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Advancing health equity in improving breast cancer screening with the use of a mobile mammography bus in marginalised population: quality improvement project

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ABSTRACT

Background Breast cancer, the second leading cause of cancer-related deaths in women in the USA, is effectively treated through early detection and screening. This quality improvement (QI) project aimed to improve mammography screening rates from the baseline of 50% to 60% within 12 months for patients aged 50–74 years at an Internal Medicine Clinic.

Methods We used the Plan, Do, Study, Act (PDSA) model. A multidisciplinary team used a fishbone diagram to identify barriers to suboptimal screening. The QI team created a driver diagram and process flow map. The mammogram screening rate was the outcome measure. Mammogram order and completion rates were the process measures. We implemented six PDSA cycles. Major interventions included the use of a nurse navigator, enhancements in health information technology, and education to patients, providers, and nursing staff. Mammograms were offered in a mobile bus, located in the hospital campus and in under-resourced inner-city neighbourhoods to improve the access. Data analysis was performed using monthly statistical process control charts.

Results The project exceeded its initial goal, achieving a breast cancer screening rate of 66% (n=490 of 744) during the study period and was sustainable at 69%, 3 months post-project. The mammogram order rate was 58% (n=432 of 744) and completion rate was 53% (n=231 of 432) within 12 months.

Conclusions We attributed the success of this QI project to the education of patients, nurses and physicians, the use of a nurse navigator and engagement of a multidisciplinary team. Access to mobile mammography bus addressed the social determinants of health barriers in a marginalised population.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Several factors including social determinants of health contribute to the higher mortality rates from breast cancer observed among African American women.

WHAT THIS STUDY ADDS

⇒ This study presents a framework for breast cancer screening in an academic, safety-net clinic using the Plan, Do, Study, Act model of healthcare improvement. Multifaceted, innovative field strategies were employed to reduce healthcare disparities in under-resourced communities.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This project addressed barriers and population health and provides a model for optimising breast cancer screening rates within a primary care setting. The findings add to the expanding body of knowledge regarding breast cancer screening interventions and provide valuable insights for future healthcare quality improvement projects.

INTRODUCTION

Background

Breast cancer is the most common non-skin cancer and the second leading cause of cancer-related deaths in women in the USA.[1] Early detection from screening has contributed to an increase in overall survival rates.[2] However, it is important to address the disparities in breast cancer outcomes among different racial and ethnic groups. African American women face significant challenges in relation to breast cancer. African American women experience the highest breast cancer mortality rate among all racial or ethnic groups in the USA, with a 40% mortality rate.[3 4] When compared with their white counterparts, the mortality rate for black women diagnosed with breast cancer is 42% higher.[1 4] Furthermore, among women under the age of 40 years, African American women have a higher incidence of breast cancer compared with white women.[1] Several factors contribute to the higher mortality rates observed among African American women. These factors

are multifactorial and may include later-stage diagnosis, socioeconomic disparities, differences in access to healthcare and biological differences in breast cancer subtype response.[1 3] Addressing these disparities requires a multifaceted approach that includes improving access to healthcare services, promoting early detection through education and screening initiatives, and addressing socioeconomic barriers.

The US Preventive Services Task Force (USPSTF)[5] recommends biennial mammography screening for women aged 50–74 years. The 2016 USPSTF guidelines are recommended for women aged 40–49 years; the USPSTF acknowledges the potential benefits and harms of mammography screening, emphasising the importance of individual decision-making based on personal values, risk factors and preferences. The USPSTF suggests that women in this age group engage in a discussion with their healthcare providers to make an informed decision.

Problem description

In a safety-net hospital-based Internal Medicine Clinic (IMC), 75% of the patient population is composed of African Americans. We discovered a significant healthcare disparity in breast cancer screening. Our baseline screening rate stood at 50%, which fell below the average rates observed in the USA.[6] The national average of the proportion of women aged 40 years and older who reported undergoing a mammogram in the past 2 years remained consistent, starting at 67.1% in 2008 and slightly declining to 65.6% in 2018. However, in 2019, there was an increase to 67.5% in this group who had received a mammogram within the previous 2 years.[6–8] This quality improvement (QI) project was aligned with the organisation's highest priority and received enormous support from administrative leadership. The objective of this QI project was to enhance breast cancer screening rates from the baseline of 50% to 60% in an academic IMC within 12 months, specifically targeting patients aged 50–74 years, based on guidelines provided by USPSTF. Our target goal of 60% from a 50% baseline rates within 1 year was set because this QI project was conducted in a safety-net clinic in an under-resourced patient population who faced various barriers to social determinants of health. We anticipated many challenges to optimise breast cancer screening rates in this unique patient population; therefore, we selected a 10% improvement within 1 year from the baseline rate. Our aim statement was achievable and realistic based on 'SMART' goals[9] and based on previous QI projects from this clinic.[10–16]

METHODS

Setting

This QI study was conducted at an academic IMC situated within a tertiary care safety-net hospital in Western New York. The IMC primarily serves an urban population that is predominantly under-resourced and consists of mostly African Americans (75.0%). Patients use the IMC for longitudinal primary care, with an average of 800 monthly visits. The IMC is staffed by a diverse healthcare team, including 35 residents from the University at Buffalo's Internal Medicine Residency Program and 4 attending physicians. The clinic's electronic health record (EHR) system did not possess the capability for medical decision support tools or chart alerts, which could aid in clinical decision-making and reminders for the physicians.

