⁴ In Lima, the National Cancer Institute (INEN for its abbreviation in Spanish, founded in 1939) is the major provider of cancer services among the SIS-subsidized population.²⁸ Two other cancer centers outside Lima were created many years later: the Regional Cancer Institute of the North (IREN-Norte, located in the city of Trujillo), constructed in 2006, and the Regional Cancer Institute of the South (IREN-Sur, located in the city of Arequipa), created in 2008. A few other MOH general hospitals provide some cancer care but with minimal capacity.⁴ The implementation of Plan Esperanza (the National Cancer Control Plan) in 2012,³ in which significant more money was allocated to improve cancer control in the country, made further progress on improving the country's treatment capacity. For example, Figure 2 shows the progressive increase of cancer diagnostic equipment around the country from 2011 to 2013.²⁸

While these efforts helped to improve the breast cancer care diagnostic and treatment resources of the country, resources remained limited in many regions. For example, in 2016, there were no cancer services in 7 of the country's 25 regions, and 9 of the 18 with oncology services only had ambulatory services.² Human resources were also lacking: nationwide, there were only 62 oncology surgeons and 49 clinical oncologists, and these were each distributed

only across 8 of the 25 regions of the country.² Furthermore, 63% of the surgeons and 70% of the clinical oncologists were located in Lima. Finally, only one other hospital in the country besides INEN had radiotherapy equipment.²

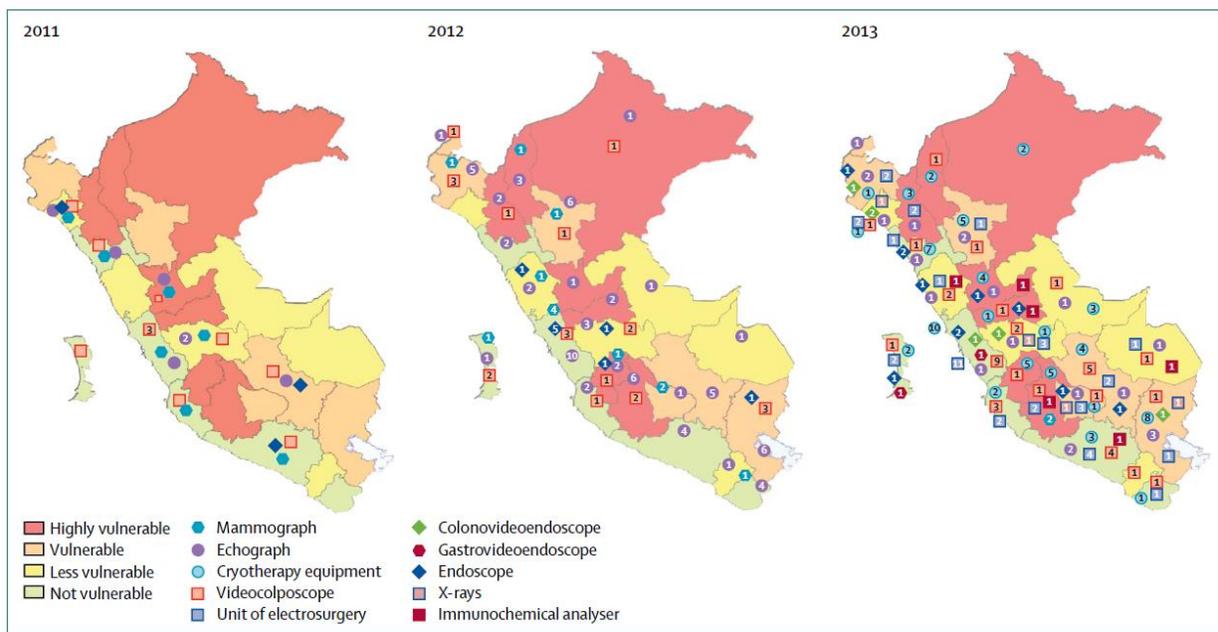


Figure 2. Increase in oncologic equipment in the 25 regions of the country after the launching of Peru’s Cancer Control Plan, from 2011 to 2013. Image taken from Vidaurre T, Santos C, Gómez H, et al. Cancer in Peru 3: the implementation of the Plan Esperanza and response to the imPACT Review. *Lancet Oncol.* 2017; 18:e595-606

Need to refer to major cities and related costs

Individuals who reside outside of Lima may bear the brunt of the lack of decentralization as they have to be referred to major cities in pursuit of breast cancer care. It has been recognized that a long distance between the patient’s home and the facility where the patient receives care is a risk factor for worse cancer outcomes. A review of this topic showed that longer distances to the hospital translated in more advanced disease and had worse prognosis and quality of life.²⁹ As has been shown in studies conducted in Peru in cervical and pediatric cancer, individuals living outside Lima and in rural settings are more likely to abandon care.^{30,31} Moreover, in

conditions such as cancer, where prolonged treatment is required, living away from the treatment facility could lead to having to reside near the hospital until treatment finishes. This would also require spending on accommodation and food in the cities. In poor populations, housing, food and transportation often consume the entirety of the family income.³² In Peru around 78% of the rural population and 75% of individuals living in poverty have SIS²⁴; thus, centralization unequally affects the most economically vulnerable population of the country.

Weak tracking of patients after referrals

Peru's weak referral system may drive patients to discontinue care after being referred. Referral systems are crucial components of healthcare systems around the world that enable patients to access more specialized medical services when those needed are not available at their usual health facility.³³ In Peru, the referral system proceeds according to the levels of care, in which patients getting care at a first-level facility should be referred to a secondary-level facility or to the following facility level that has the services needed available.³⁴ In the case of breast cancer in Peru, in which treatment is complex and limited, patients are usually directly referred to tertiary-level hospitals or healthcare institutions (considered quaternary-level), located in major cities. According to the WHO, an effective referral system should assure that the patient has arrived at the receiving hospital.³³ For example, a robust referral system could include efforts to reach out to patients, contact patients who are lost to follow up, and communicate in advance with the receiving facility. In Peru, no measures are taken to monitor the arrival of patients to the referral hospital, and there is not an electronic management system for referrals.²⁵ In a disease like cancer, where almost all patients are referred at some point during the continuum of care, a lack of monitoring systems may have a considerable impact on the continuation of care for breast

care. A recent qualitative study of women with cervical cancer in Peru living outside Lima found that being referred after an abnormal cervical screening result did not guarantee that the patient would be treated or that she would make it to the treatment facility.³⁰ The experiences of women with cervical cancer in Peru suggest that women who are referred to seek breast cancer care may also be at high risk of delaying the arrival to the hospital, or simply, getting lost on the way.

