# Get a Clue – On Surveying Techniques, Menstrual Habit Loops, and FemTech for the Sustainable Future of Breast Self-Exam (BSE)

by

Cara Elvira Salvatore

An honors thesis submitted in partial fulfillment

of the requirements for the degree of

Bachelor of Science

Undergraduate College

Leonard N. Stern School of Business

New York University

May 2017

| | |
|---|---|
| Professor Marti G. Subrahmanyam | Professor Tom Meyvis |
| Faculty Adviser | Thesis Adviser |

**Acknowledgements**

Professor Tom Meyvis – Thank you so much for acting as my advisor this past year; for sharing your knowledge of and experience with research into consumer behavior so that I would have all the tools necessary to carry out my own vision.

Professor Marti Subrahmanyam – Thank you for establishing the honors program, facilitating opportunities for us, and pushing me to believe in the potential of my research.

Dr. Mary Salvatore – Thank you, Mom, for taking the time to teach me an entirely different field of study just as I approached graduation from business school. It was a pleasure working with you and getting to know you in a new light. I will be forever thankful for the chance we had to get to know each other as professionals and partners, and for the impact your education had on my research.

My family and friends – Thank you for the years of support, love, and encouragement you have given me leading up to this point. I am the fierce, determined, unstoppable woman I am because I learned at a young age to believe in myself.

## Abstract

This study began with the observation that widespread breast cancer awareness and pink-washing of consumer packaged goods are not leading to women's improved awareness of their own individual breast health. After considering a number of environmental factors deterring women from breast self-exam and reducing its accessibility, data were collected from 855 mammogram patients at Mount Sinai Hospital from October 16, 2015 – November 30, 2015. The patients' self-reported breast exams were compared to the results of their mammograms to test for diagnosticity, an indicator of general effectiveness of the breast self-exams. The self-exam sheets note the symptoms a woman is feeling in her breasts and the associated patient files provide zip codes, mammogram history, and breast density information to track related trends. Within the sample, the breast-self exam was often counter-diagnostic of mammogram results. Income, age, and ethnicity also could not predict breast self-exam accuracy, which suggests that breast health must be treated on a more personal level. Due to the limited frequency of any positive mammogram results in the study, most findings for the breast self-exam are not significant. Both breast density and whether a patient is visiting for her first mammogram better indicate whether her mammogram will be positive than what she marks on her breast self-exam; these differences in diagnosticity are significant. The research ultimately validates the need for similar research on a larger scale that tests each environmental factor individually. It also reaffirms the Susan G. Komen Center's recommendation against continued breast self-exam in favor of more personal breast health awareness developed over time.

**Table of Contents**

**Get a Clue – On Surveying Techniques, Menstrual Habit Loops, and FemTech for the Sustainable Future of Breast Self-Exam (BSE)**

## Introduction

In the locker rooms of the hippest boutique fitness clubs, as pink mini cupcakes in the city's trendiest baked goods chains, and through branded content at top department stores, metropolitan communities have embraced the importance of breast cancer awareness (Appendix A). Despite its omnipresence in pop culture, the topic of breast self-exam has spurred significant debate, especially as it pertains to young women. A study quoted by the *New York Times* suggested physical breast exams make more of a difference in early detection of breast cancer than mammograms. The insight was caveated, however, by a disclaimer reading "if it was performed well and was accompanied by the teaching of breast self-exam."[1] A study cited by *The Atlantic* used the same caveat to warn against the promotion of breast self-exam, instead offering more general "breast-cancer awareness," because cancer is better detected by a perception of change in your own body than by a list of generic indicators. This study showed mammograms reducing breast cancer mortality in women 39 to 49 years old by fifteen percent over breast self-exam.[2] Further research sourced by the Journal of the American Association of Nurse Practitioners explained that young women conducting breast self-exam on developing breast tissue, not understanding true causes of concern, end up receiving carcinogenic diagnostic procedures without sufficient justification.[3]

---

[1] Roni Caryn Rabin, "A Fresh Case for Breast Self-Exam," *The New York Times*, February 17,
[2] Olga Khazan, "You Don't Have to Feel Your Breasts," *The Atlantic,* October 24, 2014, accessed February 8, 2017, http://www.theatlantic.com/health/archive/2014/10/breast-self-exams-are-meaningless/381834/.
[3] Carolee Polek and Thomas Hardie, "Are changes in breast self-exam recommendations and early misperceptions of breast cancer risk increasing women's future risks?" *Journal of the American Association of Nurse Practitioners,* 2015, 379-386.

Conducting informative research for consumer, or patient, insights requires first asking the right questions. The most apparent red flag in Mount Sinai's Mammography Patient Information Questionnaire derives from its failure to speak to the respondent in her own language.[4] It asks women questions such as whether or not they experience "large lymph nodes," to which the patient could not have an answer from lack of understanding or having never properly self-examined herself. Embarrassment in this context could further prevent the patient from answering honestly and instead lead her to respond randomly or under the assumption nothing is wrong. Beyond assessing the effectiveness of patient participation in the questionnaire given limited knowledge and survey response biases, I plan to assess the importance of participation more generally and whether or not it produces added benefits of increased overall patient investment in personal breast health.

This research study aims to look forward with actionable literature and data-driven insights rather than simply critique the current controversy around breast self-exam. For this reason, research and applications are not limited to the exam sheet itself but expand into surrounding socioeconomic conditions and consumer culture. The research starts by considering current intersections of women, technology, and health care, then ultimately concludes with applications of these intersections to breast awareness and health given insights from the data of 1,000 Mount Sinai mammography patients who completed breast self exam written assessments. The discrepancies in women's breast self-exams versus mammogram results will suggest breast awareness over time, facilitated by FemTech, as a better alternative to traditional breast self-exam.

---

[4] Rick Penwarden, "5 Common Survey Question Mistakes That'll Ruin Your Data," *SurveyMonkey Blog,* February 11, 2015, accessed December 7, 2016. https://www.surveymonkey.com/blog/2015/02/11/5-common-survey-mistakes-ruin-your-data/.

## Literature Review

### *Promotion of Cancer Awareness With Breast Self-Exam Causes Harmful Framing Effects*

Before assessing the validity and effectiveness of breast self-exams, it is important to understand the historical context in which they are conducted. Breast self-exams originated in 1930 with the explicit purpose of early detection of breast cancer, rather than to promote more general breast health. Medical professionals first contested their effectiveness in 1970 and the debate continues today (Appendix C). Only in 2014 did the Susan G. Komen Center stop recommending monthly breast self-examination. Even earlier in 2004, with breast cancer ranking the "second leading cause of cancer deaths in women," only one third of women conducted the exam regularly.[56]

The phenomenon of low participation for early prevention stems from terror management theory, the notion that humans' unique awareness of their mortality coupled with interests in self-preservation lead to "extreme anxiety, or terror." A study from the *Journal of Experimental Social Psychology* explains terror management as relevant to breast self-exam because the experience "leads a woman to confront her physicality" as she remains acutely aware of the purpose to detect potentially life-threatening cancer. In the experiment, a misattribution cue was implemented to distract patients from the real source of their discomfort, death-related thoughts around breast self-exam. These patients conducted "longer (and presumably more thorough)" self-exams than the patients with undistracted screening anxiety.[7] Although conducting a breast

---

[5] Circuelle Foundation, "The Mystery Uncovered: Breast Self-Exams," *Circuelle Foundation,* July 18, 2014, April 26, 2017. *http://www.circuellefoundation.org/blog/item/the-mystery-uncovered-breast-self-exams.html)*

[6] Jamie L. Goldenberg, Jamie Arndt, Joshua Hart, Clay Routledge, "Uncovering an Existential Barrier to Breast Self-Exam Behavior," *Journal of Experimental Social Psychology,* March 2008, April 26, 2017. *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2276308/#R19*

[7] Ibid.

self-exam does not give the performer cancer, this anxiety can misconstrue diagnosticity for causality and deter women from any level of comfort or interaction with their breasts.

The theory of framing effects ultimately suggests that historically associating breast self-exam with sickness rather than health leads to risk-seeking responses. A patient will not conduct self-exam because she knows it could lead to a diagnosis of cancer, while she would more likely conduct the exam if it could lead to a diagnosis of good health. These alternative wordings suggest the same set of outcomes, but a test subject will more likely seek risk and in this case, non-compliance, when breast self-exam is presented as an opportunity for loss.[8]

***Personal Breast Awareness Over Breast Self-Exam Unnecessarily Perpetuates Recall Bias***

As mentioned earlier, the current discourse around breast self-exam suggests instead that women strive for broader breast awareness. In a pop culture article for *SELF* Magazine, Susan G. Komen Center suggests we not consider breast self-exam as a screening measure because its tendency to return false positive results means twice as many negative, independently carcinogenic biopsies as necessary. The article at the same time notes women must be "familiar with how their breasts…look and feel and report any changes."[9] While at the surface this may remove the issue of self-exam associations with cancer, non-profits established to fight breast cancer are among the leading proponents of the shift. Their involvement perpetuates the same connotations of sickness while also creating further confusion around what it means for a woman to exercise effective breast health.

---

[8] Shlomi Sher and Craig R.M. McKenzie, "Framing Effects," *Psychology Dept. University of California San Diego*, n.d., accessed April 26, 2017. http://psy2.ucsd.edu/~mckenzie/SHERMCKENZIEFRAMINGEFFECTSFINAL1.pdf

[9] Zahra Barnes, "Why You Should Touch Your Boobs More Often," *SELF Magazine,* October 3, 2016, accessed April 26, 2017. http://www.self.com/story/breast-self-exams

An awareness regiment based on a woman's knowledge of herself versus knowledge of standard breast cancer symptoms also necessitates forced recall. The need to track changes in the breast over time is made more difficult because indications of breast cancer "can be extremely subtle and easy to miss."[10] Evaluating the past amidst the context of a present breast self-exam or to more generally prevent breast cancer also increases anxiety around the act, as explained in the previous section, which goes to further distort recollection. An informational on recall bias notes, "Memories can also be distorted by shock…stress…or other conditions that affect the brain."[11] Because a surveyor or patient cannot retroactively adjust for this bias, the survey designer or data collector must ensure an appropriate collection method to mitigate risk.

Women are already accustomed to tracking their bodies' rhythms and changes as they relate to reproductive health. The Always Company, a menstrual products subsidiary of Procter & Gamble, uses its website to explain the importance of a "Period Calendar" and tracking your menstrual cycle for women. The blog reads, "Charting gives you more control over your own reproductive health," and it cites the importance of recording "cramps, mood changes, changes in your vaginal discharge, pain … or other symptoms" beyond the period start and stop dates.[12] Recording rather than attempting to remember gives women the confidence to report back to their doctors accurately when asked about their most recent menstrual cycle. Recording periods may also meet greater success rates than current breast self-exam because it is not marketed as sickness preventing, but instead as health promoting. This shift is not because menstrual cycles lack associations with cancer prevention; irregular menstrual periods could actually suggest

---

[10] Ibid.
[11] Andale, "Recall Bias: Definition, Examples, Strategies to Avoid It," *Statistics How To*, November 11, 2016, accessed April 26, 2017. http://www.statisticshowto.com/recall-bias/
[12] "Period Calendar – Why Track Your Menstrual Cycle?" *Always*, n.d., accessed April 26, 2017. http://always.com/en-us/tips-and-advice/your-first-period/period-calendar-why-track-your-menstrual-cycle

ovarian cancer.[13] Perhaps because a woman's menstrual cycle creates more day-to-day implications for her life than breast awareness, related businesses and interest groups do not see a need to promote the period calendar's more serious implications.