Design

This QI initiative was structured using the Plan, Do, Study, Act (PDSA) model, a widely recognised framework for healthcare improvement.[9 17] Additionally, we incorporated the Institute of Medicine's STEEEP model, which outlines six aims for transforming the healthcare system: Safe, Timely, Effective, Efficient, Equitable and Patient-Centered into planning, implementing and assessing PDSA cycles[18] (table 1A). The multidisciplinary QI team comprised of attending physicians, resident physicians, nursing and ancillary staff, patients, a social worker, a case manager, radiologist, the manager from the mobile mammography bus, hospital leadership and information technology staff. Stakeholders' mapping strategy of Mendelow's matrix was used based on the level of interest and level of influence to engage stakeholders (figure 1A). We used the Standards for Quality Improvement Reporting Excellence 2.0 guidelines for reporting this QI project.[19] The QI team performed a root cause analysis using a fishbone diagram and identified barriers to optimal breast cancer screening (figure 1B). The significant barriers included: provider and patient knowledge gap, lack of interface with EHR and access to mammogram. We developed a process flow map to optimise opportunities to improve screening mammography (figure 1C). The QI team created a driver diagram by identifying primary and secondary drivers, and prioritising change ideas to overcome the challenges to accomplish our aim (figure 2A).

This study included women between the ages of 50 and 74 years, evaluated in the clinic from 1 September, 2018 to 30 August, 2019 and excluded patients who required diagnostic mammography. The hospital offered regular mammography in a mobile bus, available in the hospital campus and in under-resourced inner-city neighbourhoods to improve the access. The majority of mammography was performed in the mobile bus. Patients with mobility issue preferred to obtain mammography in an outside facility. Physicians discussed breast cancer screening with average-risk patients and engaged patients in shared decision-making process. Shared decision-making involves explaining all treatment options to the patient and coming to a joint decision that respects the

Table 1 (A) STEEEP model, concepts and integration into PDSA cycles for optimisation of breast cancer screening; (B) PDSA cycle 1; (C) PDSA cycles 2–6

(A)

STEEEP model	Concepts	PDSA cycles	Planning, implementing and assessing of the PDSA process
Safe	Mammogram is safe and evidence-based strategy for breast cancer screening	PDSA 2, 3 and 5	► Patient and provider education was planned and implemented based on evidence-based guidelines for breast cancer screening ► Implementing workflow to address prompt review and follow-up of abnormal results was based on improving patient safety and quality
Timely	Less wait for patients and providers	PDSA 1, 2 and 3	► Optimisation of EHR and use of 'patient navigator' were planned, implemented and assessed to provide timely service to patients and to improve provider's time management while discussing and ordering mammography ► Nurses provided brochures and education, scheduling mammogram during visits
Effective	Mammography has been proven to improve diagnosis, quality of life and mortality of breast cancer; it may lead to reduction in late-stage cancer diagnosis and its complications	PDSA 2, 3, 5 and 6	► Patient and provider education was implemented based on USPSTF guidelines for breast cancer screening ► Closing the loop for test and referrals was implemented to capture early abnormal results that require prompt evaluation and follow-up
Efficient	Streamlining processes and care coordination helps to eliminate waste and improve efficiency	PDSA 1, 4 and 5	► PDSA 1 and 5 were implemented and assessed to improve efficiency with use of a patient navigator and EHR enhancement ► Scheduling mammogram during clinic visit improved efficiency and reduced unnecessary burden of staff time for patient outreach for scheduling mammogram
Equitable	Intent to provide mammography to all patients, regardless of race or ethnicity or insurance status	PDSA 3 and 5	► Equitable care was emphasised during planning and implementing interventions ► Patient education, shared decision-making and patient-centred discussion were offered to all patients
Patient-Centered	Aim is to improve patient mortality and quality of life with patient centred	PDSA 1, 2, 3, 4 and 5	► Patient engagement was the key and shared decision-making was based on patient centredness

(B)

PDSA cycle 1	Prediction/plan	Do	Study	Act
1a: Provider reminder 1 month and continuous	Improving provider reminder will facilitate breast cancer screening discussion with patients	► Create a manual provider reminder due to lack of automated chart alert, after meeting with nursing staff and IT staff ► 2 questions were added in EHR for nursing workflow	Nursing staff perceive adding 2 questions during patient checking process will not increase the workload	This workflow increased provider awareness and improve communication with patients about breast cancer screening and mammogram orders. This step became the standard of care for all clinic visits

