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Reducing Preconception Risks among African American Women with Conversational Agent Technology

Brian Jack, MD[1], **Timothy Bickmore, PhD**[2], **Megan Hempstead, MPH**[1], **Leanne Yinusa-Nyahkoon, ScD, OTR/L**[3], **Ekaterina Sadikova, MPH**[1], **Suzanne Mitchell, MD, MSc**[1], **Paula Gardiner, MD, MPH**[1], **Fatima Adigun**[1], **Brian Penti, MD**[1], **Daniel Schulman, PhD**[4], and **Karla Damus, PhD, MSPH, RN**[1]

[1]Department of Family Medicine, Boston University School of Medicine/Boston Medical Center, Boston Massachusetts

[2]College of Computer and Information Science, Northeastern University, Boston, Massachusetts

[3]Sargent College of Health and Rehabilitation Sciences, Boston University, Boston, Massachusetts

[4]Veteran's Administration, Boston Healthcare System, Jamaica Plain, Massachusetts

Abstract

BACKGROUND—Preconception care (PCC) should be provided for all women capable of becoming pregnant to identify and treat existing risk factors for adverse perinatal outcomes for both the woman and her future baby. Additional tools are needed for providers and the public to screen for and address preconception health (PCH) risks, particularly for African American (AA) women given the national persistent health outcome and healthcare disparities. We developed and tested the "Gabby System," featuring an online interactive conversational agent programmed to discuss women's specific PCH risks and encourage behavioral change through evidence-based interventions.

METHODS—A 6-month randomized controlled trial of a purposeful, convenience sample of 100 non-gravid, primarily college-attending AA women 18–34 years of age was conducted. All participants were screened at enrollment for over 100 PCH risks and then randomized to the Gabby or control group. Controls were sent a letter listing identified PCH risks, suggesting they discuss these risks with a health care provider. The numbers, proportions, and types of risks identified and addressed were compared between groups.

RESULTS—Of the 100 women enrolled, 99 provided baseline data, 91 completed the online PCH risk assessment, and 80 completed the 6-month follow-up phone call. The mean participant age was 25.5 years and all had at least one PCH risk with a mean (sd) of 23.7 (5.9), range of 11 to 45 PCH risks. In 6 months the Gabby group had significantly greater reductions compared to controls in both the number of PCH risks (34% higher- 8.3 vs. 5.5, $p<.05$) and in the proportion of risks resolved (25% higher- 27.8% vs 20.5% $p<0.01$). Women in the Gabby group averaged 2.9

Corresponding Author: Brian Jack, MD, Department of Family Medicine, Dowling 5, Boston Medical Center, 1 BMC Place, Boston, MA 02118; brian.jack@bmc.org.

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logins and 63.7 minutes of interaction time. The most common PCH risks triggered were nutrition, activity and infectious disease. The majority of women (78%) reported it "was easy to talk to Gabby" and that they had used information from Gabby to improve their health (64%).

CONCLUSION—Among a group of reproductive age African American women, use of the Gabby system was associated with a significant reduction in identified PCH risks. More research is needed to determine if Gabby can impact risk status among a larger, more socio-demographically diverse group of black women and if reducing the number of risks is clinically significant.

Background

Despite mounting scientific evidence that enhancing a woman's health before pregnancy improves perinatal outcomes for women and their infants, many women enter pregnancy in poor health and at risk for preventable adverse pregnancy outcomes. In addition, about half of pregnancies are unplanned, making it important to promote preconception health (PCH) and deliver preconception care (PCC) to all women of reproductive age, regardless of pregnancy intention.[1] The Centers for Disease Control and Prevention (CDC) defines PCC as "interventions that aim to identify and modify biomedical, behavioral, and social risks to a woman's health or pregnancy outcome through prevention and management by emphasizing those factors that must be acted on before conception or early in pregnancy to have maximal impact."[2] PCH and PCC involve addressing a range of issues like family planning, specific medical conditions (e.g., diabetes), exposure to teratogens, substance abuse, and preventive interventions (e.g., immunization and folic acid supplementation).[3]

In 2008, the CDC Select Expert Preconception Panel's PCC Clinical Workgroup outlined those content areas important to identify and address to improve maternal and infant outcomes[4] and identified implementation strategies as a top priority.[5] In 2013 the National Action Plan for Promoting PCH in the U.S. identified the goals of: improving the knowledge, attitudes and behaviors of men and women related to PCC; eliminating disparities in adverse maternal, fetal and infant outcomes; and assuring that all U.S. women of childbearing age receive PCC services.[6] Progress towards the Healthy People 2020 goal to eliminate disparities requires that rates of adverse health outcomes fall more rapidly for AA women, which is why the Gabby system was designed for this group.