Out-of-pocket expenses for treatment

Medicines and treatment of cancer care are usually expensive and hard to afford for the majority of individuals living in poverty. Until 2011, breast cancer care was not covered under SIS. In 2012 Plan Esperanza added breast cancer diagnostic procedures and treatment to the health package covered by SIS.³ Regarding diagnostic procedures, the different types of biopsy test, immunohistochemistry, pathology reading as well as tests for the staging of the disease (i.e., magnetic resonance and computed tomography scan) began to be covered by SIS. Similarly, essential chemotherapy drugs, radiation, partial and full mastectomies, and some hormonal treatment became available for free at the MOH hospitals and INEN. While there is no evidence yet in the literature about how this public health strategy increased access to cancer care, it is believed that it has widely impacted on people's access to breast cancer care. However, in a high-cost disease such as breast cancer, any stock-out and unexpected out-of-pocket expense while receiving care would represent a high economic burden for the population subsidized by SIS. As in other low-resource settings, the lack of medicines and laboratory and medical supplies in public hospitals in Peru usually requires patients to purchase the prescribed drugs or to undergo the needed tests in private facilities.³⁶ For example, a study from 2011 to 2014 conducted in Peru showed that 61% of the total out-of-pocket expenses of people who initiated

any health care (not only breast cancer care) at a MOH hospital were incurred through use of private services.³⁷ To my knowledge, there are no reports on out-of-pocket expenses for breast cancer in Peru, but we expect out-of-pocket expenses to be high due to the complex nature of the disease, which requires care in specialized hospitals.³⁷

Conclusion

In Peru, progress has been made over the years to improve the country's capacity to diagnose and treat breast cancer. This progress includes the creation of two more cancer institutes in the regions, the slowly increasing availability of equipment for diagnosing and treating cancer, as well as the inclusion of breast cancer in the MOH insurance health package. However, the resources are still limited and centralized mainly in the capital city. This may generate an economic burden on the patients for the expenses on transportation, housing and food associated with moving to the capital or other major cities to seek breast cancer care. Moreover, it is suspected that out-of-pocket expenses for medicines and other procedures are still high and that patients are at high risk of falling through the cracks due to lack of tracking after referrals.

The ability of Peru to reduce mortality on women subsidized by SIS depends not only on the efforts to screen more women but on the ability of the healthcare system to link and secure access to biopsy and treatment for individuals with suspected and confirmed breast cancer, respectively. To date, no study has evaluated the extent to which the factors presented above are affecting women with an abnormal mammography result conducted through the tele-mammography program of the MOH of Peru. Thus, the present study aims to comprehensively understand the impact of those factors on delays and non-completion rates for obtaining a biopsy

and initiating treatment following a high-risk tele-mammography result. It will be conducted through a mixed-methods approach. Quantitative data will be obtained directly from the MOH and institutions providing care to the SIS population. Qualitative data will be collected from a wide variety of stakeholders, including the patients themselves, healthcare providers, program coordinators and decision-makers, who will provide first-hand information on their experience about the program functionality and how the expressed factors impede good outcomes on this economically disadvantaged population in Peru.

Part 2: Publishable Paper

Title and authors

Understanding Linkage to Biopsy and Treatment for Breast Cancer after a High-Risk Tele-Mammography Result in Peru: A Mixed-methods Study

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Introduction

Worldwide, breast cancer is the most commonly diagnosed cancer and the leading cause of death from cancer among women.⁶ To date, mammography screening is the only early detection method that has been proven to reduce mortality due to breast cancer.¹⁷ Pooled results from randomized clinical trials conducted in the U.S, Canada, and Europe, have demonstrated a 19% reduction in breast cancer mortality associated with mammography screening.¹⁵ Currently, the World Health Organization (WHO) supports organized, population-based mammography screening as an essential tool for the control of breast cancer.¹⁷

For mammography screening to effectively contribute to the reduction of mortality from breast cancer, high-quality treatment must follow.¹ Cancer diagnosis and treatment is complex and requires coordination across multiple facilities and disciplines; it needs adequate healthcare facilities and equipment and trained healthcare providers.²⁶ Thus, patients in low- and middle-

income countries (LMIC), where less than 5% of the necessary resources for the control of cancer are available²⁰, may face the most difficulties securing access to confirmatory diagnosis and treatment following an abnormal mammogram. Not surprisingly, delays for obtaining a biopsy and for initiating treatment for breast cancer are longer in LMIC compared to higher-income countries.¹¹

Upper-middle-income countries, with enhanced health systems, have started to implement mammography screening programs.^{21,38,39} Existing mammography programs are typically opportunistic screening programs (in which women are screened during the course of other health care interactions rather through organized screening programs targeting an entire defined population in a systematic way).⁴⁰ Prior to the scale-up of opportunistic screening into a population-based program, countries must evaluate how linkage to biopsy and treatment services after an abnormal mammography occurs. Suboptimal rates and delays could undermine the effectiveness of a widespread screening program.

In Peru, following the agenda of the National Breast Cancer Control Plan and its goal of increasing screening coverage², the Ministry of Health (MOH) launched an opportunistic telemedicine-based mammography program targeted to the population living in the provinces and subsidized by the government-based health insurance. Through this program, mammography images are transferred to the capital city to be reviewed by trained radiologists due to the lack of radiologists in Peru's provinces. Although breast cancer care is included in the package covered by the government-based insurance, cancer diagnostic and treatment services are highly centralized in the capital. As a result, women participating in the tele-mammography program may not have reliable and timely access to the diagnosis and treatment for breast cancer. We conducted a mixed-methods study to describe and understand the linkage to biopsy and treatment for breast

cancer after a high-risk tele-mammography result among women receiving government-subsidized insurance in Peru.

Methods

Study design

We conducted a mixed-methods study with a concurrent design among women receiving government-subsidized insurance in Peru.⁴¹ We described the frequency of biopsy and treatment initiation, and the time associated with obtaining them, and explored the factors impeding and facilitating care.