Continued

Table 1 Continued

(B)				
PDSA cycle 1	**Prediction/plan**	**Do**	**Study**	**Act**
1b: Capturing results 1 month and continuous	Capturing completed mammogram reports as a structured data in EHR will improve screening rates and accuracy of population health registry	► Meeting with IT to create interface of mammography results in real time from the mammography mobile bus to the clinic EHR for review by the attending physician. ► The medical office assistant (MOA) completing orders in the EHR during scanning of the report to capture mammography completion	Providers were able to address results in a timely manner and perceive adding EHR results in the task box will not significantly increase workload and will improve patient safety and quality	This workflow increased provider awareness and improve communication with patients about breast cancer screening and mammogram orders. This step became the standard of care for all clinic visits
1c: Standing orders for mammogram 1 month and continuous	Improving provider's orders for mammogram will improve mammogram completion rates	► Meeting with IT to generate standing orders for a screening mammography by the patient navigator or MOA	► Patient navigator/ MOA perceive printing and faxing mammogram order to mobile bus will not interfere with routine clinic workflow and not increase workload ► Staff from mammogram bus perceive improved communication and efficiency by receiving a fax order	This workflow increased mammogram completion rates. This step became the standard of care for all clinic visits
1d: Patient navigator 1 month and continuous	► Improving patient outreach, education and care coordination will improve screening rates ► Scheduling mammogram appointment during clinic visit before discharge will increase mammogram completion rates ► Scheduling mammogram near patient's home will improve mammogram completion rates	► Meeting with clinic administrative director and QI team to discuss appointment of a nurse patient navigator ► Patient navigator schedules mammogram in mobile mammography near patient's home, and not in the hospital ► Meeting with mobile mammography bus director for open-access calendar for scheduling appointments	► Patient navigator required training and allocated dedicated time to perform the tasks. 4–6 hours per week was needed. ► Patients' phone numbers not working, unable to reach patients ► MOA/patient navigator perceive improved satisfaction and not increase in workload for scheduling appointment	► This improved patient education, communication and care coordination for scheduling/tracking reports. ► Patient outreach for patients who were lost to follow-up was successful. ► Front staff updated patient's phone numbers during check-in for clinic visits

Continued

Table 1 Continued

(C)				
PDSA cycle	**Prediction**	**Do**	**Study**	**Act**
PDSA 2 2 months	Education of physicians and staff about evidence-based guidelines will improve awareness about breast cancer screening	Meeting with resident team leaders about the USPSTF breast cancer screening guidelines and creating PowerPoint presentations in a small group discussion setting, every week for 5 weeks	Resident physician felt that this presentation in small group discussion improved their knowledge and did not increase workload	Pretest and post-test assessments comprised of 5 multiple choice questions, demonstrated objective improvement in the residents' knowledge
PDSA 3 1 month, continuous	► Patient incentive may increase mammogram completion rates ► Patient education and engagement will create awareness about breast cancer screening and improve completion rates	► Meeting with QI team to create/select patient education materials, patient navigator-created simplified brochure for patient education. ► Meeting with clinic administrator and QI team to offer raffle tickets for NFL Buffalo Bills football game	Patient navigator and providers perceive providing educational materials will not increase workload and improve patient, provider/staff satisfaction	► There was not much disruption to routine clinic workflow and patients, staff and providers expressed satisfaction with care ► Temporary increase in mammogram completion rates during this event
PDSA 4 2 months Ongoing quarterly	Providing feedback to stakeholders will improve provider, staff and team engagement	Meeting with clinic administrator to select strategy to share data reports every 5 weeks with clinic care team, review successes and challenges	Lead physician and clinic leadership perceive accessing and sharing monthly reports for mammogram screening from population health registry was feasible and will not increase workload	Stakeholders expressed satisfaction and motivation to improve their patient's breast cancer screening
PDSA 5 2 months, standard of care	Closing the loops for referrals and tests will improve accuracy of data capturing	Team meeting to define processes for tracking reports, follow-up of abnormal results	Providers perceive receiving abnormal reports in a timely manner will improve patient safety and will not increase the workload	Patients and providers expressed satisfaction with care
PDSA 6 3 months	Refresher training to residents and nursing staff about clinic workflow, protocols and evidence-based guidelines will improve awareness about breast cancer screening	Meeting to design training schedule and contents with resident team leaders	Resident physicians perceive that this training will improve knowledge about breast cancer screening and clinic workflow	Resident physicians felt comfort about discussing and ordering mammogram for patients and improved efficiency about the process

EHR, electronic health record; IT, information technology; NFL, National Football League; QI, quality improvement; USPSTF, US Preventive Services Task Force.

patient's values.[20] Physicians ordered screening mammogram based on patients' preference and value. Physicians referred high-risk women to an oncology clinic for genetic counselling and further evaluation. This study is based on USPSTF guidelines for breast cancer screening.[5]

Measurements

An electronic patient registry for eligible patients for breast cancer screening based on (USPSTF) guidelines was created prior to this QI and was readily available. Retrospective examination of the population health registry for eligible patients seen within the past 18 months in IMC revealed a baseline breast cancer screening rate of less than 50%. Percentage of baseline screening rate was calculated from total eligible patients between the ages 50 and 74 years, seen in the clinic 18 months prior to the start of the QI project; numerator was total eligible patients minus patients who had not completed screening