Health information technology presents opportunities to develop innovative tools that assist clinicians in delivering PCC[7], and to engage and empower women to improve their PCH. Among the most encouraging advances is the conversational agent, a computerized, animated character that integrates best practices from provider-patient communication theory. They emulate the face-to-face conversational behavior of an empathic clinician, including nonverbal communicative behavior such as gaze, posture, and hand gestures, to deliver tailored education, assess comprehension, and record progress.[8, 9, 10] Conversational agents are a logical option to deliver PCH information as they can reach a large audience while providing high user acceptability through culturally-appropriate content and information appropriate to those with low health literacy.[11, 12] AA women may benefit from conversational agents due to disparities in health literacy levels as according to the 2006 report by the U.S. Department of Education, 58 percent of AA adults possess Below Basic

or Basic health literacy, compared to 28 percent of white adults.[13] There is also evidence that clinicians are more verbally-dominant and less patient-centered with AA patients,[14] and that these systems can overcome clinician time constraints[15] and assist in delivering recommended preventive care.[16] Conversational agents have also been used in studies that have shown significant clinical impact on outcomes.[11, 17, 18]

Given the success of our previous conversational agent work in inner city patients our research team spent five years developing and testing the conversational agent "Gabby," who is designed to be used by consumers to improve their PCH and seek PCC (Figure 1). Gabby can: identify women's individual health risks and assess their readiness for behavior change; provide information about each risk; and deliver longitudinal behavior change content to promote adoption of healthy behaviors and risk resolution. The system helps women create a "My Health To-Do List," a personal tool that can be updated throughout the intervention to track progress.

Our earlier testing of "Gabby" demonstrated that the system had potential to help AA women address preconception risks over a two month period.[19] In this paper we report on an enhanced version with more sophisticated elements, including tracking stages of behavioral change, which we tested in a small 6-month randomized controlled trial (RCT) of non-gravid AA women, most in college, to determine how well Gabby works and to identify additional areas for improvement. The ultimate goal is to produce an effective Gabby system for utilization either solely by women and/or integrated into shared decision making care targeting inner city, high risk, AA women with lower education and health literacy.

METHODS

We conducted a RCT from March 2013 to February 2014 to determine if interacting with Gabby could reduce the proportions, numbers, and types of PCH/PCC risks compared to a control group without access to Gabby. The study was approved by the Boston University Medical Center (BUMC) Institutional Review Board.

Design and Implementation

New dialogue scripts and supporting media were developed for Gabby to include: (1) motivational interviewing dialogue those who were "pre-contemplative" for a specific risk; (2) dialogue to simulate shared decision making interactions with clinicians; and (3) additional longitudinal interaction using techniques such as "goal setting," "problem solving," "tips," and "homework."

Sample

A purposeful, convenience sample of 100 women who self-identified as AA or black, were 18–34 years of age, had access to a telephone and computer with internet, were English-speaking, and self-reported not pregnant at enrollment were enrolled from 20 states and the District of Columbia. Participants were recruited through the US Department of Health and Human Services Office of Minority Health's national Preconception Peer Educator program[20] (n=86), a Healthy Start site in Florida (n=8), a Health Expo in Boston (n=4), and word of mouth (n=2). Recruitment materials included emails, flyers, and word of mouth.

Baseline Data

After verbal informed consent by telephone, we collected: contact information, demographics, and administered the General Self Efficacy Scale (GSE),[21] Multidimensional Scale of Perceived Social Support (MSPSS),[22] Everyday Discrimination Scale (EDS),[23] and the 66-word Rapid Estimate of Adult Literacy in Health (REALM).[24]

Randomization and Risk Assessment

Participants were randomized into the Gabby and control groups using sequentially numbered, opaque, sealed envelopes containing the random group assignment. All subjects received an email with the required system log-in information and were asked to complete the risk assessment, which included 107 distinct PCH risk factors classified among 12 content areas. A full description of the content areas and risks has been published,[20] are listed in Table 2, and outlined in the Appendix. All women received a reminder email with a link to the survey one week post-enrollment, then bi-weekly reminders until they completed the survey.