Study setting

In the Peruvian health system, individuals living in poverty receive government-subsidized health insurance, the Comprehensive Health Insurance (SIS). In 2012, breast cancer care (diagnosis, recuperative, and palliative services) was added to the SIS health package.³ Historically, cancer services for the patients receiving SIS have been centralized in the capital region, Lima, where most services are provided by the National Institute of Neoplastic Diseases (INEN).²⁸ Outside of the capital, home to 2/3 of the population²⁴, two regional cancer institutes and some general hospitals (secondary and tertiary-level hospitals) offer cancer services. Due to lack of equipment and specialized physicians, the diagnostic and treatment capacities at these facilities are variably limited. Broadly, regional institutes may have biopsy, pathology, systemic therapy (chemotherapy and hormonal therapy) and breast surgery services but lack immunohistochemistry and radiation therapy. Some tertiary-level hospitals perform biopsy tests and systemic therapy, but usually lack pathology, immunohistochemistry, surgery and radiation

services. Rarely, secondary-level hospitals provided biopsy services, but they lacked pathology reading and other services. According to Peru's National Breast Cancer Control Plan², when services are not available at one of the hospitals, the patient should be referred up to the next level hospital, and up to INEN if needed.

The Peru's MOH tele-mammography program is the primary mammography provider in the population receiving SIS. This program was started in July 2017 in 2 regions with the objective of growing into the 24 regions of Peru. By September 2018, 14 secondary and tertiary-level hospitals in 11 regions were included in the tele-mammography program network. At these hospitals, the cancer program staff conduct the tele-mammography activities, including testing, result reporting, follow-up, and referrals. Asymptomatic women aged 50 to 69 years old are invited to get a mammography during routine clinical visits, through community outreach activities and to a less extent, through local media.² Symptomatic women (regardless of age) are also invited to get a mammography if clinical suspicion exists. Once mammography is complete, the image is transferred virtually to a reading center in Lima, where trained radiologists provide a result within a few days. Following international guidelines, individuals with a BI-RADS 4 or 5 result (high-risk mammography results) are referred for biopsy.^{2,42} If a diagnosis is confirmed, treatment is planned, and referrals follow as described above.

Study population

Quantitative component

We collected data from all women aged 18 years or older, subsidized by SIS, who underwent a tele-mammography through the MOH program between July 1st, 2017 and September 30th, 2018, and obtained a high-risk result.

Qualitative component

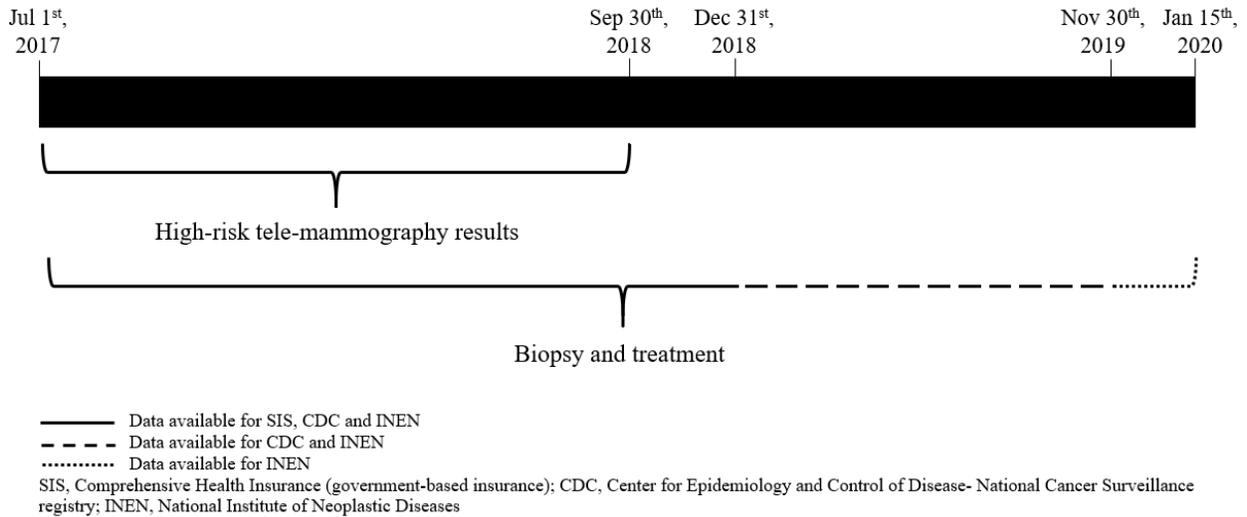
We used purposeful sampling to identify and interview 32 key stakeholders comprised of women with a high-risk tele-mammography result, healthcare providers and administrators (program coordinators and policymakers). We included women known to have faced barriers to obtaining care (as identified by the cancer program staff), and women who obtained this care more easily. Healthcare providers included cancer program nurses and midwives and physicians from the hospitals' oncology services. Program coordinators were in charge of supervising the tele-mammography program at each hospital. Policymakers were current or former staff of the MOH directly involved in policymaking and supervision of breast cancer activities around the country. Informants represented the three geographical regions of the country: the coastal region (by the Pacific Ocean, the highlands (Andes) and the rainforest (Amazon), as well as the capital city.

Key procedures

Quantitative component

Data sources: Tele-mammography results and basic demographic information of the study population were obtained from the tele-mammography reading center in Lima. Because there was no national database for tracking screened patients along the continuum of care, data on biopsy and treatment were extracted from 3 independent data sources: SIS databases, Peru's Center for Epidemiology and Control of Disease (CDC) National Cancer Surveillance registry, and INEN medical records. Data from SIS, CDC and INEN were available through December 31st, 2018, November 1st, 2019 and January 15th, 2020, respectively. Thus, each woman was followed for a minimum of 90 days following mammography (Figure 3).

Figure 3. Availability of biopsy and treatment information from the three study data sources



Measures: A high-risk tele-mammography result was defined as a BI-RADS 4 or 5 result.⁴³ The biopsy rate was defined as the proportion of women with a high-risk tele-mammography result who had evidence of a breast biopsy. The treatment initiation rate was defined as the proportion of women with confirmed breast cancer who had evidence of initiating chemotherapy, surgery, radiation, or hormonal therapy.