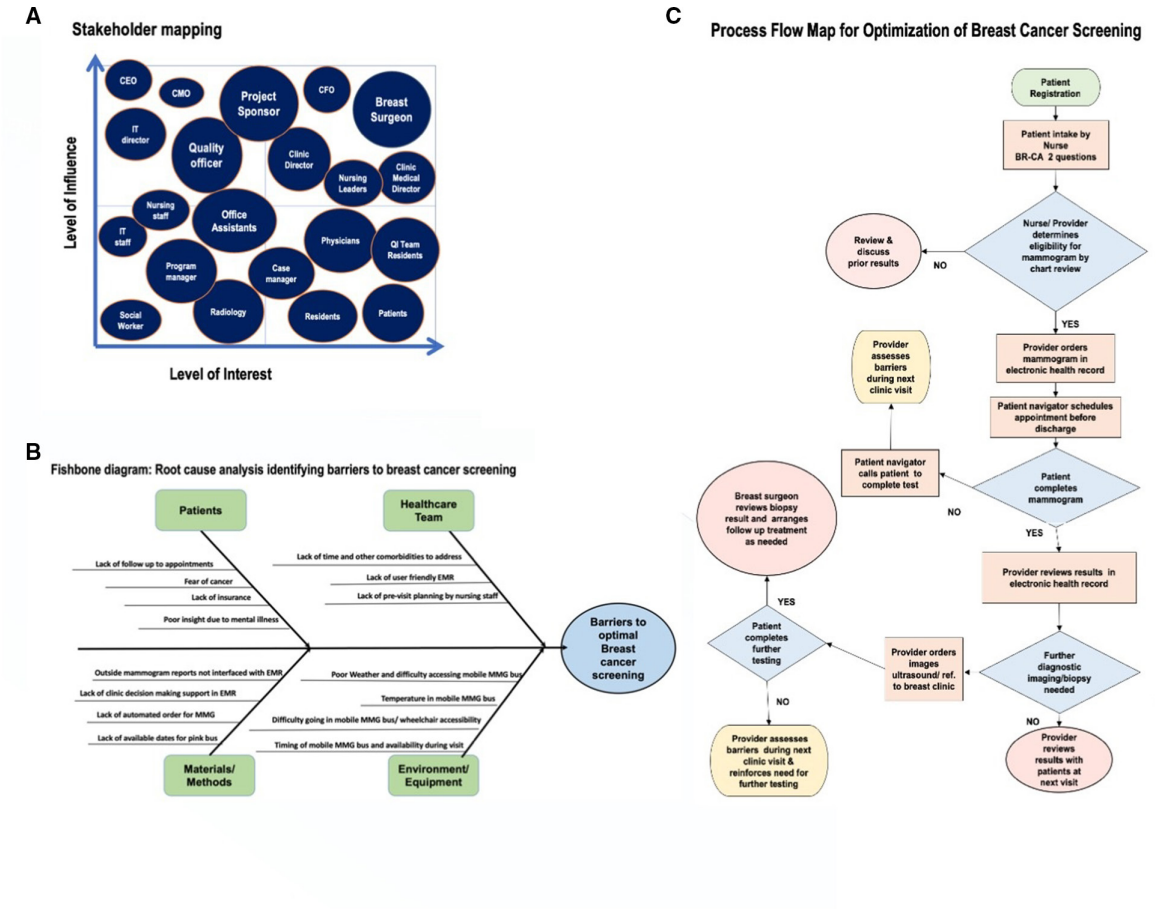

Figure 1 (A) Stakeholder mapping; (B) fishbone diagram: root cause analysis identifying barriers to suboptimal breast cancer screening; (C) process flow map. BR-CA, Breast Cancer; CEO, chief executive officer; CFO, chief financial officer; CMO, chief marketing officer; EMR, electronic medical record; IT, information technology; MMG, mammography; QI, quality improvement.

mammogram (due or overdue) and denominator was total eligible patients during 18 months. A statistical process control chart was not used to calculate the baseline screening rate. The outcome measure for this study focused on mammogram screening rates, indicating the percentage of eligible patients who underwent mammography. Mammogram order rates and completion rates served as the process measures, reflecting the frequency of ordering mammograms and the proportion of ordered mammograms that were successfully completed. As part of assessing the impact of the QI initiative, the team also considered the potential effects on patient wait times in the clinic and the level of job satisfaction among nursing staff and providers, which served as balance measures. To measure patient wait times for the primary care clinic appointment, the QI team defined the average wait time as the duration patients spent in the examination room for nursing and physicians' assessment. It was anticipated that the provision of education on breast cancer screening to patients would require additional time, potentially resulting in increased wait times.

Strategy

We have outlined specific steps of 'Plan (Predict), Do, Study and Act' phases in various PDSA cycles (table 1B: PDSA cycle 1 and 1c, PDSA cycles 2–6). We incorporated reflection and feedback of stakeholder in the assessment/study phase of each PDSA cycle (table 1B,C).[21]

PDSA cycle 1 (September 2018): optimisation of EHR and patient navigator

Physician leaders collaborated with information technology staff for enhancements in EHR for this QI project. The innovative changes in EHR are summarised in table 1B.

PDSA cycle 1a: provider reminder

The QI team created a template for new nursing workflow to alert physicians to review breast cancer screening. Two questions were inserted into the History of Presenting Illness section of the clinic visit note: (1) Did you have mammogram this year? and (2) Are you willing to discuss breast cancer screening with your physicians today? The nursing staff completed this tool in the EHR during the patient check-in process before the physician–patient encounter. In the clinic EHR, there was clinic workflow for documenting refusal of mammogram as structured data to capture this information in electronic patient registry. There was a poor compliance from the provider for this workflow as it required a manual entry in EHR