Gabby Group

Women in the Gabby Group received bi-weekly reminder emails with a link. Each interaction consisted of: 1) greeting from Gabby; 2) review of identified health risks (“My Survey Results’); 3) discussion of risks as selected by the woman (including educational content and behavior change counseling); and 4) review and update of the “My Health To-Do List”, which lists the previously-discussed risks and self-reported progress (Figure 2).

Control Group

Each control participant received a letter in the mail containing her list of PCH risks, with the suggestion to discuss her list with a health care provider.

Outcome Data

Six-month outcome data were collected from all women using an online survey followed by telephone call; questions not completed online were asked in the telephone call. Information was obtained about each baseline PCH risk to determine if it was still ‘active’ or ‘resolved.’

Additional outcome data collection included: assessment of healthcare usage during the study period, questions about pregnancy status and outcome, system satisfaction (Gabby group), and risk letter satisfaction (Control group). Number and length of logins was documented within the system. Participants received a $15 iTunes gift card after completing the outcome phone call.

Statistical Analysis

Baseline demographic, clinical, and information technology usage characteristics were compared using two-sided t-tests for continuous variables and chi-square tests or Fisher’s exact tests for categorical and dichotomous variables. Within each PCH content area, we compared the proportion of Gabby and control participants who triggered at least one risk, the aggregate number of risks triggered (applying the Z-test for proportions), and the

triggered risk rate utilizing the aggregate number of risks triggered divided by the number of participants completing the risk assessment.

To assess the Gabby impact, we first compared the average number of risks resolved between the Gabby and control groups using a two-sample t-test among participants who completed the risk assessment and the outcome interview. We then compared the proportion of participants who resolved at least one of the risks in each content area out of those who triggered at least one risk at baseline (Chi-square/Fisher's exact tests). The aggregate numbers of risks resolved were calculated by dividing the number of risks resolved by the number triggered at baseline (Z-tests for proportions). Finally, we looked at rates of risks resolved within the content areas by study group. The rates were calculated by dividing the aggregate number of risks resolved within a content area by the number of participants who triggered at least one risks in this domain at baseline and compared between the two study groups utilizing crude Poisson regressions.

RESULTS

A total of 100 women who met all inclusion criteria were consented and randomized into the study. Complete baseline and six-month outcome data were obtained from 36 women in the Gabby group and 41 in the control group (Figure 3). There was no significant difference in response rates between groups (p=0.34).

The demographic, clinical, and information technology characteristics of the 99 women who provided baseline data are presented in Table 1. The average age was 25.5 years; about two thirds were employed at least part-time and completed at least some college, and 41% were students. Over 90% read at the high school level or better, and the majority reported high self-efficacy, high social support, and low perceived racial discrimination. More than half had computer access at home and all used a computer regularly or considered themselves expert. Over 90% had used computers to access online health information. There were no significant differences in the demographics, clinical characteristics, or information technology literacy and availability between groups.

Table 2 shows the content areas of risks reported at baseline and those risks resolved or improved in 6 months by study group. The average number of risks triggered was 23.7 (S.D. 5.9), per participant, 23.2 (5.95) for the Gabby group and 24.2 (5.84) for the control group. A total of 2,158 risks were triggered by the 91 participants who completed the risk assessment, 1067 by the Gabby group, and 1091 by the control group. The most common content area triggered among all participants was "Nutrition and Activity," (27.5%), followed by "Infectious Disease" (16.4%), "Environmental Issues" (10.2%), and "Immunizations and Vaccines" (8.8%). The specific risks within each content area are listed at the bottom of Table 2.

During the 6-month intervention period, 42 women interacted with Gabby at least once. There were a total of 144 interactions totaling 2,676 minutes. The average session lasted 18.6 (S.D 12.1) minutes and the average interaction time with Gabby during the study was 63.7 (S.D 70.4, range 2.8–286) minutes per woman. Thirty percent of the total time

interacting with Gabby was spent discussing “Nutrition and Activity,” and 10.3% was spent discussing “Reproductive Health.”