Among overlooked benefits of menstrual cycle tracking include its implications for breast health. Mount Sinai Hospital's public information on breast health advises women to conduct breast self-exams three to five days after their periods, when "your breasts are not as tender or lumpy," so as to more readily identify abnormalities.[14] This information does not appear, however, in informational packets on menstrual cycles. The resultant disconnect suggests a potentially untapped opportunity based on already established habit loops around menstruation. According to The Marketing Society, habits form when a trigger or cue promotes a routine that ultimately produces a reward. The habit forms, often subconsciously, to automatically increase life efficiency.[15] Consumer packaged goods like Febreeze have used this science to turn their products from failures into successes. In order to remind customers to use Febreeze, it was marketed as the reward you spray after cleaning a room, the act that became the cue. [16] In terms of the menstrual cycle, for instance, early onset of cramps may prompt a woman to purchase feminine hygiene products so she is prepared. Relating a woman's menstrual cycle and

---

[13] Lindsey Konkel, "Irregular Periods Could Boost Ovarian Cancer Risk," *Science,* April 22, 2016, accessed April 26, 2016. http://www.sciencemag.org/news/2016/04/irregular-periods-could-boost-ovarian-cancer-risk

[14] "Breast Self-Exam," *Mount Sinai Health Library*, n.d., accessed April 26, 2017. http://www.mountsinai.org/health-library/special-topic/breast-self-exam

[15] Crawford Hollingworth and Liz Barker, "How Habits Form," *Habits The Holy Grail of Marketing* (n.d.): 6-8, accessed April 26, 2017. https://www.marketingsociety.com/sites/default/files/thelibrary/Habits%20-%20The%20Behavioural%20Architects_2.pdf

[16] Charles Duhigg, "Warning: Habits May Be Good for You," *The New York Times,* July 13, 2008, accessed May 9, 2017. http://www.nytimes.com/2008/07/13/business/13habit.html?pagewanted=all

symptoms to purchasing behavior could have predictive value for how to best encourage breast observation as routine within the already established cycle (Appendix D).

***Habits Form at Puberty While Breast Awareness and Education Do Not***

A major problem arises associating breast self-exam with breast cancer prevention because it increases the age of the target demographic for the message when pre-pubescent girls may actually prove the best listeners. As mentioned earlier, young women are often advised against breast self-exam because developing breast tissue makes it difficult to distinguish what masses should and should not cause concern, leading to unnecessary, potentially harmful procedures.[17] While this may be true, girls around the age of puberty also stand the best chance of adopting healthy breast awareness practices long-term. Digital marketing group Optimum 7 explains this phenomenon more broadly in relation to brands and marriage. Similarly to marriage, a consumer breaks loyalty with a brand when another brand's incentives meet a newly identified personal need or when the initial brand stops delivering as expected.[18] This notion applies equally to habits and switching costs, as an individual will most likely make switches in his or her behaviors when life changes dictate he or she must do so. If a girl is taught at a young age that part of dealing with her menstrual cycle involves observing her breasts, she may more likely adopt the new habit out of perceived necessity than an older woman who believes she already understands her body and has an adequate system in place for its maintenance.

The Get in Touch Foundation launched by Mary Ann Wasil uses a "Daisy Wheel" (Appendix E) to teach girls in grades 5-12 "the importance of, and how to do, a breast self

---

[17] Carolee Polek and Thomas Hardie, "Are changes in breast self-exam recommendations and early misperceptions of breast cancer risk increasing women's future risks?," 379-386.
[18] "Love and Marriage, Go Together Like Brands and Customers?" *Optimum 7*, December 5 2014, accessed April 26, 2017. https://www.optimum7.com/internet-marketing/brand-development/love-and-marriage-go-together-like-brands-and-customers.html

exam."[19] Her efforts led to laws in Connecticut requiring public schools to incorporate breast health into students' curricula; Connecticut is also the state with the highest breast cancer survival rates and higher screening rates than most states.[20] Unfortunately, the Get in Touch website has not posted since 2013 and the Daisy Wheel app no longer appears in the app store. Mary Ann Wasil originally justified teaching young girls breast health because it creates the ideal baseline for future comparison.[21] Without recording changes over time as previously mentioned, and without extending these improvements to breast health to other states, races, and income brackets, Wasil's improvement only perpetuates the better health of the upper classes.

***Breast Self-Exam is Not One Size Fits All, but FemTech Can Be***

Wasil likely found success in Connecticut because the public schools in state can afford new health programs for breast awareness. In Wasil's hometown of Milford, Connecticut, the average household income is $95,022, compared to the Connecticut average of $71,346 and the US average of $55,775 in 2015.[22][23] Although women approach breast self-exam and overall breast health with different degrees of understanding and education, the exam does not reflect these differences. This phenomenon is apparent at both the national and international levels, as "more than 70% of all cancer deaths in 2005 occurred in low- and middle-income countries,"

---

[19] Mary Ann Wasil, "About the Founder," *The Get in Touch Foundation*, n.d., accessed April 27, 2017. http://getintouchfoundation.org/about-us/about-mary-ann-wasil/

[20] Peter Hvizdak, "New Connecticut Law Requires Breast Health Education to be Taught In Public Schools; Milford Senator Cheers," *The Middletown Press*, October 5, 2016, accessed April 27, 2017. http://www.middletownpress.com/article/MI/20161005/NEWS/161009782

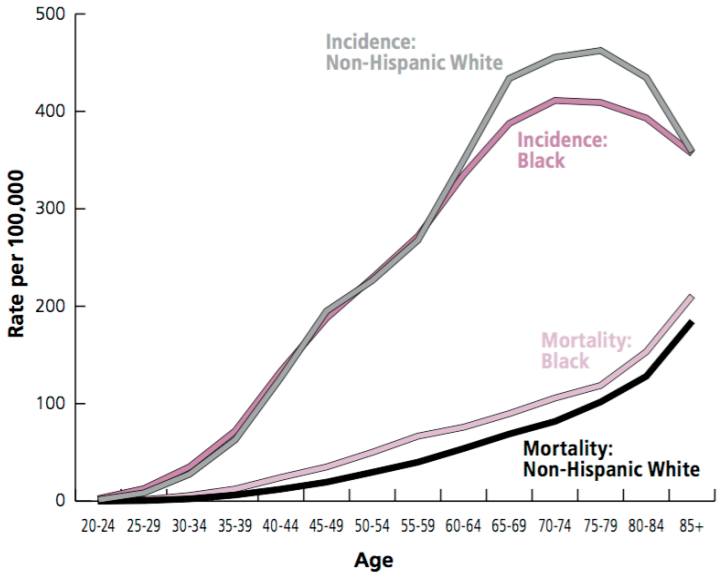
[21] Wasil, "About the Founder."

[22] "06460 Income Statistics," *Income By Zip Code*, 2017, accessed April 27, 2017. https://www.incomebyzipcode.com/connecticut/06460

[23] "Connecticut Household Income," *Department of Numbers*, 2015, accessed April 27, 2017. http://www.deptofnumbers.com/income/connecticut/

with breast cancer ranking as the most frequent cancer occurrence among women.[24] An American Cancer Society paper highlights further demographic differences in mortality rates from and interaction with breast cancer. It notes the majority of new cases occur from ages 50-69 in the US, and that while incidence rates are higher among non-Hispanic white women than black women, mortality is higher among black women (Figure 1, Table 1).[25]

**Figure 1. Age-specific Female Breast Cancer Incidence and Mortality Rates, US, 2008-2012**




**Sources:** Incidence: North American Association of Central Cancer Registries (NAACCR), 2015. Mortality: US mortality data, National Center for Health Statistics, Centers for Disease Control and Prevention.

American Cancer Society, Inc., Surveillance Research, 2015

[24] L. Abu Sharour BSN, MSN, PhD, Associate Professor et al. "Predictors of Breast Self-Examination Performance Among Jordanian University Female Students," *Wiley European Journal of Cancer Care* (November 2016): 1. doi: 10.1111/ecc.12622

[25] American Cancer Society, "Breast Cancer Basic Facts," *Breast Cancer Facts & Figures 2015-2016*, 2015, accessed April 27, 2017. https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2015-2016.pdf

**Table 1. Estimated New Female Breast Cancer Cases and Deaths by Age, US, 2015***

| Age | In Situ Cases | Invasive Cases | Deaths |
|---|---|---|---|
| <40 | 1,650 | 10,500 | 1,010 |
| 40-49 | 12,310 | 35,850 | 3,690 |
| 50-59 | 16,970 | 54,060 | 7,600 |
| 60-69 | 15,850 | 59,990 | 9,090 |
| 70-79 | 9,650 | 42,480 | 8,040 |
| 80+ | 3,860 | 28,960 | 10,860 |
| **All ages** | **60,290** | **231,840** | **40,290** |

*Rounded to the nearest 10.

American Cancer Society, Inc., Surveillance Research, 2015

Technology offers the greatest opportunities for equal access to breast health education because it eliminates the need for funding for large-scale education initiatives, instead imparting knowledge on a more individual level. The solution is not perfect: in developing countries only one in ten people have regular internet access, most of whom are wealthy and male. Still, the UN's recognition of Internet access as a human right in 2016 suggests continued emphasis on progress in this arena.[26] Of particular interest to breast awareness and education is the growing field of FemTech, meaning "female technology." This subsection of tech struggled to take off a few years ago; breast cancer mobile phone apps failed to meet usability recommendations and therefore went underutilized.[27] In 2017, predominantly women-led companies are creating healthcare and consumer-driven apps for female health concerns such as period tracking and birth control reminders, and top investors are funding their endeavors. A *Forbes* article adds,

[26] Tim Sandle, "UN Thinks Internet Access is a Human Right," *Business Insider*, July 22, 2016, accessed April 28, 2017. http://www.businessinsider.com/un-says-internet-access-is-a-human-right-2016-7

[27] Tamar Ginossar et al. "Content, Usability, and Utilization of Plain Language in Breast Cancer Mobile Phone Apps: A Systematic Analysis," *JMIR MHealth and UHealth* (2017): 1.

"Nine female-focused digital-health companies raised $82 million through the third quarter of 2015, up from $29 million in 2014."[28]

A popular period-tracker called Clue specifically received a $20 million investment from Nokia Growth Partners.[29] Founder Ida Tin did not build the app for women specifically, rather she designed it "for happiness, rapid data entry, and to help in the discovery of accurate insights."[30] Screenshots from within the app show its functionality extends beyond period tracking alone, leaving room for easy incorporation of features related to breast health (Figure 2). Apps such as Clue resolve previously discussed issues such as recall bias without necessitating too much effort. In a Boston-based study for breast health a researcher explain that eighty-one percent of women wanted a reminder system, not further education.[31] Customizable FemTech apps reinforce the importance of personal awareness over generic solutions to women's health.

---

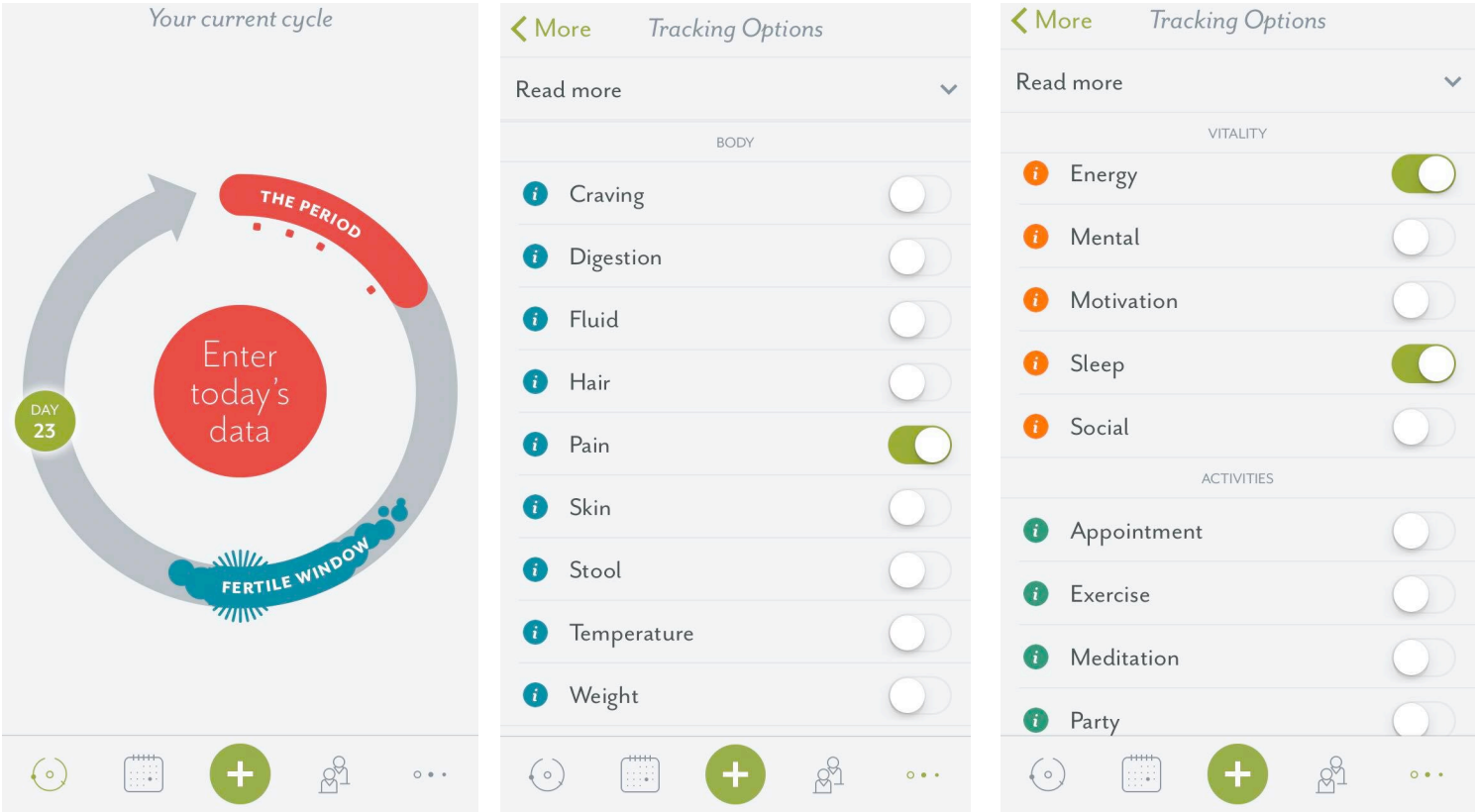
[28] Jill Richmond, "The New Year of Optimism for Femtech," *Forbes*, December 21, 2016, accessed April 28, 2017. https://www.forbes.com/sites/jillrichmond/2016/12/31/the-new-year-of-optimisim-for-femtech/#7338d2454c97