We calculated time to biopsy and treatment initiation among those with evidence of having reached these points in the continuum. We adapted time intervals definitions from a consensus statement⁴⁴, for use in this study. We defined the diagnosis interval as the time from tele-mammography result to biopsy result, the treatment interval as the time from biopsy result to treatment initiation, and the health system interval as time from tele-mammography result to treatment initiation. For each interval, we calculated the proportion of women who experienced delays. Although few studies examine delays from the date of high-risk mammography to the initiation of treatment, a time interval greater than 90 days from the time of breast cancer

symptoms discovery to treatment initiation has been associated with advanced stage at diagnosis and worse survival.^{11,45} We defined a health system delay as a health system interval greater than 90 days, and diagnosis and treatment delays as corresponding intervals greater than 45 days.

In addition, we defined a woman as lost from the continuum of care if we found no evidence of biopsy or no evidence of treatment initiation following a positive biopsy, and as having experienced a delay in care if she experienced a biopsy or treatment delay or was lost from the continuum of care. We calculated the frequencies of delays in care and losses from the care continuum.

Qualitative component

Data collection: We conducted individual, in-depth interviews using semi-structured interview guides. Interviews covered the following topics in women with a high-risk tele-mammography result: a) the experience pursuing care at the hospitals (i.e., getting appointments, communication with providers, insurance coverage), b) the experience of being referred for care (accessing transportation, accommodation, and food; support received), c) how they overcame difficulties in seeking care, and d) recommendations for improving the experience. The interviews with healthcare providers and administrators covered: a) how breast cancer care is administered, b) what is working well for the system and the patients, and c) what can be improved. For policymakers we also asked about the role of the MOH in improving services. The first author conducted all interviews in person and in Spanish (the local language and the first author's native language). Interviews lasted approximately 50 minutes and were audio-recorded, transcribed verbatim and loaded into the qualitative software program Dedoose, for analysis. Illustrative quotes for each emergent theme were extracted and translated into English.

Data analysis

Quantitative component

We reported descriptive statistics and analyzed data using Stata v14.

Qualitative component

The interview transcripts in Dedoose were analyzed using content analysis.⁴⁶ First, a subset of the interviews was open-coded using short descriptive labels. Second, based on the labels, the first version of the codebook was constructed. The codebook was piloted in a separate subset of the interviews, where codes were added, eliminated or merged to create the final version of our codebook. Then, the dataset was coded using the codebook. The coded data were inductively analyzed to identify key themes related to the barriers and facilitators for obtaining a biopsy or initiating treatment. Using an iterative approach, the draft themes were revised, resulting in a set of final themes that were represented in the results section.

Ethical considerations

The study was approved by Institutional Review Boards from Harvard University, Universidad Peruana Cayetano Heredia and INEN. For the quantitative component, we obtained a waiver of the consent. For the qualitative component, all participants provided written consent.

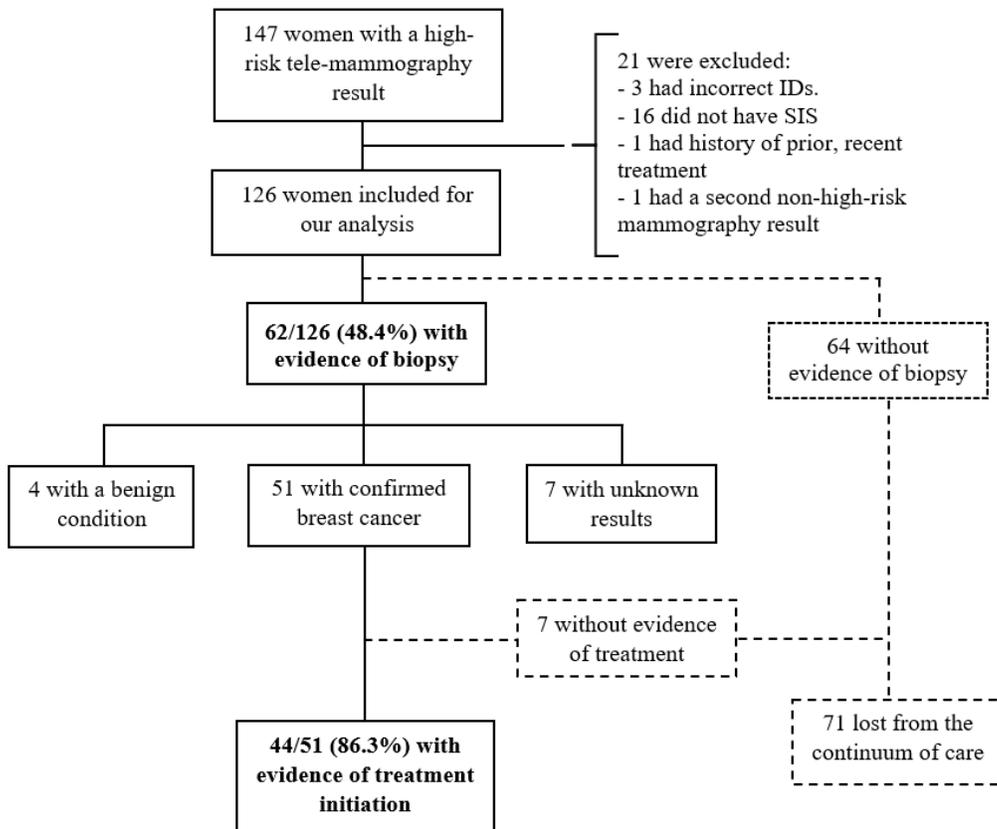
Results

Quantitative findings

Biopsy and treatment initiation rates and delays

From July 1st, 2017 to September 30th, 2018, 6899 tele-mammography tests were conducted through the MOH services. Of these, 147 women had a high-risk mammography result. After the exclusion of 21 individuals with data discrepancies or who did not meet the inclusion criteria (Figure 4), 126 women were included for analysis. Their mean age was 53.3 years (standard deviation: 11.3).