Significant differences in risk resolution were found between the Gabby and control groups. Among the 77 women for whom both baseline data and six month outcome data were available, 27.8% (297/1,067) of the reported risks were resolved in the Gabby group, compared to 20.5% (224/1,091) in the control group (Table 2, $p<0.01$). At six months, women in the Gabby group resolved 8.3 risks on average (from 23.2 identified on average), compared to 5.5 (of 24.2) in the control group, ($p<0.01$). The risks most often resolved by those in the Gabby group were: “Bad diet or food choices” (18 resolved), “Not using multivitamin with folic acid or folic acid supplement” (16), “At risk for sexually transmitted infection” (15), “Not taking iron supplement” (13), “Use of caffeine” (12), and “At risk for tuberculosis” (12). These six risks accounted for 29 percent of the risks resolved among the Gabby group. On the other hand, there were clinically-important risks that infrequently or never resolved, such as: “Any current tobacco use” (0 Gabby group participants resolved it out of 6 identified at baseline); “Currently taking any over-the-counter medicines” (1 resolved out of 13); and “No birth control” (3 resolved out of 20).

Most women in the Gabby group felt that it was easy to talk with Gabby (78%) and reported that they trusted her (59%). More than half (56%) stated that Gabby did a good job of answering their questions, almost two thirds reported that they had used information from Gabby to improve their health, and another 22% planned to do so in the future.

DISCUSSION

The study findings demonstrate that among a group of mostly college-educated, computer literate African American women, the Gabby system can identify preconception risks and initiate actions to reduce the number of preconception risks. Interacting with Gabby was significantly associated with a higher proportion (28% vs 21%) and a greater average number (8.3 vs 5.5) of PCH risks being resolved within 6 months compared to women who did not interact with Gabby.

The Gabby system allows women to choose what risks to discuss and when, allowing a woman to avoid talking about risks that might be very important to her health and the health of a future baby (e.g. substance use, intimate partner violence), which can lead to shortfalls where a serious risk is identified but discussion and intervention are avoided. However, our previous qualitative work supports providing autonomy and supporting a shared decision making approach that is more empowering.[20]

The nutrition and physical activity content area contained the most risks triggered, discussed, and resolved. The Nutrition section is unique within the Gabby program as it features a curriculum, allowing users to “browse” through a menu of topics; this approach will be applied to other content areas, such as reproductive life planning, in future versions. The system will also feature more culturally-tailored content to engage young AA women from a social context.[25] Current development includes adding six narratives that provide background into Gabby’s “personal life” and conversational dialogue about topics such as

hair care, skin care, relationships, and other topics more immediately relevant and applicable to young women's lives.

Our findings regarding participants' trust in Gabby are consistent with other studies that indicate patients prefer sharing sensitive information with computerized agents who they perceive to be less judgmental and have more time than traditional providers.[26] Gabby group participants also reported that it was easy to talk to Gabby and most indicated that they had already or were planning to use information from Gabby to improve their health. They were also more likely than those in the control group (64% vs 51%, p=.21) to report at least one primary care appointment within 6 months, an important but non-significant finding potentially due to the relatively short follow-up period. We believe that women will be asking for interactive health information technology systems, and systems like Gabby will become an important part of health promotion in the future.

In its current state, the Gabby system is designed for use on a desktop or laptop computer; uptake of the system may have been limited due to the preference of our target population to use a telephone or tablet instead of traditional computer. The average 2.9 logins per user over 6 months fell short of our ideal goal of one session per week and underscores the need to plan for the future of Gabby and how women will interact with her outside of the research setting. Mobile devices are an obvious channel, but others, such as integration into clinics and community centers, offer the benefit of weaving Gabby in to existing infrastructure, allowing Gabby to immediately connect to services, counseling, and initiate referrals. Moreover, multiple channels could be used simultaneously to reach a broader audience.

A limitation of this research is that the follow-up period was relatively short and behavior change takes time. In addition, data are self-reported and participants potentially could have misunderstood a question, accidentally selected the wrong response, or provided intentional misinformation. There could also be social desirability bias when reporting risk status to staff, recall bias affecting baseline and follow-up data, and self-selection bias for study participation.