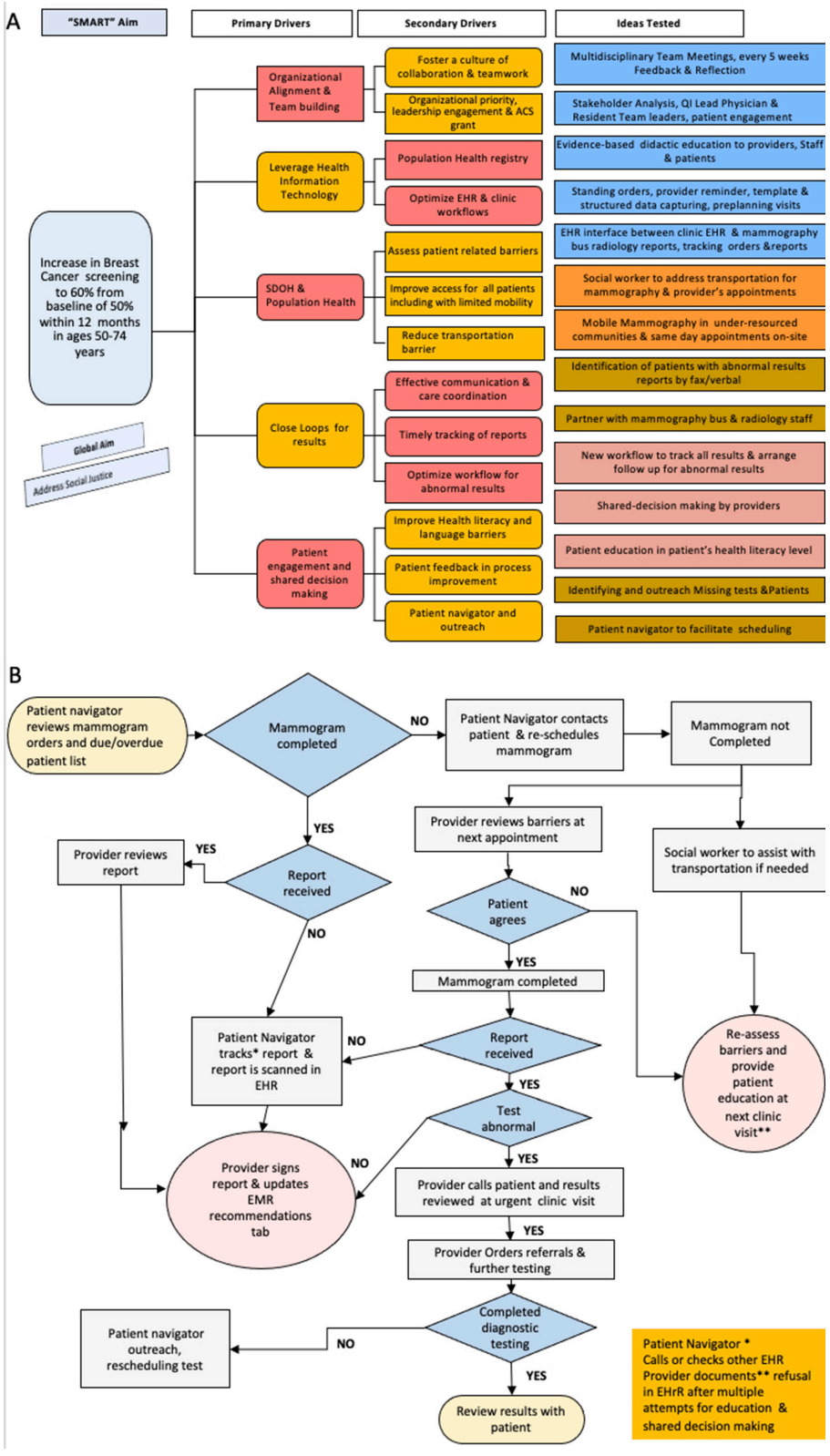

Figure 2 (A) Driver diagram; (B) process flow map for closing the loop for referrals and tests. *Patient navigator calls or checks other EHRs. **Provider documents refusal in EHR after multiple attempts for education and shared decision-making. ACS, american cancer society; EHR, electronic health record; QI, quality improvement; SDOH, social determinants of health.

and providers were not able to document structured data due to time constraints during clinic visits, but it was mentioned in the provider clinic note as unstructured data.

PDSA cycle 1b: capturing results

The QI team collaborated with information technology staff and developed an interface of mammography results in real time from the mammography

mobile bus for review by the attending physician. The medical office assistant scanned and completed the report to capture mammography completion as a structured data in EHR. This step was crucial to ensure the accuracy of electronic patient registry.

PDSA cycle 1c: standing orders for mammogram

The patient navigator and medical office assistant had the ability to generate standing orders for a screening mammography.

PDSA cycle 1d: patient navigator

The QI team appointed a nurse as the patient navigator to educate and counsel patients about breast cancer screening. The patient navigator was given access to order, schedule and reschedule mammography. The patient navigator was provided an open-access calendar from the mammography mobile bus to schedule appointments for those seen in the clinic and those lost to follow-up in the clinic but were overdue for screening. The newly created EHR workflow and the use of patient navigator continued during the study period, beyond this PDSA cycle.

PDSA cycle 2 (October–November 2018): physician and staff education

Resident team leaders identified a gap in residents' knowledge of the USPSTF breast cancer screening guidelines. Team leaders educated physicians and clinic staff through PowerPoint presentations in a small group discussion setting. The resident team leaders focused the training on USPSTF breast cancer screening guidelines, modifiable risk factors for breast cancer including smoking cession, limiting alcohol intake, exercising and maintaining healthy weight and healthy diet. Redesign of EHR and nursing workflow were also reviewed. Pre-test and post-test assessments comprised of 5 multiple choice questions were conducted to evaluate objective improvement in the residents' knowledge (table 1C).