Figure 4. Flowchart of biopsy and treatment initiation rates among women with a high-risk tele-mammography result



ID, National Identification Number; SIS, Comprehensive Health Insurance (the government-subsidized insurance)

We found evidence of biopsy in 62/126 (48.4%). (Figure 2) Of these, the dates of the biopsy results were available in 48, of whom 18 (37.5%) experienced a diagnosis delay (diagnosis interval median= 39.5 days [IQR= 5.5-65; range= 7-263]). Of the 62 women with

biopsy, 51 were positive for breast cancer, 4 had a benign condition and 7 had an unknown result. Of the 51 women with confirmed breast cancer, we found evidence that 44/51 (86.3%) initiated treatment. Of these 44 women, the dates of the biopsy results and treatment initiation were available in 39, of whom 27 (69.2%) experienced a treatment delay (treatment interval median = 65.3 days [IQR= 32-118; range= 8-416]). Also, in women who initiated treatment, we found that 29/44 (65.9%) experienced a health system delay (health system interval median= 109.5 days [IQR= 69.5-168; range= 10-442]). Overall, 71/126 (56.3%) women were lost from the continuum of care (Figure 2). Delay in care could not be calculated in 14 women for whom we lacked date of biopsy; among the remaining 112, 106 (94.7%) experienced a delay in care.

Table 1. Time intervals and delays to biopsy and treatment initiation among 126 women with a high-risk tele-mammography result

	Median days (IQR; range)	Delay n (%)
From tele-mammography result to biopsy result (n=48, N=62)	39.5 (25.5-65; 7-263)	18 (37.5)
From biopsy result to treatment initiation (n=39, N=44)	65.3 (32-118; 8-416)	27 (69.2)
From tele-mammography result to treatment initiation (n=44, N=44)	109.5 (69.5-168; 10-442)	29 (65.9)

Qualitative findings

Study population

We interviewed 32 people: 13 women with a high-risk tele-mammography result (one participant was accompanied by husband), 13 healthcare providers, 3 program coordinators and 3 policymakers. See Table 2 for interviewee characteristics.

Findings

Table 2. Characteristics of the 32 participants of the in-depth interviews

	Patients	Providers	Program coordinators	Policymakers
Provenance				
<i>Lima (capital, coast)</i>	-	4	-	3
<i>North (coast)</i>	3	1	1	-
<i>Center (highlands)</i>	3	2	1	-
<i>South (highlands)</i>	4	4	-	-
<i>East (rainforest)</i>	3	2	1	-
Care situation				
<i>No biopsy</i>	2			
<i>Negative biopsy result</i>	3			
<i>Positive biopsy result & did not initiate treatment</i>	1			
<i>Positive biopsy result & Initiated treatment</i>	7			
Job situation				
<i>Current employee</i>		13	3	1
<i>Former employee</i>		-	-	2

Undergoing a biopsy test and initiating treatment for breast cancer in this population was impeded by several factors expressed in themes A-C. Some of these factors primarily affected the diagnosis interval, while others influenced mainly the treatment interval; others impacted both intervals. This relationship is illustrated in Figure 5. Although scarce, a few facilitators were identified and detailed in theme D.

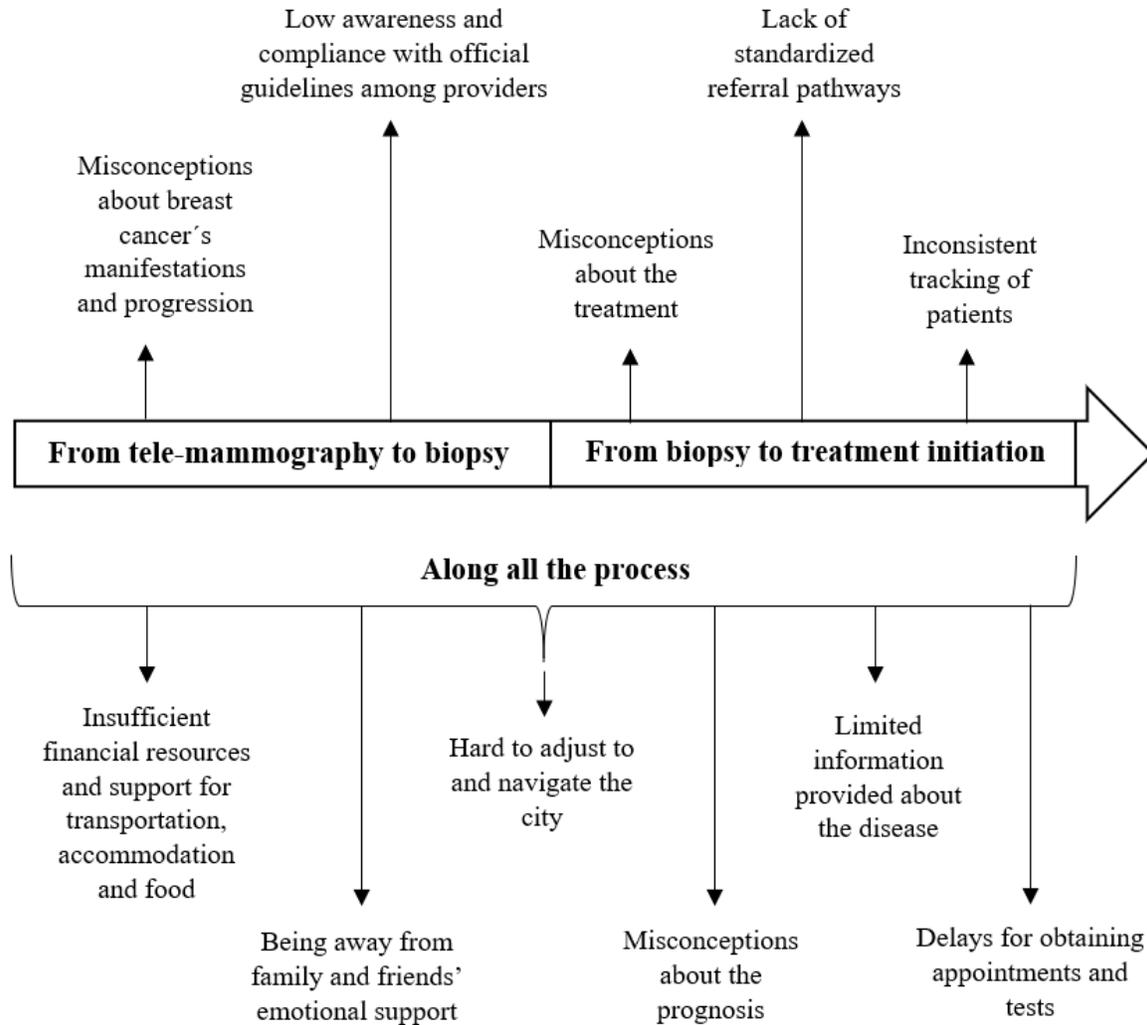
Theme A: The toll of getting care in major cities following referrals