Another limitation that may have led to an underestimation of Gabby's impact is that the control group also received an intervention with the personalized letter listing their identified risks and suggesting that they share this information with their health care provider.

Building on the information gleaned from this RCT we continue to enhance the Gabby system and in 2015 we are recruiting nationally for a much larger RCT to include women from a broader range of educational attainment and health literacy over a 12 month period to determine the impact on PCH risk mitigation. Additional research is planned to determine the impact on clinical outcomes, health care utilization and ultimately whether Gabby and even a parallel system for male PCH can meaningfully impact some of the racial disparities in reproductive outcomes.

CONCLUSIONS

This version of the Gabby system, with its personally-tailored, relational and comprehensive approach, holds great promise for improving access to the primary and preventive care assessments women need in order to prepare for pregnancy. The information gleaned has informed the next version which is being tested in a much larger RCT. Additional research is also needed to investigate how Gabby can help African American women set their own positive reproductive health agendas, achieve meaningful health behavior changes, and engage in beneficial discourse with their healthcare provider, partners, and others who provide assistance and support. Gabby can potentially address problems regarding fidelity and cultural sensitivity of message, scale, ease of delivery, and clinician time constraints and can be used across a range of settings, addressing problems identified as barriers to translating PCC best practices to clinical care[27].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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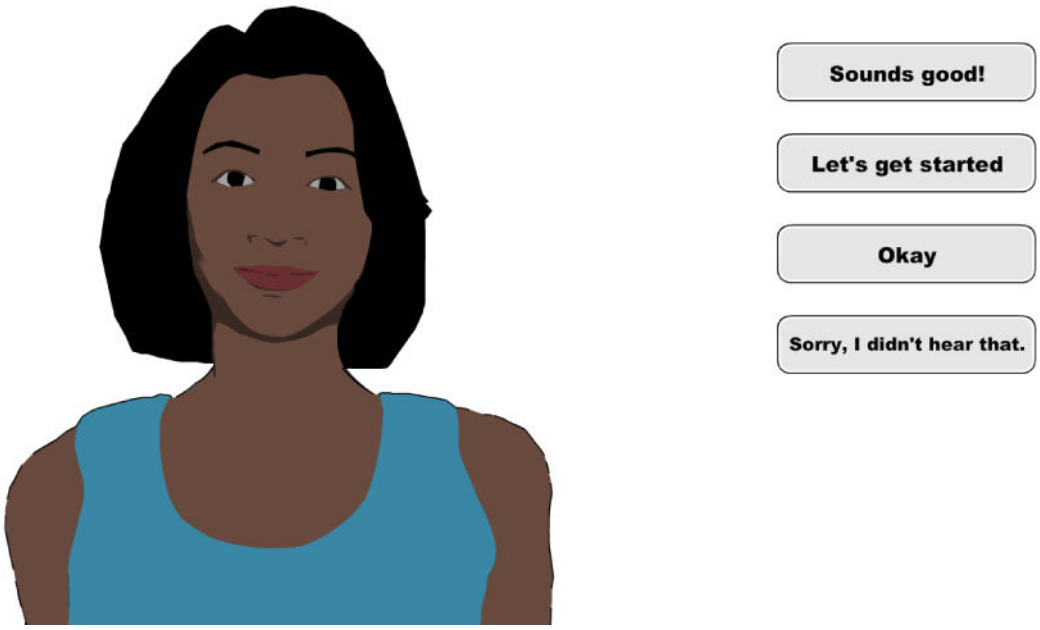