PDSA cycle 3 (December 2018–January 2019): patient education and engagement

The nursing staff provided pamphlets and booklets about breast cancer screening to patients during their clinic visits. The hospital sponsored free raffle tickets for attendance to a National Football League Buffalo Bills game once patients completed mammogram screening. This incentive was offered for 1 month to complete the screening when they were due or overdue for mammography (table 1C).

PDSA cycle 4 (February–March 2019): feedback to stakeholders

The lead physician shared reports every 5 weeks with the resident physicians and nursing staff.

PDSA cycle 5 (April–May 2019): close loops for referrals and tests

Our specific steps to close loops for referrals and tests are summarised in the process flow map (figure 2B). The patient navigator nurse tracked completion of mammograms and rescheduled mammography when a patient missed their appointment. An appointment was offered that was at a convenient location to the patient near home or work, or in hospital campus. Free transportation was offered to the patients with assistance from a social worker when needed. The QI team improved care coordination and communication between clinic staff and staff from the mammography bus to increase scheduling and completion of mammogram. The patient navigator reviewed a list of due/overdue mammogram orders and called patients to schedule. The patient navigator and nursing staff printed a mammogram report from HEALTHeLINK (a digital clinical database from hospitals, physicians, health plans and other healthcare providers in the eight counties of Western New York state), when the report was not in the clinic EHR. This report was scanned and sent to physicians for a review. The nursing staff also called outside facilities to track reports of completed mammography. The team designed a clinic protocol for timely review of mammography results to address abnormal results. Normal results were scanned in the EHR and/or received electronically in the physician's task box. Physicians were trained to verify a mammography report within 48 hours. Abnormal mammography reports were received by fax or by verbal report on the phone. Physicians addressed abnormal mammography results the same day. Physicians notified patients in a timely manner of abnormal mammograms, ordered diagnostic imaging as needed and referral to breast surgeon for further evaluation (table 1C).

PDSA cycle 6 (June–August 2019): refresher training to residents and nursing staff

Resident team leaders conducted training for new interns and refresher training for resident physicians and nursing staff. The redesigned clinic workflow for ordering and completing mammography was also reinforced in the training (table 1C).

Data analysis

We used QI macros software to plot monthly statistical process control p-charts.

RESULTS

Demographics

The majority of patients were African Americans (73.5%) with the remainder of the patients being white (20.9%) or other races (5.6%), and 55.0% had body mass index ≥30 or more. The mean age was 61.6 years (SD=6.4).

Process measures

Mammogram order rate

During the 1-year study period, we achieved a mammogram order rate of 58% (n=432 of 744). During the project and 3 months after the project period, we achieved a mean order rate of 61% (figure 3A).

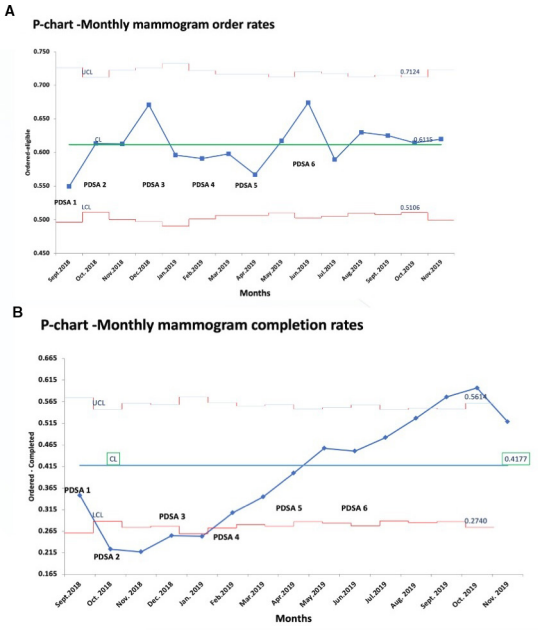

Figure 3 (A) Monthly statistical process control p-chart mammogram order rates; (B) monthly statistical process control p-chart mammogram completion rates. LCL, lower control limit; PDSA, Plan, Do, Study, Act; UCL, upper control limit.

Mammogram completion rate

During the 1-year project period, we achieved mammogram completion rate of 53% (n=231 of 432). During the project and after the project period, we achieved a mean completion rate of 41% (figure 3B).

Outcome measures

Breast cancer screening rates

During the 1-year project period, we achieved a mammogram average screening rate of 66% (n=490 of 744). During the various PDSA cycles, we achieved a variable and sustainable increase in mammogram screening rates. During the project and 3 months after the project period, we achieved a mean screening rate of 69% (figure 4).

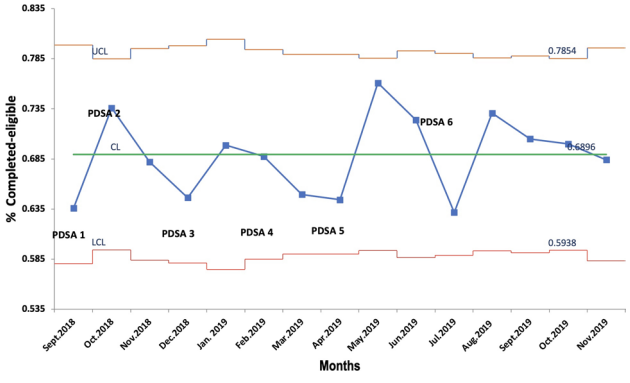

Figure 4 Monthly statistical process control p-chart mammogram screening rates. LCL, lower control limit; PDSA, Plan, Do, Study, Act; UCL, upper control limit.