[29] Sarah Buhr. "Period Tracking App Clue Pulls in $20 Million Series B from Nokia Growth Partners," *TechCrunch*, October 30, 2016, accessed April 28, 2017. https://techcrunch.com/2016/11/30/period-tracking-app-clue-pulls-in-20-million-series-b-from-nokia-growth-partners/

[30] Charmaine Li, "A Close-Up of Clue, the Startup That Aims to Help Women Make Sense of Their Fertility Cycle," *Tech.Eu*, September 5, 2014, accessed April 28, 2017. http://tech.eu/features/2607/clue-app-profile-ida-tin/

[31] S Berger, CC Huang, CL Rubin, "The Role of Community Education in Increasing Knowledge of Breast Health and Cancer: Findings from the Asian Breast Cancer Project in Boston, Massachusetts," *J Cancer Education,* September 15, 2015, accessed April 28, 2017. https://www.ncbi.nlm.nih.gov/pubmed/26373418

*Figure 2* Clue App Interface




## Fieldwork Review

### *General Issue*

The review of contemporary breast health and marketing literature revealed several obstacles and opportunities related to breast self-exam. Breast self-exam's strict associations with cancer rather than general breast health create framing effects that incite fear and deter women from conducting breast self-exam at all. Moving away from breast self-exam toward general breast health awareness could mitigate these negative associations, but this shift also introduces the new problem of recall bias. While a woman conducting breast self-exam must identify lumps, nodes, nipple discharge, and other symptoms in the moment, breast awareness means tracking less defined changes over time. Looking backward at personal health while

thinking forward to the potential discovery of breast cancer increases a woman's anxiety and further limits the accuracy of her memory. Women have successfully implemented written records to track their reproductive cycles and this act for many is habitual. Although breast health is relatable to the menstrual cycle, this link remains underpublicized. Technology around period tracking similarly neglects opportunities to incorporate breast health. Today, at the cusp of the FemTech revolution, hospitals continue collecting generic, paper breast self-exam forms from patients scheduled for mammograms. These forms play a minimal role and live untouched in hospital databases. This research questions the value of the breast self-exam in terms of diagnosticity and aims to improve on its usefulness given other advances in women's health.

***Question***

Are breast self-exams indicative of breast cancer, based on their correlation with actual mammogram results? How does an individual's profile (age, income, geographic location, clinical history) impact the predictive validity of the self-exam?

***Research Questions***

1. To what extent are breast self-exams diagnostic of breast cancer?
2. To what extent is the diagnostic potential of breast self-exam influenced by income?
3. To what extent is the diagnostic potential of breast self-exam influenced by ethnicity?
4. To what extent is the diagnostic potential of breast self-exam influenced by age?
5. To what extent is the diagnostic potential of breast self-exam influenced by prior mammogram experience?
6. To what extent is the diagnostic potential of breast self-exam influenced by breast density?

***Procedure***

The above hypotheses were tested on data collected from 1,000 Mount Sinai patients' breast self-exam sheets from October 16, 2015 through November 30, 2015 with the assistance of Mount Sinai's Radiology department. Because several patients' records were deemed highly classified, only data from 855 of the 1,000 patients recorded were usable. The physical exam sheet, shown in English in Appendix B, asks women to record their breast symptoms among seven options (lump or thickening, large lymph nodes, pain or tenderness, infection or inflammation, recent breast injury, nipple discharge, and other nipple abnormality) as appearing on the left, right, both, or neither breast. Another section asks to indicate any previous breast biopsies or procedures, which for the purposes of this experiment were only considered as "surgery," or "no surgery" if the patient left the section blank.

These data were obtained through the hospital databases, which store self-exam sheets with patient's digital records. The data were codified and transferred to Excel, and then patient records were used to retrieve demographic information such as age, zip code, and ethnicity. Age was grouped into patients 0-49 years old, 50-64 years old, and 65+ years old in order to have enough data for each age bracket. Zip codes were used first to obtain average household income for each patient studied, and then these incomes were grouped into five brackets of $50,000 ending with $200,000+. Records also made note of breast density. The four categories of breast density include 0-25%, 26-50%, 51-75%, and 76-100%.

Mammogram results were the final addition to the data, used to determine whether a woman's self-exam was indicative of actual health concerns. Ratings of 0-6 were given for the final mammogram result and these designations determined whether or not the patient's study was considered negative (no cancer) or positive (cancer). A final mammogram score of zero

meant incomplete, one meant no findings, two meant benign findings, three meant probably benign, four meant suspicious, five meant very suspicious, and six meant cancer. Results three through six were considered a positive mammogram, meaning a mammogram with a significant finding, while 0s, 1s, and 2s were considered negative mammograms findings. All physical exam sheets were considered positive that marked occurrence of any listed symptom. After analyzing the breast self-exam sheet with subsequent mammogram results, mammogram history and breast density were considered independently for their ability to predict mammogram results.

Before manipulating the data, the data were cleansed of all personally identifiable information from the patients so as not to breach HIPAA confidentiality. Data manipulation included tracking the individual predictive power of each symptom on the breast self-exam sheet, grouping zip codes into income brackets to track success rates across socioeconomic levels, comparing the success rates of Spanish and English self-exams, and assessing the data for success rates across age ranges, breast history, and breast density.

Among the most important considerations in this experiment were comparisons between false negative and true positive results, meaning the differences between women who felt nothing but produced positive mammogram findings and women who felt something then produced mammogram results similarly indicative of cancer. A false positive alternatively noted something on breast self-exam but her mammogram returned negative, while a true negative marked nothing on her breast self-exam and her mammogram was also negative. The ultimate goal for analyzing these differences was to conclude with improvements for breast awareness and potentially for breast self-exam, based on identified response patterns.

***Data Collection and Findings (Appendix F)***

Form Diagnosticity

| Mammogram (M) | BSE − | BSE + |
|---|---|---|
| − | True Negative [neg., unmarked] | False Positive [neg., marked] |
| + | False Negative [pos., unmarked] | True Positive [pos., marked] |

$$P(M^+ \mid BSE^-) = \frac{FN}{(FN + TN)} \qquad P(M^+ \mid BSE^+) = \frac{TP}{(TP + FP)}$$

$$\mathbf{P(M^+ \mid BSE^-) < P(M^+ \mid BSE^+)}$$

| *BSE Overall* | | BSE Unmarked (n = 773) | BSE Marked (n = 82) |
|---|---|---|---|
| M | − | 696 | 77 |
| | + | 77 | 5 |

| BSE Overall | Not Marked (n = 773) | Marked (n = 82) |
|---|---|---|
| *P (M+)* | 10.0% | 6.1% |

| *Pain* | | Pain Unmarked (n = 788) | Pain Marked (n = 67) |
|---|---|---|---|
| M | − | 709 | 64 |
| | + | 79 | 3 |

| Pain | Not Marked (n = 788) | Marked (n = 67) |
|---|---|---|
| *P (M+)* | 10.0% | 4.5% |

| | | |
|---|---|---|
| **Lumps** *P (M+)* | *Not Marked (n = 843)* 9.7% | *Marked (n = 12)* 0.0% |
| **Nodes** *P (M+)* | *Not Marked (n = 849)* 9.7% | *Marked (n = 6)* 0.0% |
| **Infection** *P (M+)* | *Not Marked (n = 852)* 9.6% | *Marked (n = 3)* 0.0% |
| **Trauma** *P (M+)* | *Not Marked (n = 854)* 9.6% | *Marked (n = 1)* 0.0% |
| **Discharge** *P (M+)* | *Not Marked (n = 845)* 9.5% | *Marked (n = 10)* 20.0% |
| **Surgery** *P (M+)* | *Not Marked (n = 696)* 9.8% | *Marked (n = 159)* 8.8% |

Out of 855 patients, only 82 marked any symptoms on their breast self-exam forms and only 82 returned with positive mammogram findings, though these 82 patients did not perfectly overlap. Insufficient marked forms and positive data meant that a regression could not produce actionable results and the data could not adequately represent the population at large, however, a

more basic statistical analysis produces noteworthy observations. With each category tested, the probability of a positive mammogram given a negative self-exam, also known as a false negative, was tested against the probability of a positive mammogram given a positive self-exam, or true positive. A positive mammogram meant a mammogram with a finding suggestive of cancer and a positive self-exam meant one where a woman indicated any symptom at all as occurring with her breasts. The formulas for the probability calculations can be found above, with the stated goal of probability for false negative being less than probability for true positive. Part of symptom recording from the breast self-exam became recording the percentage of times noting a particular symptom actually led to a positive mammogram. Only indicators of nipple discharge had a higher occurrence of positive mammograms than those who did not indicate nipple discharge, 20.0% versus 9.5%. This finding, however, produced an insignificant p-value. For other symptoms, marking their occurrence on the breast self-exam sheet proved contraindicative of mammogram results. This contraindication was present for prior surgery/biopsy, though the findings were similarly insignificant, and for pain. A possible explanation for this phenomenon is that while nipple discharge is a readily observable, in-the-moment phenomenon, a symptom like pain requires multiple past points of reference in order to establish deviations from the norm. The occurrence rates of marking these symptoms lingered mostly around 1% of the sample population, suggesting most patients do not fill out the in-office self-exam in its entirety, or truly believe nothing is wrong. Aside from surgery, the most commonly cited symptom by patients was pain, noted by 7.8% of the sample. Symptoms like lumps, trauma, nodes, and infection could not be tested because when these symptoms were marked none of the sample population included had positive mammogram results. The occurrences of false negatives above true positives, although not substantial enough to directly

apply to the population beyond the sample, suggests we at least take seriously new recommendations in favor of personal breast awareness over generic self-exam guidelines. The best way to properly observe your breasts for inconsistencies is to do so over time, not as isolated exam experiences.

*(The following data sections are organized into separate demographics or qualifiers and concurrent diagnosticity of breast self-exam based on the probabilities of false negative versus true positive results within the segments.)*

Income Diagnosticity

| **Income 1** | *Not Marked (n = 147)* | *Marked (n = 20)* |
|---|---|---|
| *P (M+)* | 4.8% | 0.0% |

| **Income 3** | *Not Marked (n = 81)* | *Marked (n = 3)* |
|---|---|---|
| *P (M+)* | 14.8% | 0.0% |

| **Income 2** | *Not Marked (n = 473)* | *Marked (n = 50)* |
|---|---|---|
| *P (M+)* | 10.6% | 10.0% |

| **Income 4** | *Not Marked (n = 35)* | *Marked (n = 5)* |
|---|---|---|
| *P (M+)* | 17.1% | 0.0% |

| **Income 5** | *Not Marked (n = 36)* | *Marked (n = 4)* |
|---|---|---|
| *P (M+)* | 5.6% | 0.0% |

After recording the zip code of each patient in the sample and the corresponding average household income, the zip codes were mapped to determine the location of the sample. As expected, the majority of patients came from neighborhoods around New York City, though a few cited zip codes beyond the tri-state area (Appendix G). The zip codes were then grouped into five segments of $50,000 intervals ending at $200,000+ (Appendix H). It is important to note, however, that the lowest average household income in the study was still above $31,000, meaning the sample could not accurately report on breast self-exam conditions for those in extreme poverty within the United States or globally. The second income bracket of $50,000 to $99,999 accounted for an overwhelming majority of the sample, 523 out of 855 patients. This was the only group with usable findings because it was the only group that produced any positive

mammogram results with marked breast self-exams. Still, within the second income bracket breast self-exam was counter-diagnostic and insignificant. The three middle-income brackets also shared relatively similar occurrence rates of positive mammogram results, suggesting risks of breast cancer plague women across income levels and that solutions must uniquely address the needs of each group in terms of access and education. The fact that discrepancies existed in self-exam and mammogram across income levels suggests, similarly to the previous section, that more personal breast awareness may better serve diverse populations than generic self-exam guidelines.