Figure 1.
An Image of “Gabby,” the Preconception Care Conversational Agent

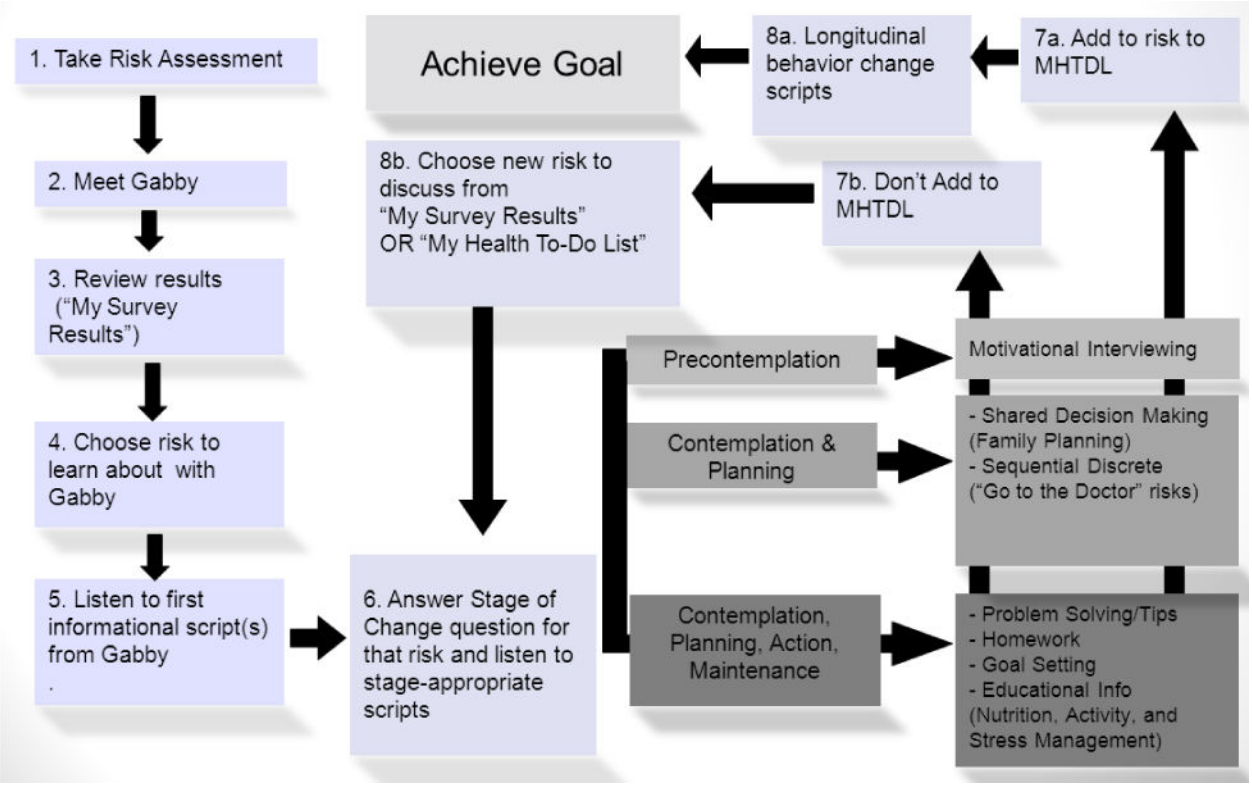

Figure 2.
Diagram of a typical Gabby System interaction

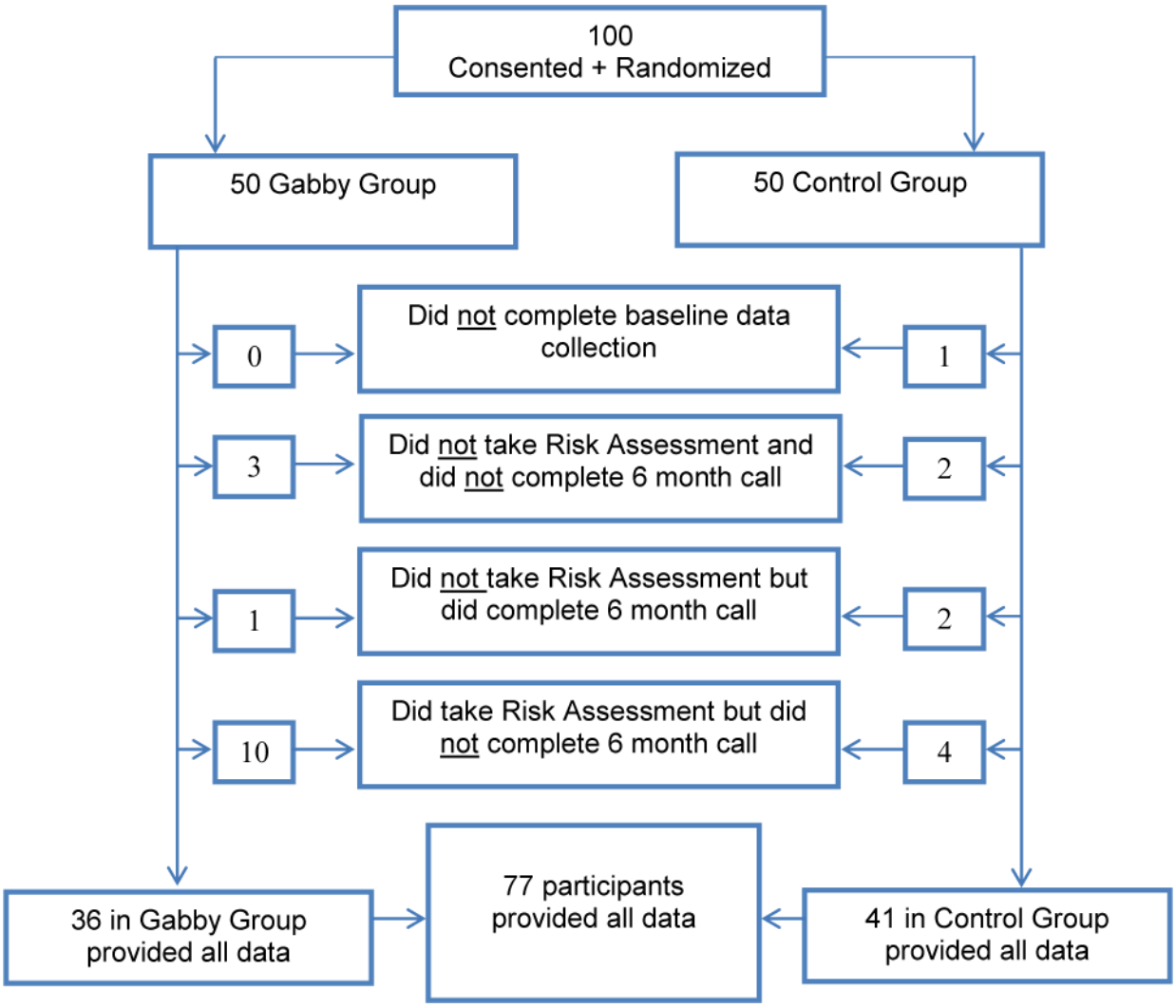

Figure 3.
Diagram of subject participation in study phases

Table 1

Participant Demographics, Clinical Characteristics, and Computer Literacy and Availability* by Study Group (n=99)

	Gabby Group (n=50)	Control Group (n=49)
DEMOGRAPHICS		
Age (Mean(SD))	25.86(3.38)	25.12(3.66)
Of Hispanic, Latino, or Spanish origin (N(%))		
No	47 (94.0%)	47 (95.9%)
Yes	3 (6.0%)	2 (4.1%)
Household Income (N(%))		
Less than $20,000	3 (6.0%)	3 (6.1%)
$20,000–$50,000	13 (26.0%)	7 (14.3%)
$50,000 or more	15 (30.0%)	23 (46.9%)
Don't know/Refused	19 (38.0%)	16 (32.7%)
Education (N(%))		
At least some college	36 (72.0%)	30 (61.2%)
Less than college	14 (28.0%)	19 (38.8%)
English as a primary language (N(%))		
No	5 (10.0%)	1 (2.0%)
Yes	45 (90.0%)	48 (98.0%)
Currently a student (N(%))		
No	30 (60.0%)	28 (57.1%)
Yes	20 (40.0%)	21 (42.9%)
Currently employed full-time or part-time (N(%))		
No	16 (32.0%)	12 (24.5%)
Yes	34 (68.0%)	37 (75.5%)
CLINICAL CHARACTERISTICS		
REALM Score Mean(SD)±, ±±		
	61.54 (11.22)	63.00 (4.79)
REALM - 2-category N (%)§		
High School	42 (91.3%)	40 (88.9%)
Less than High School	4 (8.7%)	5 (11.1%)
General Self-Efficacy Scale Mean (SD)//		
	33.88 (4.67)	33.76 (3.78)
Multidimensional Scale of Perceived Social Support Mean(SD)¶		
	71.00 (9.43)	70.14(9.11)
Everyday Discrimination Scale- 10-item, Mean(SD)#		
	12.44 (8.89)	12.73 (6.83)