Insufficient financial resources and support for transportation, accommodation and food

Referral to a hospital in a major city at some point after a high-risk tele-mammography result was inevitable for almost all patients living in one of the provinces. Informants agreed that the majority of this population did not have the resources to afford the transportation, housing and food expenses associated with residing outside of their hometowns for the prolonged time required for cancer care. Patients mentioned that they did not receive any kind of subsidy from

SIS to cover these expenses; one policymaker agreed that this support was not available through SIS. Providers and administrators perceived that these constraints usually made patients unable to get care.

Figure 5. Barriers for obtaining a biopsy and initiating treatment and related affected intervals after obtaining a high-risk tele-mammography result



They have to assume the expenses; they have to. So, often, because of the little money that they have, they don't go [to the city]. [midwife, highlands]

Patients highlighted the need to find external sources of financial support. This led families to organize fundraising activities in the community such as *polladas* (informal fundraisers common in Peru where a meal is sold), bingo and raffles. Nonetheless, the economic scarcity could be so severe that some families found themselves with no other option than to sell their assets, including land, poultry and cattle.

We sold some animals. On the farm, we had sheep, cattle, and we sold everything, even the land we had to sell, to save her. If we hadn't made those efforts, my wife wouldn't be alive now. We did it to save her. [patient's husband, highlands]

Some non-profit organizations, churches or local municipalities provided financial support for transportation or the living expenses at the city; however, all interviewees agreed that these charity resources were very limited. Some organizations had limited budget, and others had prioritized their spots to other vulnerable populations such as pediatric patients. Also, some housing resources that included food services provided them under a daily fee, that although small, still represented a hardship. One patient explained how she had to leave the shelter because she could not afford the ancillary costs:

Interviewer: How much did the shelter cost?

Interviewee: It didn't cost, but you needed money to stay there because you had to pay for the food, so I had to leave. [patient, coast]

Being away from family and friends' emotional support

Close relatives and friends were a vital source of motivation and emotional support as patients confronted difficulties during breast cancer care. Patients referred to their loved

transmitting confidence with their words and presence. Interviewees acknowledged that this accompaniment was essential, especially around the time of diagnosis.

Interviewer: How important do you think it is the family support during this time [before having the biopsy]?

Interviewee: Well, you are desperate, you feel like dying, but they talk to you, they talk with you. They give you support, psychological support. It's as if they were saying, "Mom, you are not alone; you are with me". [patient, highlands]

When patients left their hometowns to reside in the cities, this support greatly diminished. Patients expressed that they were not always able to be accompanied by a relative when staying in the city because of added costs or due to competing responsibilities, such as childcare. Providers and administrators referred that a lack of support network put patients at risk of withdrawing from care.

Interviewee: If they come from the provinces, they come alone. They can't come with all their family. Or they come to the first consult with a relative, and then they say things like "well, he is my husband, but he has to go back to my town to take care of my children" And they leave. That's the reality of the people from the provinces.

Interviewer: How does it affect care?

Interviewee: It affects care because the patient must think twice before continuing care.

Either she abandons it or comes irregularly. [physician, coast]

Hard to adjust to and navigate the city

For some patients, referral to and residence in a metropolitan area represented a major cultural change and logistical challenge. As noted by informants, many patients pursuing care in the cities who were farmers or fishermen were accustomed to the countryside's system. Living in and navigating a new city, many times in a different language, was seen as providers and program coordinators as a barrier to getting care. A physician commented on his perception about how this impacted patient's continuation in care:

The cultural shock [of going to the city] is very strong. They feel overwhelmed; sometimes so overwhelmed that they prefer to leave care and go back to their towns
[physician, highlands]

Theme B: Patients' misconceptions and knowledge of the disease

Misconceptions about breast cancer's manifestations and progression

Some misconceptions about how breast cancer manifests and progresses contributed to delays in pursuing a biopsy. For example, a high-risk mammography result was not taken seriously by some patients and denied by others if symptoms such as a lump or pain were not present. A woman explained how having this thought prevented them to seek further care after receiving the mammograph result:

I did not give it too much importance because I did not have any pain. I thought that maybe they were wrong. I didn't give it importance so I didn't do anything. [patient, highlands]

Other patients felt that manipulating the breast "awakens" the disease, preferring to "let it rest" instead of obtaining a biopsy. Informants noted that sometimes it was the family members

or friends who, based on these conceptions, discouraged patients from seeking care. A nurse described how some patients may have agreed to obtain a biopsy but then people in the community tried to convince them against doing it:

It's on their way back home when they pass across with relatives or friends that say "Why are you doing it? I have it, the neighbor has it and so far, nothing has happened to her and she is not feeling any [symptom]. Why are you taking it [the biopsy]? It would be worse if you have it." [nurse, highlands]

Misconceptions about the treatment

Providers reported that women usually looked for therapies with herbs and shamans as their first treatment option. Sometimes this caused disengagement from health facility-based care with women returning when no improvement was seen with traditional treatment, at which point she may have had more advanced disease.

When you tell someone she has breast cancer, the first thing they think of is that it is daño [a sort of witchcraft], so they go first to the shamans and later, if they continue feeling sick, they come back. [program coordinator, rainforest]

Misconceptions about the prognosis

Prior experiences with breast cancer led women to perceive the disease as a non-curable condition. Whether because they had heard about others' terrible experiences with breast cancer or having seen fatal cases themselves, many women expressed feeling that the ultimate outcome of breast cancer was always death. This acquired fatal conception of breast cancer made some women question the utility of treatment, creating delays for accepting care.

Many times I've heard that when you have cancer you have it until the end. [...] You just have to wait for your death. [patient, highlands]

Limited information provided about the disease

Many patients noted the limited information about the disease, its treatment and prognosis communicated to them by the clinical team after a suspicious or confirmed diagnosis. Instead, they felt that communication was focused on conveying information about the next administrative steps. As some referred, a better explanation would have led to making good choices earlier.