Balance measures

Increase in wait time

Prior to the implementation of this QI project, the average time spent in the clinic during a follow-up visit was approximately 1 hour. Throughout the course of the project, this time frame remained consistent and did not change significantly. These findings suggest that the implementation of shared decision-making and discussions did not result in noticeable delays or prolonged wait times for patients attending the clinic.

Nurse and physician satisfaction

Physicians reported overall satisfaction and did not feel constrained by time during clinic visits. Similarly, the nursing staff expressed satisfaction with the project and did not report any significant increase in the workload. These observations were gathered through informal feedback and reflection sessions, where anecdotal reports were shared and discussed.

DISCUSSION

This QI study aimed to improve breast cancer screening rates in an academic IMC, specifically targeting the identified gap in screening in a marginalised population. The study used a multifaceted approach to address barriers and enhance screening rates. The interventions included improving access to screening services, providing education to patients and healthcare providers, and leveraging innovative technologies for a streamlined screening process. The study aimed to reduce disparities in screening, particularly among under-resourced populations. By implementing these strategies in the IMC, the goal was to positively impact screening rates, promote early detection and improve treatment outcomes for at-risk women. We exceeded our goal and achieved 66% breast cancer screening rates within 12 months and continued to sustain it during the 3-month period post-project at 69%. We observed a gradual, sustainable increase in mammography completion rates after initial decline during October 2018 (PDSA cycle 2). Decrease in mammogram completion rates may be related to an initial increase in mammogram orders resulting in an increase in workload for the patient navigator to assist with scheduling and tracking completion of mammography. In addition, providers may have ordered mammography during patient visits in October 2018, regardless of the exact month of the patient's actual due date for biennial mammography. Mammography was not scheduled until it was exactly 2 years from the patient's last mammogram date due to insurance regulation; therefore, it may be completed at a later date. We observed variability and decrease in mammogram screening rates during December 2018, March–April 2019 and July 2019. This may be due to the holidays and weather during the winter months. Additionally, a decrease in order rates may be due to new resident physicians in July 2019 at the start of a new academic year and other providers' related barriers.

Numerous studies have demonstrated the effectiveness of patient navigation programmes in improving breast cancer screening rates, reducing disparities and enhancing patient satisfaction.[22–26] These programmes have been particularly successful in reaching under-resourced populations and improving access to screening services. Patient navigators play a crucial role in educating individuals about the importance of breast cancer screening and addressing any concerns or misconceptions they may have. Patient navigators provide assistance with appointment scheduling, transportation arrangements, language interpretation and addressing financial concerns. Patient navigators facilitate communication between patients and healthcare providers, ensuring that patients receive appropriate follow-up care and timely interventions if abnormalities are detected during screening.[26] In 2014, a patient navigation model was implemented to improve breast and cervical cancer screening among homeless women in five shelters and shelter clinics in New York City. The patient navigation approach included opt-out screening, cancer health and screening education, scheduling and follow-up for screening completion, result communication to patients and providers, and care coordination with social services organisations. The findings suggest that patient navigation programmes can help improve screening rates in vulnerable populations.[27] The current study used a patient/nurse navigator who collaborated with patients to create a simplified patient education pamphlet, incorporating their valuable feedback. Through this process, patients were able to identify barriers to screening mammograms. The study identified two significant barriers: knowledge gaps leading to a lack of interest and limited access to transportation. These findings highlight the importance of addressing patient education needs and providing transportation support to overcome barriers and increase the completion of mammograms for breast cancer screening. Patients played an active role in this QI project, engaging in shared decision-making with their physicians regarding breast cancer screening.

Implementing appointment reminder systems through phone calls, text messages or email notifications can help patients stay informed and ensure they do not miss their scheduled screening.[28 29] Ahmed *et al* conducted a study that demonstrated the effectiveness of a stepwise intervention approach in improving mammography rates among hard-to-reach, low-income, insured women.[30] The study found that a prompt letter from the primary care physician and counselling from lay health workers significantly increased the likelihood of breast cancer screening by 80%. These findings highlight the importance of implementing comprehensive interventions to overcome barriers and improve mammography rates in under-resourced populations. This study focused on using phone call communications by patient navigator and an automated call from the mobile mammography bus as a reminder.

Previous studies have explored the use of mobile mammography for early screening and detection of breast cancer. They enhance accessibility to breast cancer screening services by reaching under-resourced populations, including rural areas and urban communities with limited access to healthcare. This increased accessibility contributes to higher screening rates and early detection of breast cancer. Mobile mammography units help reduce patient travel and wait times, making screening more convenient for individuals.[31 32] This study enhanced patients' access to mobile mammography at various locations within under-resourced communities and in the hospital campus.

Providing financial rewards or reimbursements to patients who complete recommended breast cancer screening has shown promising results in improving screening rates. These incentives can include gift cards, cash rewards or reductions in healthcare costs associated with screening.[33] This study included a financial incentive, the hospital-sponsored free raffle tickets for attendance to a National Football League Buffalo Bills game once patients completed mammogram screening. This incentive was offered to complete the screening when they were due or overdue for mammography. Offering patient incentive is not feasible and sustainable in a safety-net clinic with limited resources.