Language Diagnosticity

| **English BSE** | *Not Marked (n = 587)* | *Marked (n = 70)* |
|---|---|---|
| *P (M+)* | 10.2% | 4.3% |
| **Spanish BSE** | *Not Marked (n = 186)* | *Marked (n = 12)* |
| *P (M+)* | 9.1% | 16.7% |

Breast self-exam forms at Mount Sinai are only administered in English and Spanish. This study used those two options to identify Hispanic and Non-Hispanic patients among the sample. The Spanish form, used by 198 of the 855 patients in the sample, led to more true positives and fewer false negatives than the English form while both populations saw equal occurrence of positive and negative mammogram results in general. The breast self-exam is diagnostic within the sample for Spanish-speaking patients and counter-diagnostic for English-speaking patients, but the sample is too small to imply anything significant about larger Spanish and English-speaking populations (Appendix I). It is still important to note that although Hispanic people report with greater accuracy and therefore have arguably heightened breast awareness, which would ideally mean fewer instances of breast cancer in the population, their

rates of positive mammograms equal those of Non-Hispanics. This finding goes toward the point that breast self-exam may not test the right qualities, or that its success rates may be inflated because nothing can be done to treat some findings. It should not be used make inferences about income levels' correlations with true or false positive results without accumulation of more data and research into the average household incomes of these patients.

Age Diagnosticity

| | | |
|---|---|---|
| **Age 0-49** | *Not Marked (n = 186)* | *Marked (n = 26)* |
| *P (M+)* | 14.5% | 7.7% |

| | | |
|---|---|---|
| **Age 50-64** | *Not Marked (n = 321)* | *Marked (n = 42)* |
| *P (M+)* | 8.7% | 7.1% |

| | | |
|---|---|---|
| **Age 65+** | *Not Marked (n = 268)* | *Marked (n = 12)* |
| *P (M+)* | 8.2% | 0.0% |

The plurality of 42.5% in the 50-64 years old age bracket makes sense given the new American Cancer Society guidelines to begin conducting mammograms every other year at age 50, no longer at 40. Across age segments no individual group outperformed false negatives with true positive results. This suggests, at least among the sample, that years of experience with breast self-exam do not improve accuracy. This finding is limited, however, by the fact that the youngest woman in the study was twenty-three and an outlier, with the next youngest age marked as thirty-six years old. It is also impossible to tell whether old women in the sample have completed more breast self-exams than the younger women studied. Findings related to age and occurrences are concurrent with reports from the American Cancer Society that the majority of

new cases of cancer occur around ages 50-69. [32] In order to know with greater certainty whether very young women could accurately perform breast self-exam, the sample population would need more participants in their teens. As teenagers do not typically receive mammograms, this prompts considerations of other potential data sources.

Mammogram History Diagnosticity

| | | |
|---|---|---|
| **First Mammo** | *Not Marked (n = 134)* | *Marked (n = 16)* |
| *P (M+)* | 22.4% | 25.0% |

| | | |
|---|---|---|
| **Not First Mammo** | *Not Marked (n = 639)* | *Marked (n = 66)* |
| *P (M+)* | 7.4% | 1.5% |

Similarly to age, comparing patients for whom this was their first or not their first mammogram was meant to indicate whether accuracy improves over time given experience and perhaps heightened awareness. Instead the results show significantly higher accuracy and greater probability for true positives than false negatives among first time mammogram patients than repeat patients. The first time mammogram patient group also demonstrates a higher occurrence of positive mammogram results in general. This finding again suggests experience with breast self-exam does not improve accuracy. Another explanation and point to consider are that first time mammogram patients may have been prompted to visit by new symptoms. Repeat patients may instead be returning more so out of routine and therefore have less to report but more to feel anxious about given potential history. This inference draws on the literature review of terror management theory discussed above. Ultimately, breast self-exam was slightly diagnostic among

[32] American Cancer Society, "Breast Cancer Basic Facts"

first time mammogram patients and counter-diagnostic among non first-time patients, but the differences in diagnosticity were not significant (Appendix J).

Breast Density Diagnosticity

| | | |
|---|---|---|
| **Density 1** | *Not Marked (n = 110)* | *Marked (n = 10)* |
| *P (M+)* | 5.5% | 10.0% |
| **Density 2** | *Not Marked (n = 390)* | *Marked (n = 48)* |
| *P (M+)* | 9.2% | 6.3% |
| **Density 3** | *Not Marked (n = 246)* | *Marked (n = 21)* |
| *P (M+)* | 12.6% | 4.8% |
| **Density 4** | *Not Marked (n = 26)* | *Marked (n = 3)* |
| *P (M+)* | 15.4% | 0.0% |

Finally, breast density was recorded to determine whether or not a greater concentration of breast tissue would make it more difficult for women to accurately identify symptoms of breast cancer in breast self-exam. Positive mammogram results in the sample occurred at a greater rate among density tiers three and four than in the general sample population. Accuracy also declined as breast density increased, with only tier 1's true positives outranking said tier's probability of false negative results. The self-exam is diagnostic when breast density equals one and counter-diagnostic if density equals two, three, or four, but the impact of density on the diagnosticity of breast self-exam is not significant. Among only the patients who checked pain, density has a marginally significant impact on diagnosticity of self-reporting this symptom; self-reported pain is somewhat diagnostic when density equals one but counter diagnostic and marginally significant with p=0.0894 when density equals two, three, or four (Appendix K). Because breast density potentially influences success rates at breast self-exam, this statistic again

suggests breast awareness and tracking changes over time at a personal level as a potential improvement over generic self-exam.

Non-BSE Diagnosticity

**Mammogram Experience Analysis of Maximum Likelihood Estimates**

| Parameter | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|
| *Intercept* | 1 | 1.9219 | 0.1229 | 244.6539 | <.0001 |
| *First Mammo* | 1 | 0.6946 | 0.1229 | 31.9605 | <.0001 |

| **Mammogram** | *First Mammogram (n = 150)* | *2nd+ Mammogram (n = 705)* |
|---|---|---|
| *P (M+)* | 22.7% | 6.8% |

**Breast Density Analysis of Maximum Likelihood Estimates**

| Parameter | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|
| *Intercept* | 1 | 3.0199 | 0.3967 | 57.9397 | <.0001 |
| *Density* | 1 | -0.3363 | 0.1591 | 4.47 | 0.0345 |

| **Breast Density** | *Density 1 (n = 120)* | *Density 2 (n = 438)* | *Density 3 (n = 267)* | *Density 4 (n = 29)* |
|---|---|---|---|---|
| *P (M+)* | 5.8% | 8.9% | 12.0% | 13.8% |

Given the failures identified with breast self-exam, other information such as mammogram history and breast density were tested again, separately, to see whether they could better predict mammogram results. Both whether it was a patient's first mammogram and a patient's breast density were significant indicators of mammogram results, with p-values under 0.05, even though neither of these findings significantly impacted whether the breast self-exam was positive (Appendix L). These findings matter in that they reaffirm the impact of external factors on a women's breast health and breast awareness, factors currently unadjusted for by breast self-exam. Women with greater breast density are generally at higher risk for breast cancer, so knowing this risk and your individual breast density will achieve greater strides for breast health than promoting a generic test that cannot establish a personal baseline for everyone.

***Limitations, Implications, and Future Work***

In reviewing results from the data, the vast contraindicative findings among breast self-exam reported symptoms were at first sight most alarming. Further discussion helped make sense of why breast self-exam beginning around middle age could not work – it assumes every woman will analyze her breast health the same way. In reality, a very health conscious woman will likely mark more potential symptoms on her self-exam than a woman who does not take care of herself, even though the healthy woman is less likely to have a positive mammogram finding. A woman's health-consciousness cannot be perceived from the current breast self-exam form administered at Mount Sinai Hospital.

Further, questions such as age, whether or not this is a woman's first mammogram, and zip code are only proxies for more desirable information. Whether or not this is a woman's first time conducting a breast self-exam, how regularly she conducts said exam, and whether her timing is cognizant of her menstrual cycle would provide more accurate information as to how experience with breast self-exam influences accuracy. Actual incomes of the patients instead of inferences from average household incomes in their zip code would better reflect health education differences and concurrent breast self-exam accuracy across income levels.

Still, the data in this research study matters in that it affirms the Susan G. Komen Center's advice against traditional breast self-exam and suggests alternative screening mechanisms to mitigate the limitations of breast self-exam. These recommendations stem from the literature review and how it aligns with the fieldwork findings. Because the self-exam sheet does not account for changes in an individual woman's body over time, she is not currently incentivized to conduct breast self-exam regularly. This causes the diagnosticity of the self-exam to suffer as a woman reports on symptoms without a point of reference as to what is her

"normal." New breast health campaigns that promote tracking over time, as suggested in the literature review, could reconcile this issue introduced in the data. Just as a woman at the gynecologist can turn to her FemTech app to precisely report the date of her last period, a FemTech app with breast health functionality could aggregate breast symptoms felt over time to alert an individual when one of her symptoms is more alarming; when it deviates from her norm.

The literature review also noted that habit loops are most likely to form at the onset of a new need, meaning girls will adopt new feminine health practices at the onset of puberty more likely than at fifty years old. If a teenage girl can learn how to track her breast health alongside her period, this will better normalize the experience and reduce fear than current campaigns led by cancer research foundations. Tracking breast health over time in a woman's own words, through free technology, reduces framing effects, recall bias, and any potential demographic differences in access to health education. Reminder features could also aid in regular reporting at the same time of the menstrual cycle each month, three to five days after a woman's period. The idea that this movement would target teenage girls reduces the instances of technological illiteracy.

Because these insights stem from a small pool of positive mammogram results, conducting further tests to verify these findings would be an important step before a complete overhaul of current policies. The first step in further testing would require accumulating more self-exams from women with positive mammogram results. In order to isolate the impact of framing effects, another test could compare breast self-exam accuracy after positive versus negative probing, while also considering for how much time a woman under each circumstance will interact with the self-exam sheet. The amount of time may suggest how much fear and avoidance the woman carries with her to the breast self-exam experience. Separately, conducting

market research with a company like Clue on a prototype breast health tracking function for its period tracking app could provide useful insights into whether recall bias plays a significant role in accurate reporting. Another test could compare teens' retentions of breast health education and subsequent follow-through to the retention and follow-through rates of middle-aged women. This insight would provide greater clarity around habit loop formation based on age. Finally, teaming up with global nonprofits focused on providing feminine hygiene products to women in developing countries would help better identify the unique, added hurdles standing between these women and breast health. This added step is of especial importance given the higher mortality rates from breast cancer in the developing world.