I would have liked for them to explain it to me more thoroughly, perhaps that way I would have gone, it would have encouraged me. Because sometimes, when they explained to you well, you are conscientious and go. But if they give you a test result that only says get another test because the first test wasn't normal, you don't give it adequate importance. [...] They didn't say anything more than giving you a number, where I should go, and all of that. [patient, highlands].

Theme C: Administrative and operational barriers

Delays for obtaining appointments and tests

Informants spoke about the existing difficulties when trying to obtain an appointment for a medical visit or a test. For example, in 'first come, first served' medical services, many had to arrive at the facility very early in the morning and wait in long lines without the guarantee of an appointment for that day, having to repeat the same procedure another day until getting one. One woman expressed that this process frustrated her, and so she discontinued seeking care.

Interviewer: What happened the day that you went to the hospital? How did it go?

Interviewee: I went very early, very early, but the line was already long, and as I needed to work, I got bored and didn't go back. So, I haven't done the test. Nothing. I left it there.

[patient, highlands]

When appointments were able to be booked in advance, these were often scheduled for several weeks later. Patients reported that this was common when booking an appointment for an auxiliary imaging test (i.e., ultrasound and computed tomography), the results of which could also be delayed for weeks or even months. Providers noted that tests sent to Lima for reading (i.e., biopsy and immunohistochemistry) also took a long time to come back. When everything was ready for initiating treatment, the date scheduled for receiving the treatment may be weeks later. One provider summarized the delays faced by patients:

For these tests, they have to come one day and for these others another day. And that's how the time passes by. I've seen patients that even took 3 months to get an appointment or to start chemotherapy. So sometimes when they are told to do one more test they say 'Miss, I've been there, 3 months have passed, and I haven't started treatment yet'. [nurse, highlands]

Low awareness and compliance with official guidelines among providers

Not all physicians reported being aware of the MOH tele-mammography program. Those not informed about the existence of the tele-mammography program doubted the validity of mammography results (thinking that they were reported by local non-trained radiologists) and

usually ordered a second mammography test at their hospital. One policymaker described how a patient had to take a new mammography after being referred to the treatment hospital:

We had a patient with BI-RADS 4 who needed a biopsy, but the closest hospital didn't have biopsy services. So, we coordinated to refer her to a regional cancer center. After a lot of insistence, they could transfer her to the cancer center and it happens that when she arrives at the facility they order to repeat the mammography. [policymaker, coast]

In other cases, after a high-risk tele-mammography result, the cancer program's nurses and midwives wanted to 'make sure' about each tele-mammography result so they ordered a breast ultrasound in all patients before referring for biopsy, contrary to national guidelines. These extra procedures contributed to delays and the administrative burdens on the patient.

Lack of standardized referral pathways

There is no formal standardized referral pathway for high-risk tele-mammography results. The decision of referral hospital, particularly for treatment, was usually based on the providers' perception of the hospital with the services available or the one traditionally known to provide 'good care'. As commented by the informants, INEN was often the hospital chosen. Policymakers agreed that this approach did not take advantage of the resources available at closer regional hospitals. Also, a patient commented on how this system failed to account for her convenience:

Interviewer: Did they ask you if you wanted to go to [region X] instead of Lima?

Interviewee: No, they didn't say anything. If I had known that in [region X] they had chemotherapy, I wouldn't have been to Lima, because I didn't have enough money or someone to help me. If I knew they had it here, I would have stayed. [patient, coast]

Inconsistent tracking of patients

The follow-up of women did not occur uniformly along the continuum of care. While the cancer program staff kept close contact with patients who received care in the local hospital, the tracking of patients to upper-level hospitals was not as stringent. One of the program coordinators acknowledged:

Interviewer: What type of follow-up do you do here?

Interviewee: Once they have a biopsy in the [local] hospital, and it comes back positive, they call the patient or her primary care center to inform her of the result. They talk with the patient to see what's best: to send her to [the regional hospital] or to Lima. [...]

Interviewer: And what happens once they are referred?

Interviewee: We don't do more follow-up. I'd be lying if I say we do. We don't do more follow-up. [program coordinator, coast]

The cancer program staff described inconsistent use of the programmatic follow-up tool and an absence of monitoring by the MOH on its use. This was sometimes aggravated by high staff turnover, and the consequent adaptation period needed to become familiarized with the program's follow-up procedures. Providers expressed that the high staff turnover also affected the patient's continuity in care as they lose sources of support that they had at the hospital.

It [high staff turnover] affects things because patients get used to a specific person. Patients call [the former staff] and say “Miss, you haven't called me back. When do I need to go back to the hospital?”, and she [the former staff] answers, “I'm sorry, I don't work there anymore. [...]”. The patient feels left adrift. They say, “The other midwife helped me with my appointments, with the referrals, she was aware of me”. [midwife, highlands]

Theme D: Facilitators

Having family or a friend living in the city

Interviewees regularly expressed that having a relative or a close friend living in the city where patients were referred facilitated seeking care. In such cases, patients were able to stay with this friend or family member and, although it did not eliminate economic hardship, it alleviated much of it. Also, patients felt secure in knowing that someone could help them navigate the city or take care of them once treatments start.

They say: “I don't worry much about the stay, Miss, I have family there.” The majority that wants to go to [a major city] is because they have family there. [midwife, coast]

Collaborative and family-inclusive explanation

Addressing the patients' concerns about breast cancer through a multidisciplinary approach was seen by providers as useful for improving the patient's understanding of the disease and for making prompt medical decisions. Collaborative work among clinicians, psychologists, and sometimes social workers, was helpful for communicating the meaning of

the diagnosis and expectations for future care. Providers emphasized that involving the family in this process was necessary, as, family played a determinant role in healthcare decision making.

Interviewer: How do you convince them [to obtain a biopsy]?