Lessons learnt

The team discovered that the most effective approach to assessing breast cancer screening was to seize every opportunity during any patient encounter, regardless of the type of visit, rather than deferring it to a later date specifically for an annual wellness visit. During the prestudy period, patients were instructed to call the mammography mobile bus and schedule an appointment after a physician ordered a screening mammography. However, patients had many barriers and were not able to schedule this appointment. The QI team proposed a new idea of sharing open appointment slots for our clinic patients with a nurse navigator in the clinic, and appointments were scheduled before patients were discharged from the clinic. This new workflow helped tremendously; patients were appreciative of getting appointment and were able to keep the appointment due to the open-access calendar from the mammography mobile coach. Many patients lost their prescription for a mammogram order; therefore, the clinic administrative staff developed a new process of faxing the mammogram order to the mammography mobile bus. The nurse navigator sent a task to physicians in the EHR to create a mammogram order for due or overdue mammography when patients were not scheduled in the clinic. The team noticed a delay in receiving an order from physicians; therefore, the team designed a new clinic protocol for a standing order for a screening mammogram. The nurse navigator and clinic administrative staff generated the mammogram order and faxed it to the mammography mobile bus. The mammography mobile bus staff reminded patients for a scheduled appointment through automated phone calls and sent letters to reschedule when patients missed their

appointment. The nurse navigator reviewed a monthly list of overdue/due patients, generated by the electronic patient registry and called patients to reinforce the mammogram recommendation and scheduled mammography. Due to limited resources, the nurses were unable to implement workflow for previsit planning to identify patients who were due for mammogram and to create a chart alert for physicians. Regular team meetings with the residents and QI team members led to redesigning of workflow and various interventions. The lack of clinical decision support tool was identified as the biggest barrier.

There are few limitations in this study. The QI project was conducted in a safety-net primary care clinic, focusing on patients with multiple comorbidities. As a result, the barriers and interventions identified may not be directly generalisable to other healthcare settings with different patient populations or resources. The unique characteristics of the safety-net clinic and its patient population may have influenced the study outcomes. The study may have underestimated breast cancer screening rates for two reasons. First, the inability to access mammogram reports performed at outside facilities may have led to incomplete data on completed screening. This limitation may have affected the accuracy of the screening rate calculations. Second, although efforts were made to integrate mammogram reports into the EHR during screening conducted in the mobile coach bus, the process was not consistently successful. Consequently, completed mammogram orders were not captured as structured data, potentially resulting in an underestimation of the screening rates. Time constraints on clinic staff may have hindered the manual completion of mammogram orders and contributed to the inaccuracy in the electronic database.

This study stands out due to the implementation of multifaceted strategies within a unique setting, specifically using a mobile mammography bus to address social determinants of health in a marginalised population. Notably, the project incurred minimal costs, making it a cost-effective initiative. The patient navigator dedicated an average of 4–6 hours per week, ensuring the smooth functioning of the intervention. The study demonstrated internal validity. The clinical workflow and EHR enhancements developed during the project have now become the standard of care for breast cancer screening in IMC. Moreover, hospital and clinic administrative leadership has fostered a patient safety and quality culture. These attributes will ensure the sustainability of this QI project. Offering transportation assistance for mammogram is facilitated by a clinic social worker. In New York state, the Medicaid Transportation Programme ensures patients with Medicaid insurance can get to and from their medical appointments at no cost to them.[34] The social worker assists patients to schedule transportation for a prescheduled appointment to primary care and for necessary testing. Trips are arranged at the most medically appropriate, cost-effective level of service. These include public transit, taxi, wheelchair van and personal vehicle mileage reimbursement. Members generally travel using the same mode they use for daily living. Patients with other insurance who need transportation will have an option of scheduling mammogram within a walking distance from their home in a mobile mammography bus and/or schedule at a time when the patient can get a ride from a family or a friend. These strategies can be feasible and sustainable in the long term to assist patients for appointments to primary care provider and mammogram. Various system-level long-lasting changes in the EHR, clinic operation and workflow are integrated as a standard of care and will be sustainable.

The success of these strategies suggests their potential for replication in other healthcare settings, particularly those serving under-resourced populations. During the post-study period, the team organised a fair and educational workshop in the hospital to raise breast cancer awareness among patients, visitors and employees. Future directions for this project involve assessing barriers for patients' refusal, implementing motivational interview techniques to help physicians overcome barriers to screening mammograms, enhancing patient education through educational videos and conducting outreach to eligible patients who were lost to follow-up in the IMC. These future directions highlight the team's commitment to continuous improvement and population health management.

CONCLUSIONS

In conclusion, this study demonstrates the effectiveness of multifaceted strategies, including the utilisation of a mobile mammography coach bus, in advancing health equity to improve breast cancer screening rates. Use of a patient navigator, optimisation of EHR, improving access by using a mobile mammography bus and highly engaged multidisciplinary team were the critical factors for the success of this QI study. The findings contribute to the growing body of knowledge on breast cancer screening interventions and provide valuable insights for future QI projects in healthcare.

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Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not required.

Ethics approval This study was approved by the Human Subjects Institutional Review Board (HSIRB) of the University at Buffalo and was exempt from patient consent. The work was deemed a quality improvement project and not a study on human subjects.

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