*An epiphany only matters in so much as something positive comes from it. Though this research merely skims the surface of breast self-exam inaccuracy, it takes an important step in positing real solutions. Please feel encouraged by the potential presented here to embark on further study of the real meaning of breast awareness, and the real implications.*

# Appendices

## A. Breast Cancer Awareness at SoulCycle, Crumbs Bake Shop, and Bloomindgales

**B. Mount Sinai Mammography Patient Information Questionnaire**

Mount Sinai Dubin Breast Center of The Tisch Cancer Institute
1176 Fifth Avenue
1st Floor
New York, NY 10029
212-241-3300

Mount Sinai Center for Advanced Medicine
17 East 102nd Street
6th Floor
New York, NY 10029
212-824-7700

Name: LAST NAME FIRST NAME
DOB: ___/___/___ MR# Gender:
Address: Apt.
CITY STATE ZIP CODE
Daytime Phone: Evening:
Ordering Physician:

## MAMMOGRAPHY PATIENT INFORMATION QUESTIONNAIRE

**Please answer each question below. Your technologist will review and may ask for clarification.**

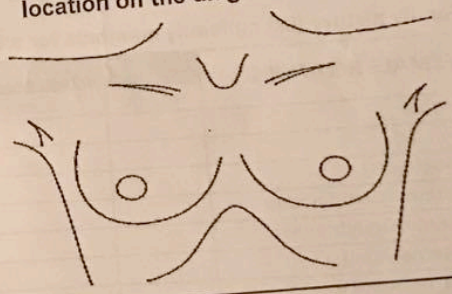
| General history | Date |
|---|---|
| Last physical breast exam | |
| Age at first menstruation | |
| Age at birth of first child (if applicable) | |
| Last menstrual Period | |

| Menopausal status (check one) | |
|---|---|
| Premenopausal (currently having periods regularly) | |
| Perimenopausal (approaching menopause, irregular periods) | |
| Postmenopausal (no longer having periods) | |

| Mammography history | |
|---|---|
| Is this your first mammogram? | |
| If you had previous, list date & site of most recent two: | |

**If you have experienced any symptoms since your last visit, please indicate which and mark the location on the diagram below:**

| Symptom | None | Right | Left |
|---|---|---|---|
| 1. Lump or Thickening | | | |
| 2. Large lymph nodes | | | |
| 3. Pain or tenderness | | | |
| 4. Infection or inflammation | | | |
| 5. Recent breast injury | | | |
| 6. Nipple discharge | | | |
| 7. Other nipple abnormality | | | |



8. Any else you want to tell us:

**Have you had a breast biopsy or other breast-related procedure/treatment?**

| Procedure | Right | Left | Date(s) | Results/Pathology/Other details |
|---|---|---|---|---|
| 1. Lumpectomy for cancer | | | | |
| 2. Mastectomy for cancer | | | | |
| 3. Radiation to breast or chest wall | | | | |
| 4. Chemotherapy | | | | |
| 5. Needle biopsy | | | | |
| 6. Surgical biopsy | | | | |
| 7. Breast implant(s) | | | | Type: (silicone/saline/other) |
| 8. Breast reduction | | | | |

## C. Breast Self-Exam History

# THE MYSTERY UNCOVERED: BREAST SELF-EXAMS

A historical look at the importance of breast self-exams

**1930** Breast Self-Exam (BSE) first introduced

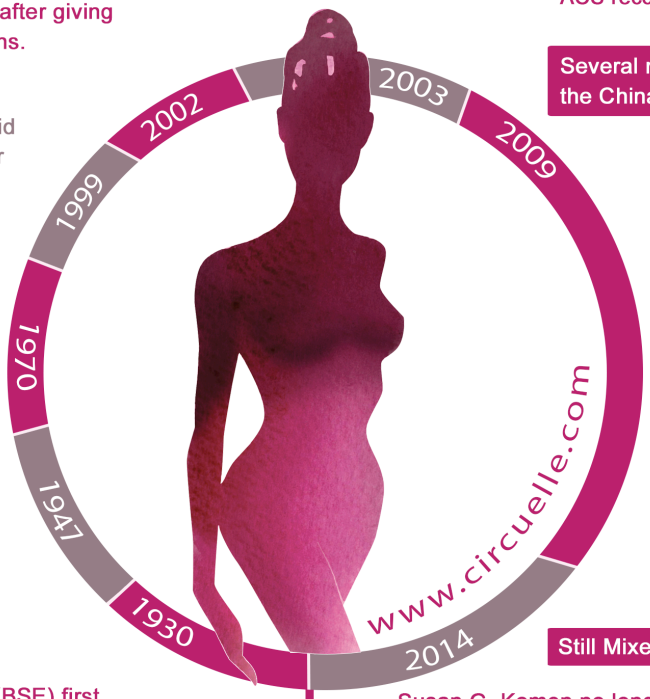
**1947** American Cancer Society (ACS) initiated campaign: Cancer's Danger Signals "Look for a Lump or Thickening in the Breast".

**1970** First studies evaluating BSE presented. Women confused about proper technique & relied on clinical breast exam.

**1999** Russian study found BSE did not decrease Breast Cancer mortality.

**2002** China study found no decrease of Breast Cancer deaths after giving women BSE instructions.

**2003** Malaysia and other countries where mammography is scarce, declared women should conduct monthly Breast Self-Exam.




**2009** US Preventive Service Task Force, (USPSTF) recommended against teaching BSE.
ACS recommended against BSE.

**Several new studies directly refute the China and Russia studies:**

**DUKE**
Found 46.6% of the cancers diagnosed were first found during the Breast Self-Exam.

**HARVARD**
71% of cancers detected were first detected by BSE in women under 40.

**MAYO CLINIC**
Found that women under 50 were more likely to find cancer by BSE than detected by mammography.

**Still Mixed Messages**

**2014** Susan G. Komen no longer recommends monthly BSE, but encourages women to become familiar with the way their breast normally look and feel.
(but, isn't that a breast self-exam?)

A popular women's magazine published "Breast Self-Exam Debate Finally Settled". Quoting the 2002 China study, telling women "don't massage your breasts..."

**Breast self-exams** are a necessary part of a woman's basket of healthy rituals. They are **simple**, **inexpensive**, **non-invasive** and **non-hazardous** and **accessible to all**. And above all, by definition, they **empower women** to **know their breasts**. That knowledge is powerful!

Share this information for **breast awareness** with all the women in your life.

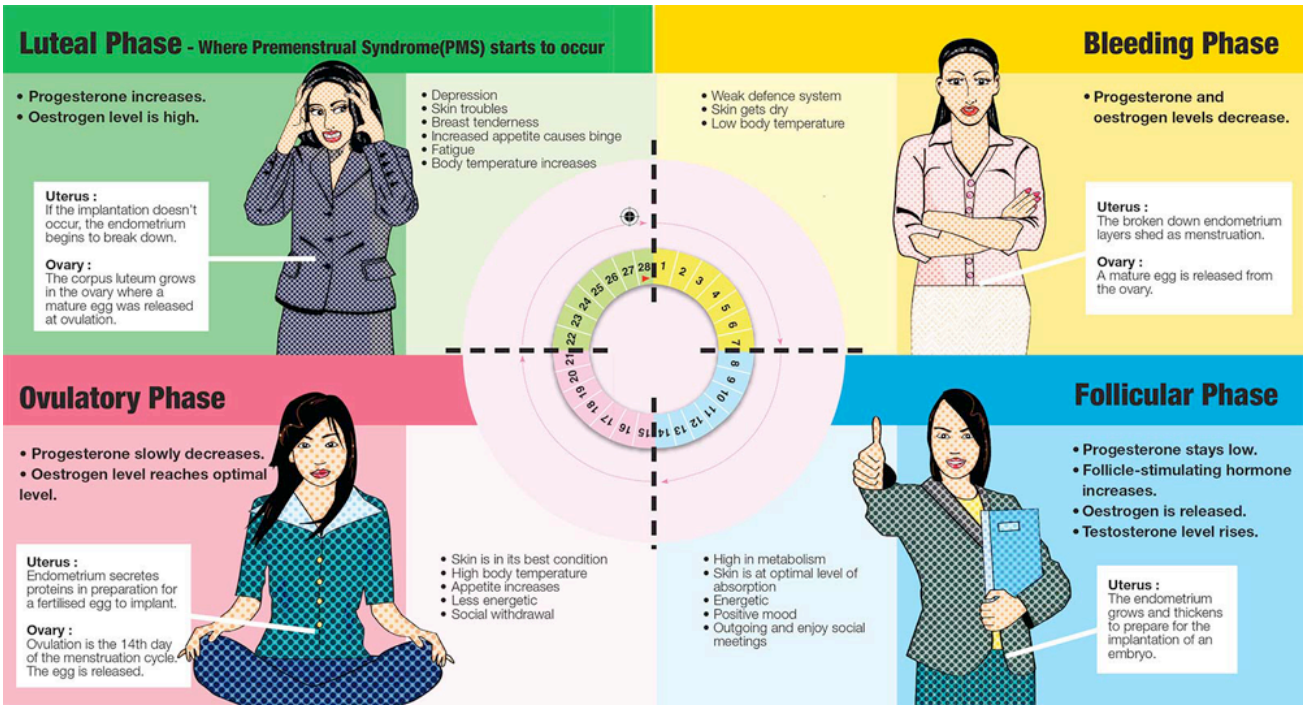
www.circuelle.com

**Take Action**

- ACS & USPSTF reversed opinion; BSE should be optional, and encourages women to become breast aware.
- USPSTF is reevaluating recommendations on breast cancer screening and asking for input from the public.
- Circuelle™ developed the first clinically proven Breast Ritual Crème for Breast Self-Exam.

**D. Menstrual Cycle and Symptoms**

(https://sanescohealth.com/wp-content/uploads/2016/03/4_Phases_of_Menstrual_Cycle.png)



**E. The Get in Touch Foundation Daisy Wheel with How-To Guide**


Try the Daisy Wheel | 8 Tips | GIT Daisy Wheels | FREE Mobile App

As shown below, the back of the Daisy Wheel has corresponding diagrams to match each "petal." We want you to get the idea and see how easy it is to do a BSE – *for life!*


## Daisy Wheel 8 Tips

1. BSE Breast Self Exam – Think of your breast as a daisy.
2. Look at your breasts in the mirror – hands on hips – tighten your chest. Anything weird? Discharge, puckering, dimpling?
3. Lying down, firmly press 3 fingers on your breast in a circular motion. Examine each "petal."
4. Apply 3 different levels of pressure – light, medium, firm – with your finger pads to check your breast tissue.
5. Use pressure level (L, M, F) on each "petal" before moving to the next.
6. Start by your armpit and move down to just below your breast, using the same circular motion in an up and down pattern, covering your whole breast. Repeat on other breast.
7. Sitting or standing, raise your arm slightly and use the same circular motions with your finger pads to examine your underarm. (Standing in the shower is a great place to do this!)
8. Did you see or feel something that worries you? Don't be embarrassed – tell your mother, father, sister, grandmother, school nurse, teacher, your BFF! Talk about it – GET IN TOUCH!

**F. Fieldwork Summary Expanded**

(+) mammogram = final 3, 4, 5, 6 = 82/855 // (-) mammogram = final 1, 2 = 773/855

True Negative = Unmarked Self Exam + Negative Mammogram
True Positive = Marked Self Exam + Positive Mammogram
False Negative = Unmarked Self Exam + Positive Mammogram
False Positive = Marked Self Exam + Negative Mammogram

Marked Anything: (82 / 855)
% also (+) mammogram (5/82) v. % (-) mammogram (77/82)
Unmarked Anything: (773 / 855) = 90.4%
% oppositely (+) mammogram (77/773) v. % also (-) mammogram (696/773)

Marked Lumps: (12 / 855)
% also (+) mammogram (0/12) v. % (-) mammogram (12/12)
Unmarked Lumps: (843 / 855) = 98.6%
% oppositely (+) mammogram (82/843) v. % also (-) mammogram (761/843)

Marked Lymph nodes: (6 / 855)
% also (+) mammogram (0/6) v. % (-) mammogram (6/6)
Unmarked Nodes: (849 / 855) = 99.3%
% oppositely (+) mammogram (82/849) v. % also (-) mammogram (767/849)

Marked Pain: (67 / 855)
% also (+) mammogram (3/67) v. % (-) mammogram (64/67)
Unmarked Pain: (788 / 855) = 92.2%
% oppositely (+) mammogram (79/788) v. % also (-) mammogram (709/788)

Marked Infection: (3 / 855)
% also (+) mammogram (0/3) v. % (-) mammogram (3/3)
Unmarked Infection: (852 / 855) = 99.6%
% oppositely (+) mammogram (82/852) v. % also (-) mammogram (770/852)

Marked Trauma: (1 / 855)
% also (+) mammogram (0/1) v. % (-) mammogram (1/1)
Unmarked Trauma: (854 / 855) = 99.9%
% oppositely (+) mammogram (82/854) v. % also (-) mammogram (772/854)

Marked Nipple Discharge: (10 / 855)
% also (+) mammogram (2/10) v. % (-) mammogram (8/10)
Unmarked Discharge: (845 / 855) = 98.8%
% oppositely (+) mammogram (80/845) v. % also (-) mammogram (765/845)