Interviewee: Taking your time and explaining kindly. Sometimes the patient accepts [undergoing biopsy], but the relative doesn't, so you need to explain it all to the family, too. [...] You need to explain to every one of them because in their way of living, all the family influences, and then they accept. [physician, highlands]

Facilitated appointments

Some hospitals and providers facilitated appointments for their patients. In two hospitals, the medical appointments were scheduled for the same day or the following day for patients coming from remote areas. In another hospital, all patients arriving before a certain time had to be seen that day. In other cases, the nursing staff, midwives or physicians, coordinated appointments to reduce the administrative burden on the patients or tried to use their influence to get an early appointment. These approaches, although not perfect, helped reduced appointment delays.

Interviewer: How do patients from other regions get care here?

Interviewee: They just come and get an appointment. Here in the oncology department, we have a system that we called 'unlimited appointments.' We give an appointment to everyone who arrives before 9:00 a.m.

Interviewer: What day is the appointment?

Interviewee: For the same day. So, they don't have to come back another day. [physician, highlands]

Discussion

This is the first study to evaluate linkage to care of the largest national tele-mammography program of Peru. Among women with a high-risk tele-mammography result, we found evidence of biopsy in less than half (48.4%). Most women (86.3%) with pathologically confirmed breast cancer did have evidence of treatment initiation. However, more than half (56.3%) of the women in need of biopsy or treatment did not get such care. These results reflect either a suboptimal rate of follow-up care, a lack of systematic and coordinated data collection to adequately evaluate whether the tele-mammography program leads to subsequent diagnosis and treatment or, probably most likely, a combination of both factors. Our quantitative findings are complemented by qualitative evidence of substantive factors that impeded access to biopsy and treatment services, and few factors facilitated it. Overall, through a mixed-methods design, we were able to elucidate the ways in which diagnosis and treatment services for breast cancer were not easily accessible for women living in poverty across different regions of the country even though the government-based insurance covered the majority of those services.

Among women for whom we could confirm care, delays were common. We found that around 65% of women experienced a health system delay, with longer times for initiating treatment after a breast cancer confirmed diagnosis than for obtaining a biopsy following the mammography result. There is limited literature to which to fairly compare the time from an abnormal mammography result to posterior steps in the continuum of care as the majority of studies evaluated delays starting from the time of symptoms discovery. We identified one study conducted in a public screening program for vulnerable population in the United States that reported health system delays in only 24% of the sample.⁴⁷ Our results are more similar to those of other LMIC, where over 70% of patients started treatment after 3 months of abnormal

screening or symptoms discovery.¹¹ Long health system intervals have been associated with advanced stage at disease⁴⁸, a known risk factor for decreased survival for breast cancer.⁴⁹ Furthermore, health system delays in LMIC are suggested to be determined by the low access and quality of cancer care.¹¹ Thus, our findings suggest that Peru's MOH services may have a number of health delivery gaps that leave a substantial number of women with suspected cancer unattended and a high number of women with confirmed breast cancer at high risk for death.

Public cancer care in Peru is still centralized in the capital city and few other major cities, requiring people to travel to cities for care. In this study, insufficient financial resources for affording transportation, accommodation and food for traveling and staying in the cities was the most distinguishable barrier for pursuing breast cancer care. As has also been shown in other studies conducted in Peru in cervical and pediatric cancer, individuals living outside Lima and in rural settings are at higher risk of discontinuing care.^{30,31} In our study, while some women found significant economic and practical relief by staying at a relative or friend's home in the city, this is not a viable a public health strategy. According to the National Cancer Control Plan launched in 2012, Peru's current health policies include coverage of traveling and living expenses for the patient and one companion.³ Our findings call into question whether this policy has been disseminated or implemented on a broad scale. A recent study of cervical cancer in Peru also reported this policy-practice gap.⁵⁰ Centralization of cancer care facilities have been found to disproportionately affect socioeconomically vulnerable populations^{51,52}, and are thought to contribute to persistent care disparities for breast cancer care in LMIC.⁵³ Decentralization of breast cancer care in Peru could highly benefit women receiving public health insurance.

Our qualitative results indicate that gaps on knowledge and implementation of guidelines, absence of a standardized referral pathway, and weak, poorly supervised tracking of patients

were present throughout the different regions studied. Besides, through the quantitative data collection process, we witnessed how fragmented the health information system is across the different institutions in charge of health management and care of the SIS-subsidized population, coupled with a lack of accountability of what MOH office should be in charge of follow-up during the continuum of care. As stated by the WHO¹⁷, validated protocols for all steps of the continuum of care, adherence to guidelines, quality assurance and information systems covering the entire screening process including follow-up, among others, are part of the criteria for the successful implementation of an organized screening program. Thus, the administrative and operational components of the breast cancer delivery system in place, need to be comprehensively reinforced to widely increase the screening coverage with adequate monitoring of linkage to biopsy and treatment.

This study has some limitations. The quantitative results presented here were our best intent to disentangle a health information puzzle that did not allow appropriate tracking of women with a high-risk tele-mammography result. Evaluating breast cancer care using routinely collected data was challenging due to a lack of integration of health information systems of the different institutions that managed and provided healthcare to the population subsidized by SIS. Although we used multiple data sources to capture care access through different pathways; they had varying levels of follow-up and data completeness, which may have led to an underestimate in the proportion of women who obtained care. A second limitation is that, we did not include in the study women whose location and contact information were unknown by the hospitals' staff. These women might have been lost-to-follow-up and could have faced significant barriers to getting care. However, we believe that we interviewed women who faced barriers that are representative of those experienced by many women. Moreover, this information was further

complemented by interviewing healthcare providers and program coordinators who had contact with patients with all types of barriers. Overall, this study is a comprehensive evaluation that used both quantitative and qualitative research techniques to understand the situation occurring in diverse geographical and cultural backgrounds of the country. Thus, this study provides a close perspective of what could be happening in the other regions part of the MOH tele-mammography network in Peru.

In conclusion, our study points to the need for strengthening the breast cancer diagnostic and treatment capacity of regional hospitals in Peru to remove barriers and facilitate access to timely breast cancer services. Major requirements to allow adequate progression in the continuum of care and monitoring of the process include better awareness of guidelines among providers, standardized referral pathways, and robust tracking and information systems. Finally, this population might benefit if the health system could address the patient's misconceptions of breast cancer through a multicomponent and family-inclusive approach. Ensuring timely linkage to diagnosis and treatment for women with an abnormal result in the tele-mammography program will be critical to ensuring the screening program's success, specially before up leveling it to widespread screening.

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