Marked Surgery: (159 / 855) —> also means not 1st mammogram

% also (+) mammogram (14/159) v. % (-) mammogram (145/159)
Unmarked Surgery: (696 / 855) = 81.4%
% oppositely (+) mammogram (68/696) v. % also (-) mammogram (628/696)

Zip code Income Brackets:
1: $0-49,999 = 167 / 855
- abnormal self-exam: 20 / 167
- % also (+) mammogram (0/20)
- % oppositely (-) mammogram (20/67)
- normal self-exam: 147 / 167
- % oppositely (+) mammogram (7/147)
- % concurrently (-) mammogram (140/147)

2: $50,000-99,999 = 523 / 855
- abnormal self-exam: 50 / 523
- % also (+) mammogram (5/50)
- % oppositely (-) mammogram (45/50)
- normal self-exam: 473 / 523
- % oppositely (+) mammogram (50/473)
- % concurrently (-) mammogram (423/473)

3: $100,000-149,999 = 84 / 855
- abnormal self-exam: 3 / 84
- % also (+) mammogram (0/3)
- % oppositely (-) mammogram (3/3)
- normal self-exam: 81 / 84
- % oppositely (+) mammogram (12/81)
- % concurrently (-) mammogram (69/81)

4: $150,000-199,999 = 40 / 855
- abnormal self-exam: 5 / 40
- % also (+) mammogram (0/5)
- % oppositely (-) mammogram (5/5)
- normal self-exam: 35 / 40
- % oppositely (+) mammogram (6/35)
- % concurrently (-) mammogram (29/35)

5: $200,000+ = 40 / 855
- abnormal self-exam: 4 / 40
- % also (+) mammogram (0/4)
- % oppositely (-) mammogram (4/4)
- normal self-exam: 36 / 40
- % oppositely (+) mammogram (2/36)
- % concurrently (-) mammogram (34/36)

Spanish Form (Hispanic) = 198 / 855
- abnormal self-exam: 12 / 198
- % also (+) mammogram (2/12)
- % oppositely (-) mammogram (10/12)
- normal self-exam: 186 / 198
- % oppositely (+) mammogram (17/186)
- % concurrently (-) mammogram (169/186)

English Form (Non-Hispanic) = 657 / 855
- abnormal self-exam: 70 / 657
- % also (+) mammogram (3/70)
- % oppositely (-) mammogram (67/70)
- normal self-exam: 587 / 657
- % oppositely (+) mammogram (60/587)
- % concurrently (-) mammogram (527/587)

Age @ Exam 0 - 49: 212 / 855
- abnormal self-exam: 26 / 212
- % also (+) mammogram (2/26)
- % oppositely (-) mammogram (24/26)
- normal self-exam: 186 / 212
- % oppositely (+) mammogram (27/186)
- % concurrently (-) mammogram (159/186)

Age @ Exam 50 - 64: 363 / 855
- abnormal self-exam: 42 / 363
- % also (+) mammogram (3/42)
- % oppositely (-) mammogram (39/42)
- normal self-exam: 321 / 363
- % oppositely (+) mammogram (28/321)
- % concurrently (-) mammogram (293/321)

Age @ Exam 65+: 280 / 855
- abnormal self-exam: 12 / 280
- % also (+) mammogram (0/12)
- % oppositely (-) mammogram (12/12)
- normal self-exam: 268 / 280
- % oppositely (+) mammogram (22/268)
- % concurrently (-) mammogram (246/268)

Married (=1): 241 / 745 *** excluded patients with info unknown
- abnormal self-exam: 28 / 241
- % also (+) mammogram (2/28)

- % oppositely (-) mammogram (26/28)
- normal self-exam: 213 / 241
- % oppositely (+) mammogram (19/213)
- % concurrently (-) mammogram (194/213)

Single (=2,3,4,5): 503 / 745 *** excluded patients with info unknown
- abnormal self-exam: 45 / 503
- % also (+) mammogram (2/45)
- % oppositely (-) mammogram (43/45)
- normal self-exam: 458 / 503
- % oppositely (+) mammogram (41/458)
- % concurrently (-) mammogram (417/458)

First Mammogram: 150 / 855
- abnormal self-exam: 16 / 150
- % also (+) mammogram (4/16)
- % oppositely (-) mammogram (12/16)
- normal self-exam: 134 / 150
- % oppositely (+) mammogram (30/134)
- % concurrently (-) mammogram (104/134)

Not First Mammogram: 705 / 855
- abnormal self-exam: 66 / 705
- % also (+) mammogram (1/66)
- % oppositely (-) mammogram (65/66)
- normal self-exam: 639 / 705
- % oppositely (+) mammogram (47/639)
- % concurrently (-) mammogram (592/639)

Breast Density (1): 120 / 854 *** excluded patients with info unknown
- abnormal self-exam: 10 / 120
- % also (+) mammogram (1/10)
- % oppositely (-) mammogram (9/10)
- normal self-exam: 110 / 120
- % oppositely (+) mammogram (6/110)
- % concurrently (-) mammogram (104/110)

Breast Density (2): 438 / 854 *** excluded patients with info unknown
- abnormal self-exam: 48 / 438
- % also (+) mammogram (3/48)
- % oppositely (-) mammogram (45/48)
- normal self-exam: 390 / 438
- % oppositely (+) mammogram (36/390)
- % concurrently (-) mammogram (354/390)

Breast Density (3): 267 / 854 *** excluded patients with info unknown
- abnormal self-exam: 21 / 267
- % also (+) mammogram (1/21)
- % oppositely (-) mammogram (20/21)
- normal self-exam: 246 / 267
- % oppositely (+) mammogram (31/246)
- % concurrently (-) mammogram (215/246)

Breast Density (4): 29 / 854 *** excluded patients with info unknown
- abnormal self-exam: 3 / 29
- % also (+) mammogram (0/3)
- % oppositely (-) mammogram (3/3)
- normal self-exam: 26 / 29
- % oppositely (+) mammogram (4/26)

% concurrently (-) mammogram (22/26)

| BSE Overall | Not Marked (n = 773) | Marked (n = 82) |
|---|---|---|
| P (M+) | 10.0% | 6.1% |

| BSE Overall | | BSE Unmarked (n = 773) | BSE Marked (n = 82) |
|---|---|---|---|
| M | - | 696 | 77 |
| | + | 77 | 5 |

| Lumps | Not Marked (n = 843) | Marked (n = 12) |
|---|---|---|
| P (M+) | 9.7% | 0.0% |

| Lumps | | Lumps Unmarked (n = 843) | Lumps Marked (n = 12) |
|---|---|---|---|
| M | - | 761 | 12 |
| | + | 82 | 0 |

| Nodes | Not Marked (n = 849) | Marked (n = 6) |
|---|---|---|
| P (M+) | 9.7% | 0.0% |

| Lymph Nodes | | Lymph Nodes Unmarked (n = 849) | Lymph Nodes Marked (n = 6) |
|---|---|---|---|
| M | - | 767 | 6 |
| | + | 82 | 0 |

| Pain | Not Marked (n = 788) | Marked (n = 67) |
|---|---|---|
| P (M+) | 10.0% | 4.5% |

| Pain | | Pain Unmarked (n = 788) | Pain Marked (n = 67) |
|---|---|---|---|
| M | - | 709 | 64 |
| | + | 79 | 3 |

| Infection | Not Marked (n = 852) | Marked (n = 3) |
|---|---|---|
| P (M+) | 9.6% | 0.0% |

| Infection | | Infection Unmarked (n = 852) | Infection Marked (n = 3) |
|---|---|---|---|
| M | - | 770 | 3 |
| | + | 82 | 0 |

| Trauma | Not Marked (n = 854) | Marked (n = 1) |
|---|---|---|
| P (M+) | 9.6% | 0.0% |

| Trauma | | Trauma Unmarked (n = 854) | Trauma Marked (n = 1) |
|---|---|---|---|
| M | - | 772 | 1 |
| | + | 82 | 0 |

| Discharge | Not Marked (n = 845) | Marked (n = 10) |
|---|---|---|
| P (M+) | 9.5% | 20.0% |

| Discharge | | Discharge Unmarked (n = 845) | Discharge Marked (n = 10) |
|---|---|---|---|
| M | - | 765 | 8 |
| | + | 80 | 2 |

| Surgery | Not Marked (n = 696) | Marked (n = 159) |
|---|---|---|
| P (M+) | 9.8% | 8.8% |

| Surgery | | Surgery Unmarked (n = 696) | Surgery Marked (n = 159) |
|---|---|---|---|
| M | - | 628 | 145 |
| | + | 68 | 14 |

| Income 1 | *Not Marked (n = 147)* | *Marked (n = 20)* |
|---|---|---|
| *P (M+)* | 4.8% | 0.0% |

| *Income 1 ($0-49,999)* | | Income 1 (n = 167) Unmarked (n = 147) | Marked (n = 20) |
|---|---|---|---|
| M | - | 140 | 20 |
| | + | 7 | 0 |

| Income 2 | *Not Marked (n = 473)* | *Marked (n = 50)* |
|---|---|---|
| *P (M+)* | 10.6% | 10.0% |

| *Income 2 ($50,000-99,999)* | | Income 2 (n = 523) Unmarked (n = 473) | Marked (n = 50) |
|---|---|---|---|
| M | - | 423 | 45 |
| | + | 50 | 5 |

| Income 3 | *Not Marked (n = 81)* | *Marked (n = 3)* |
|---|---|---|
| *P (M+)* | 14.8% | 0.0% |

| *Income 3 ($100,000-149,999)* | | Income 3 (n = 84) Unmarked (n = 81) | Marked (n = 3) |
|---|---|---|---|
| M | - | 69 | 3 |
| | + | 12 | 0 |

| Income 4 | *Not Marked (n = 35)* | *Marked (n = 5)* |
|---|---|---|
| *P (M+)* | 17.1% | 0.0% |

| *Income 4 ($150,000-199,999)* | | Income 4 (n = 40) Unmarked (n = 35) | Marked (n = 5) |
|---|---|---|---|
| M | - | 29 | 5 |
| | + | 6 | 0 |

| Income 5 | *Not Marked (n = 36)* | *Marked (n = 4)* |
|---|---|---|
| *P (M+)* | 5.6% | 0.0% |

| *Income 5 ($200,000+)* | | Income 5 (n = 40) Unmarked (n = 36) | Marked (n = 4) |
|---|---|---|---|
| M | - | 34 | 4 |
| | + | 2 | 0 |

| English BSE | *Not Marked (n = 587)* | *Marked (n = 70)* |
|---|---|---|
| *P (M+)* | 10.2% | 4.3% |

| *English BSE* | | English BSE (n = 657) Unmarked (n = 587) | Marked (n = 70) |
|---|---|---|---|
| M | - | 527 | 67 |
| | + | 60 | 3 |

| Spanish BSE | *Not Marked (n = 186)* | *Marked (n = 12)* |
|---|---|---|
| *P (M+)* | 9.1% | 16.7% |

| *Spanish BSE* | | Spanish (n = 198) Unmarked (n = 186) | Marked (n = 12) |
|---|---|---|---|
| M | - | 169 | 10 |
| | + | 17 | 2 |

| **Age 0-49** | *Not Marked (n = 186)* | *Marked (n = 26)* |
|---|---|---|
| *P (M+)* | 14.5% | 7.7% |

| ***Age 0-49*** | | **Age 0-49 (n = 212)** Unmarked (n = 186) | Marked (n = 26) |
|---|---|---|---|
| **M** | **-** | **159** | **24** |
| | **+** | **27** | **2** |

| **Age 50-64** | *Not Marked (n = 321)* | *Marked (n = 42)* |
|---|---|---|
| *P (M+)* | 8.7% | 7.1% |

| ***Age 50-64*** | | **Age 50-64 (n = 363)** Unmarked (n = 321) | Marked (n = 42) |
|---|---|---|---|
| **M** | **-** | **293** | **39** |
| | **+** | **28** | **3** |

| **Age 65+** | *Not Marked (n = 268)* | *Marked (n = 12)* |
|---|---|---|
| *P (M+)* | 8.2% | 0.0% |

| ***Age 65+*** | | **Age 65+ (n = 280)** Unmarked (n = 268) | Marked (n = 12) |
|---|---|---|---|
| **M** | **-** | **246** | **12** |
| | **+** | **22** | **0** |

| **First Mammo** | *Not Marked (n = 134)* | *Marked (n = 16)* |
|---|---|---|
| *P (M+)* | 22.4% | 25.0% |

| ***First Mammogram*** | | **First Mammogram (n = 150)** Unmarked (n = 134) | Marked (n = 16) |
|---|---|---|---|
| **M** | **-** | **104** | **12** |
| | **+** | **30** | **4** |

| **Not First Mammo** | *Not Marked (n = 639)* | *Marked (n = 66)* |
|---|---|---|
| *P (M+)* | 7.4% | 1.5% |

| ***Not First Mammogram*** | | **Not First Mammogram (n = 705)** Unmarked (n = 639) | Marked (n = 66) |
|---|---|---|---|
| **M** | **-** | **592** | **65** |
| | **+** | **47** | **1** |

| **Density 1** | *Not Marked (n = 110)* | *Marked (n = 10)* |
|---|---|---|
| *P (M+)* | 5.5% | 10.0% |

| ***Breast Density 1 (0-25%)*** | | **Breast Density 1 (n = 120)** Unmarked (n = 110) | Marked (n = 10) |
|---|---|---|---|
| **M** | **-** | **104** | **9** |
| | **+** | **6** | **1** |

| **Density 2** | *Not Marked (n = 390)* | *Marked (n = 48)* |
|---|---|---|
| *P (M+)* | 9.2% | 6.3% |

| ***Breast Density 2 (26-50%)*** | | **Breast Density 2 (n = 438)** Unmarked (n = 390) | Marked (n = 48) |
|---|---|---|---|
| **M** | **-** | **354** | **45** |
| | **+** | **36** | **3** |

| **Density 3** | *Not Marked (n = 246)* | *Marked (n = 21)* |
|---|---|---|
| *P (M+)* | 12.6% | 4.8% |

| ***Breast Density 3 (51-75%)*** | | **Breast Density 3 (n = 267)** Unmarked (n = 246) | Marked (n = 21) |
|---|---|---|---|
| **M** | **-** | **215** | **20** |
| | **+** | **31** | **1** |

| **Density 4** | *Not Marked (n = 26)* | *Marked (n = 3)* |
|---|---|---|
| *P (M+)* | 15.4% | 0.0% |

| ***Breast Density 4 (76-100%)*** | | **Breast Density 4 (n = 29)** Unmarked (n = 26) | Marked (n = 3) |
|---|---|---|---|
| **M** | **-** | **22** | **3** |
| | **+** | **4** | **0** |

| **Mammogram** | *First Mammogram (n = 150)* | *2nd+ Mammogram (n = 705)* |
|---|---|---|
| *P (M+)* | 22.7% | 6.8% |

| ***Mammogram Experience*** | | **Mammogram (n = 855)** | |
|---|---|---|---|
| | | **First Time (n = 150)** | **2nd+ Time (n = 705)** |
| **M** | **-** | **116** | **657** |
| | **+** | **34** | **48** |

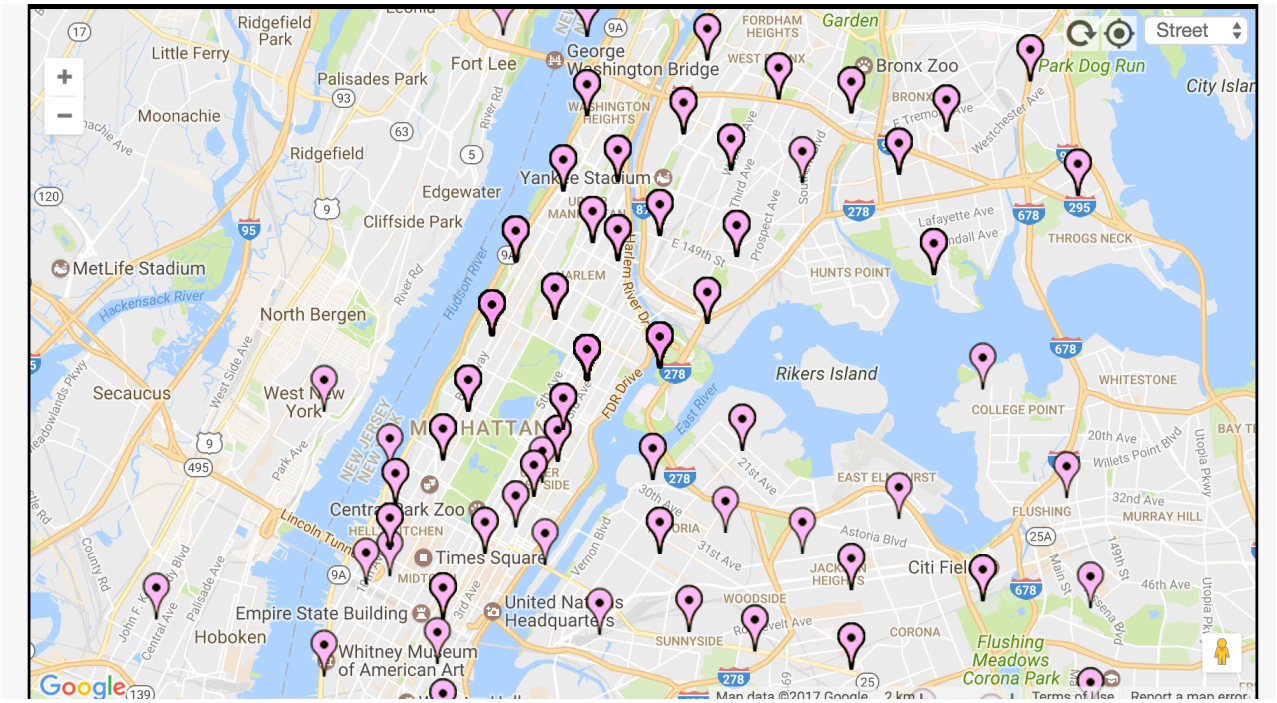
| **Breast Density** | *Density 1 (n = 120)* | *Density 2 (n = 438)* |
|---|---|---|
| *P (M+)* | 5.8% | 8.9% |

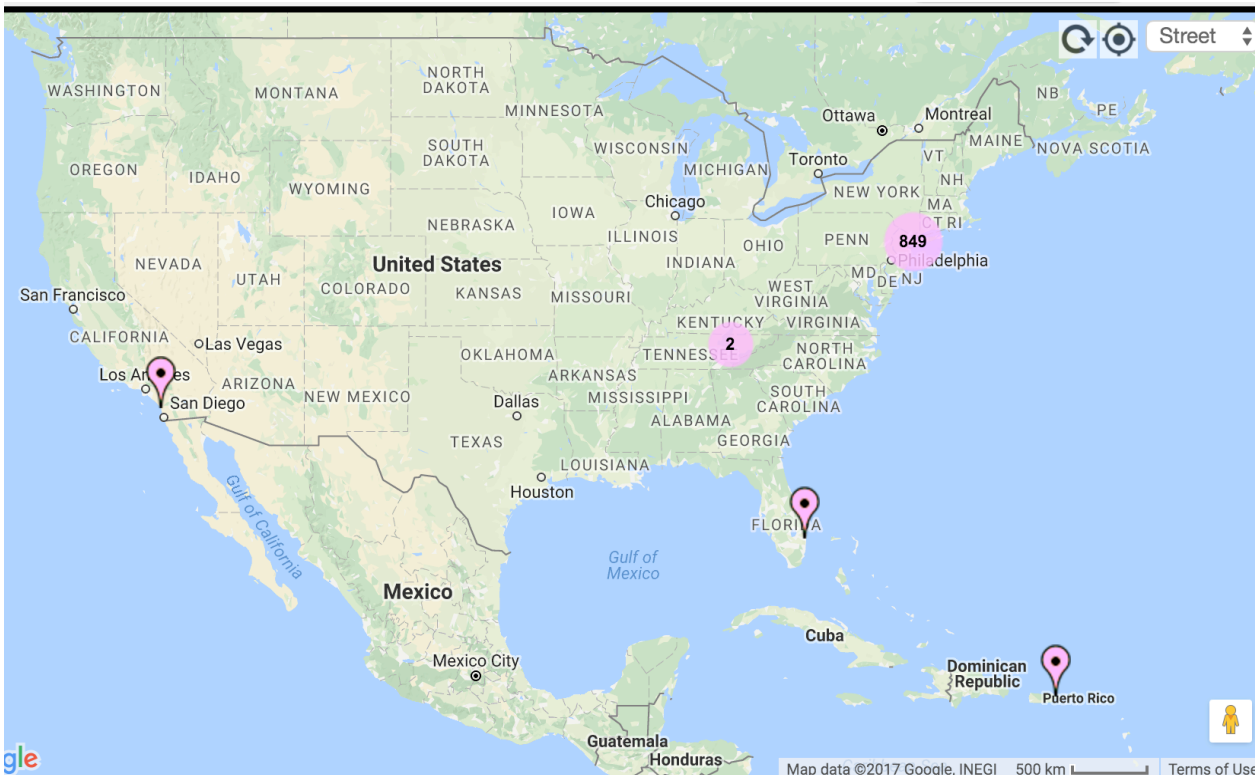
| ***Breast Density*** | | **Total Densities (n = 854)** | |
|---|---|---|---|
| | | **Density 1 (n = 120)** | **Density 2 (n = 438)** |
| **M** | **-** | **113** | **399** |
| | **+** | **7** | **39** |

| **Breast Density** | *Density 3 (n = 267)* | *Density 4 (n = 29)* |
|---|---|---|
| *P (M+)* | 12.0% | 13.8% |

| ***Breast Density*** | | **Total Densities (n = 854)** | |
|---|---|---|---|
| | | **Density 3 (n = 267)** | **Density 4 (n = 29)** |
| **M** | **-** | **235** | **25** |
| | **+** | **32** | **4** |

## G. Zip Code Regional Maps



**H. Zip Codes By Income Bracket in USD** (https://www.incomebyzipcode.com)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 0-49,999 | 50,000-99,999 | 100,000-149,999 | 150,000-199,999 | 200,000+ |
| 07107 | 01230 | 06085 | 06824 | 07043 |
| 10035 | 06708 | 07302 | 07059 | 10013 |
| 10451 | 07024 | 07666 | 07738 | 10021 |
| 10452 | 07029 | 08857 | 10001 | 10022 |
| 10453 | 07093 | 10018 | 10005 | 10024 |
| 10454 | 07105 | 10019 | 10010 | 10028 |
| 10455 | 07307 | 10025 | 10014 | 10065 |
| 10456 | 07601 | 10036 | 10016 | 10069 |
| 10457 | 07740 | 10044 | 10023 | 10075 |
| 10458 | 08859 | 10471 | 10128 | 10533 |
| 10459 | 08861 | 10543 | 10280 | 10583 |
| 10460 | 10002 | 10591 | 10607 | 10804 |
| 10467 | 10009 | 10956 | 10708 | 11559 |
| 10468 | 10026 | 11003 | 11201 | 11576 |
| 10472 | 10027 | 11215 | | |
| 11206 | 10029 | 11231 | | |
| 11207 | 10030 | 11561 | | |
| 11208 | 10031 | 11694 | | |
| 11213 | 10032 | 11721 | | |
| 11239 | 10033 | 11780 | | |
| | 10034 | | | |
| | 10037 | | | |
| | 10039 | | | |
| | 10040 | | | |
| | 10304 | | | |
| | 10314 | | | |
| | 10461 | | | |
| | 10462 | | | |
| | 10463 | | | |
| | 10465 | | | |
| | 10466 | | | |
| | 10469 | | | |
| | 10470 | | | |
| | 10473 | | | |
| | 10475 | | | |
| | 10701 | | | |
| | 10703 | | | |
| | 10704 | | | |
| | 10705 | | | |
| | 10805 | | | |
| | 10970 | | | |
| | 11101 | | | |

11102
11103
11104
11105
11106
11205
11209
11210
11211
11216
11218
11219
11220
11221
11223
11224
11225
11226
11229
11230
11233
11234
11235
11236
11237
11238
11354
11355
11356
11364
11367
11368
11369
11370
11372
11373
11374
11375
11377
11378
11379
11385
11416
11417
11420
11421

11422
11427
11428
11432
11433
11434
11692
11693
11757
12783
30519
33411
92008

**I. Language Diagnosticity Significance**

Spanish:

**Table of mam_pos by abnormal**

| mam_pos | abnormal(abnormal) | | |
|---|---|---|---|
| | **0** | **1** | **Total** |
| **0** | 169 | 10 | 179 |
| | 85.35 | 5.05 | 90.40 |
| | 94.41 | 5.59 | |
| | 90.86 | 83.33 | |
| **1** | 17 | 2 | 19 |
| | 8.59 | 1.01 | 9.60 |
| | 89.47 | 10.53 | |
| | 9.14 | 16.67 | |
| **Total** | 186 | 12 | 198 |
| | 93.94 | 6.06 | 100.00 |

English:

**Table of mam_pos by abnormal**

| mam_pos | abnormal(abnormal) | | |
|---|---|---|---|
| | **0** | **1** | **Total** |
| **0** | 527 | 67 | 594 |
| | 80.21 | 10.20 | 90.41 |
| | 88.72 | 11.28 | |
| | 89.78 | 95.71 | |
| **1** | 60 | 3 | 63 |
| | 9.13 | 0.46 | 9.59 |
| | 95.24 | 4.76 | |
| | 10.22 | 4.29 | |

**Analysis of Maximum Likelihood Estimates**

| Parameter | | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|---|
| **Intercept** | | | 1 | 2.2962 | 0.2539 | 81.7867 | <.0001 |
| **abnormal** | **0** | | 1 | -0.0614 | 0.2539 | 0.0585 | 0.8089 |
| **language** | **1** | | 1 | 0.3431 | 0.2539 | 1.8264 | 0.1766 |
| **language*abnormal** | **1** | **0** | 1 | -0.4050 | 0.2539 | 2.5450 | 0.1106 |

**P = 0.11 → not significant**

**J. First Mammogram Diagnosticity Significance**

**Table of mam_pos by abnormal**

| mam_pos | abnormal(abnormal) 0 | 1 | Total |
|---|---|---|---|
| **0** | 104 | 12 | 116 |
| | 69.33 | 8.00 | 77.33 |
| | 89.66 | 10.34 | |
| | 77.61 | 75.00 | |
| **1** | 30 | 4 | 34 |
| | 20.00 | 2.67 | 22.67 |
| | 88.24 | 11.76 | |
| | 22.39 | 25.00 | |
| **Total** | 134 | 16 | 150 |
| | 89.33 | 10.67 | 100.00 |

**Table of mam_pos by abnormal**

| mam_pos | abnormal(abnormal) 0 | 1 | Total |
|---|---|---|---|
| **0** | 592 | 65 | 657 |
| | 83.97 | 9.22 | 93.19 |
| | 90.11 | 9.89 | |
| | 92.64 | 98.48 | |
| **1** | 47 | 1 | 48 |
| | 6.67 | 0.14 | 6.81 |
| | 97.92 | 2.08 | |
| | 7.36 | 1.52 | |
| **Total** | 639 | 66 | 705 |
| | 90.64 | 9.36 | 100.00 |

**Joint Tests**

| Effect | DF | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|
| **abnormal** | 1 | 1.5816 | 0.2085 |
| **first_mam** | 1 | 13.4788 | 0.0002 |
| **abnormal*first_mam** | 1 | 2.2526 | 0.1334 |

**K. Breast Density Diagnosticity Significance**

**Analysis of Maximum Likelihood Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|
| **Intercept** | | 1 | 2.4005 | 0.7749 | 9.5965 | 0.0019 |
| **abnormal** | **0** | 1 | 0.6888 | 0.7749 | 0.7902 | 0.3740 |
| **density** | | 1 | 0.0513 | 0.3621 | 0.0201 | 0.8873 |
| **density*abnormal** | **0** | 1 | -0.4337 | 0.3621 | 1.4345 | 0.2310 |

**Analysis of Maximum Likelihood Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|
| **Intercept** | | 1 | 1.7179 | 0.9514 | 3.2606 | 0.0710 |
| **pain_pos** | **0** | 1 | 1.3630 | 0.9514 | 2.0526 | 0.1519 |
| **density** | | 1 | 0.5122 | 0.5236 | 0.9568 | 0.3280 |
| **density*pain_pos** | **0** | 1 | -0.8937 | 0.5236 | 2.9132 | 0.0879 |

**Analysis of Maximum Likelihood Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|
| **Intercept** | | 1 | 2.7298 | 0.3650 | 55.9358 | <.0001 |
| **pain_pos** | **0** | 1 | -0.6201 | 0.3650 | 2.8858 | 0.0894 |

**L. Non-BSE Diagnosticity**

**Analysis of Maximum Likelihood Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|
| **Intercept** | | 1 | 1.9219 | 0.1229 | 244.6539 | <.0001 |
| **first_mam** | **0** | 1 | 0.6946 | 0.1229 | 31.9605 | <.0001 |

**Analysis of Maximum Likelihood Estimates**

| Parameter | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|
| **Intercept** | 1 | 3.0199 | 0.3967 | 57.9397 | <.0001 |
| **density** | 1 | -0.3363 | 0.1591 | 4.4700 | 0.0345 |

Impact on Self-Exam: null

**Analysis of Maximum Likelihood Estimates**

| Parameter | | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|---|
| **Intercept** | | 1 | 2.1977 | 0.1472 | 222.8964 | <.0001 |
| **first_mam** | **0** | 1 | 0.0725 | 0.1472 | 0.2426 | 0.6223 |

**Analysis of Maximum Likelihood Estimates**

| Parameter | DF | Estimate | Standard Error | Wald Chi-Square | Pr > ChiSq |
|---|---|---|---|---|---|
| **Intercept** | 1 | 2.0902 | 0.3719 | 31.5925 | <.0001 |
| **density** | 1 | 0.0683 | 0.1598 | 0.1828 | 0.6690 |

**References**

"06460 Income Statistics." *Income By Zip Code*, 2017. Accessed April 27, 2017. <https://www.incomebyzipcode.com/connecticut/06460>.

American Cancer Society, "Breast Cancer Basic Facts." *Breast Cancer Facts & Figures 2015-2016*, 2015. Accessed April 27, 2017. <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2015-2016.pdf>.

Andale, "Recall Bias: Definition, Examples, Strategies to Avoid It," *Statistics How To*, November 11, 2016, accessed April 26, 2017. <http://www.statisticshowto.com/recall-bias/>.

Barnes, Zahra, "Why You Should Touch Your Boobs More Often," *SELF Magazine*, October 3, 2016, accessed April 26, 2017. <http://www.self.com/story/breast-self-exams>.

Berger, S, CC Huang, CL Rubin, "The Role of Community Education in Increasing Knowledge of Breast Health and Cancer: Findings from the Asian Breast Cancer Project in Boston, Massachusetts." *J Cancer Education,* September 15, 2015. Accessed April 28, 2017. <https://www.ncbi.nlm.nih.gov/pubmed/26373418>.

"Breast Self-Exam," *Mount Sinai Health Library*, n.d., accessed April 26, 2017. <http://www.mountsinai.org/health-library/special-topic/breast-self-exam>.

Buhr, Sarah. "Period Tracking App Clue Pulls in $20 Million Series B from Nokia Growth Partners." *TechCrunch*, October 30, 2016. Accessed April 28, 2017. <https://techcrunch.com/2016/11/30/period-tracking-app-clue-pulls-in-20-million-series-b-from-nokia-growth-partners/>.

Circuelle Foundation, "The Mystery Uncovered: Breast Self-Exams," *Circuelle Foundation,* July 18, 2014, accessed April 26, 2017. <*http://www.circuellefoundation.org/blog/item/the-mystery-uncovered-breast-self-exams.html)*>.

"Connecticut Household Income." *Department of Numbers*, 2015. Accessed April 27, 2017. <http://www.deptofnumbers.com/income/connecticut/>.

Duhigg, Charles. "Warning: Habits May Be Good for You." *The New York Times*, July 13, 2008. Accessed May 9, 2017. <http://www.nytimes.com/2008/07/13/business/13habit.html?pagewanted=all>.

Ginossar, Tamar et al. "Content, Usability, and Utilization of Plain Language in Breast Cancer Mobile Phone Apps: A Systematic Analysis,." *JMIR MHealth and UHealth* (2017): 1.

Goldenberg, Jamie L., Jamie Arndt, Joshua Hart, Clay Routledge, "Uncovering an Existential Barrier to Breast Self-Exam Behavior," *Journal of Experimental Social Psychology,* March 2008, accessed April 26, 2017. <*https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2276308/#R19*>.

Hollingworth, Crawford and Liz Barker. "How Habits Form." *Habits The Holy Grail of Marketing* (n.d.): 6-8. Accessed April 26, 2017. <https://www.marketingsociety.com/sites/default/files/thelibrary/Habits%20-%20The%20Behavioural%20Architects_2.pdf>.

Hvizdak, Peter. "New Connecticut Law Requires Breast Health Education to be Taught In Public Schools; Milford Senator Cheers." *The Middletown Press*, October 5, 2016, accessed April 27, 2017. <http://www.middletownpress.com/article/MI/20161005/NEWS/161009782>.

Khazan, Olga. "You Don't Have to Feel Your Breasts." *The Atlantic*. October 24, 2014, accessed February 8, 2017. <http://www.theatlantic.com/health/archive/2014/10/breast-self-exams-are-meaningless/381834/>.

Konkel, Lindsey. "Irregular Periods Could Boost Ovarian Cancer Risk." *Science*, April 22, 2016, accessed April 26, 2017. <http://www.sciencemag.org/news/2016/04/irregular-periods-could-boost-ovarian-cancer-risk>.

Li, Charmaine. "A Close-Up of Clue, the Startup That Aims to Help Women Make Sense of Their Fertility Cycle." *Tech.Eu*, September 5, 2014. Accessed April 28, 2017. <http://tech.eu/features/2607/clue-app-profile-ida-tin/>.

"Love and Marriage, Go Together Like – Brands and Customers?" *Optimum 7*, December 5, 2014, accessed April 26, 2017. <https://www.optimum7.com/internet-marketing/brand-development/love-and-marriage-go-together-like-brands-and-customers.html>.

Penwarden, Rick. "5 Common Survey Question Mistakes That'll Ruin Your Data." *SurveyMonkey Blog*. February 11, 2015, accessed December 7, 2016. <https://www.surveymonkey.com/blog/2015/02/11/5-common-survey-mistakes-ruin-your-data/>.

"Period Calendar – Why Track Your Menstrual Cycle?" *Always*, n.d., April 26, 2017. <http://always.com/en-us/tips-and-advice/your-first-period/period-calendar-why-track-your-menstrual-cycle>.

Polek, Carolee and Thomas Hardie. "Are changes in breast self-exam recommenations and early misperceptions of breast cancer risk increasing women's future risks?" *Journal of the American Association of Nurse Practitioners,* 2015, 379-386.

Rabin, Roni Caryn. "A Fresh Case for Breast Self-Exams." *The New York Times.* February 17, 2014, accessed February 8, 2017. <http://well.blogs.nytimes.com/2014/02/17/a-fresh-case-for-breast-self-exams/?_r=0>.

Richmond, Jill. "The New Year of Optimism for Femtech." *Forbes*, December 31, 2016. Accessed April 28, 2017. <https://www.forbes.com/sites/jillrichmond/2016/12/31/the-new-year-of-optimisim-for-femtech/#7338d2454c97>.

Sandle, Tim. "UN Thinks Internet Access is Human Right." *Business Insider*, July 22, 2016. Accessed April 28, 2017. <http://www.businessinsider.com/un-says-internet-access-is-a-human-right-2016-7>.

Sharour BSN, MSN, PhD, Associate Professor, L. Abu et al. "Predictors of Breast Self-Examination Performance Among Jordanian University Female Students," *Wiley European Journal of Cancer Care* (November 2016): 1. doi: 10.1111/ecc.12622

Sher, Shlomi and Craig R.M. McKenzie. "Framing Effects," *Psychology Dept. University of California San Diego*, n.d., accessed April 26, 2017. <
<http://psy2.ucsd.edu/~mckenzie/SHERMCKENZIEFRAMINGEFFECTSFINAL1.pdf>.

Wasil, Mary Ann. "About the Founder." *The Get in Touch Foundation*, n.d., accessed April 27, 2017. <http://getintouchfoundation.org/about-us/about-mary-ann-wasil/>.

*This work is my own. I have fully and appropriately referenced any work and efforts of others on which I relied and I did not engage in any method or means that provided me an unfair advantage. I confirm that I have adhered to the NYU Stern Code of Conduct in its completion.*