	Gabby Group (n=50)	Control Group (n=49)
INFORMATON TECHNOLOGY LITERACY AND ACCESS		
Location of accessible computer N(%)		
Home	27 (55.1%)	28 (57.1%)
Work	15 (30.6%)	17 (34.7%)
Other	7 (14.3%)	4 (8.2%)
Computer Experience (N(%)		
I'm an expert	23 (46.0%)	28 (57.1%)
I use one regularly	27 (54.0%)	21 (42.9%)
I've never used one	0(0%)	0(0%)
I've tried one a few times	0(0%)	0(0%)
Computer Attitude N(%)		
I love playing with them	45 (90.0%)	42 (85.7%)
They're okay	5 (10.0%)	7 (14.3%)
I don't like them	0 (0%)	0 (0%)
Do you ever read about health information online? N(%)		
No	3 (6.0%)	3 (6.1%)
Yes	47 (94.0%)	46 (93.9%)
Do you ever ask questions or share health information on social networking sites like Facebook, Twitter, or elsewhere? N (%)		
No	18 (36.0%)	24 (49.0%)
Yes	32 (64.0%)	25 (51.0%)
How frequently do you use the internet for health information? N(%)		
Never	3 (6.0%)	3 (6.1%)
Rarely	2 (4.0%)	1 (2.0%)
Sometimes	18 (36.0%)	17 (34.7%)
Frequently	9 (18.0%)	16 (32.7%)
Very Frequently	18 (36.0%)	12 (24.5%)

* None of the data were statistically significant between the two groups at baseline.

± Columns do not always add up to number of participants because of missing data.

±± **REALM Score**[25]: The REALM is a screening tool designed to measure adults' ability to read common medical words or lay terms that correspond to anatomy or illnesses. It is a 66-item list, with possible scores ranging from 0–66.

§ **REALM - 2-category**: REALM scores dichotomized by: High school or above (score of 61–66), and Less than high school (60 or below).

// **General Self-Efficacy (GSE)**[22]: 10-item psychometric scale designed to assess optimistic self-beliefs related to ability to cope with difficult demands in life. Response options were: Never (1), Sometimes (2), Usually (3), or Almost Always (4), with possible score ranging from 10–40.

¶ **Multidimensional Scale of Perceived Social Support (MSPSS)**[23]: 12-item scale to measure perceived support from family, friends, and significant others. Response options ranged between: Strongly Disagree (1), Neutral (4), Strongly Agree (7), and were summed for total score.

Everyday Discrimination Scale (EDS)[24]: 10-item scale to measure perceived frequency of 10 specific discriminatory experiences. Response options include: Never (0), Less than once a year (1), A few times a year (2), A few times a month (3), At least once a week (4), Almost every day (5), with a possible total score ranging from 0–50.

Table 2

Risks Identified on Baseline Survey and Risks Reported to be Resolved or Improved at 6 months, by Content Area and Study Group

		Gabby Group Baseline N=46, 6-Months N=36	Control Group: Baseline N=45, 6-Months N=41	p-value
Emotional and Mental Health Risks	Participants who triggered one or more risks (%)	21 (45.6%)	19 (42.2%)	0.74
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	12/18 (66.7%)	4/16 (25.0%)	0.02
	Risks triggered that were resolved/total # risks triggered	15/35 (43.0%)	4/32 (13.0%)	0.01
Environmental Risks	Participants who triggered one or more risks (%)	44 (95.6%)	43 (95.6%)	1.00
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	11 (32.4%)	5 (12.8%)	0.04
	Risks triggered that were resolved/total # risks triggered	13/119 (10.9%)	6/102 (5.9%)	0.18
Genetic Health History Risks	Participants who triggered one or more risks (%)	46 (100.0%)	45 (100.0%)	0.32
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	14/36 (38.9%)	12/41 (29.3%)	0.37
	Risks triggered that were resolved/total # risks triggered	19/71 (26.8%)	15/67 (22.4%)	0.55
Health Care Risks	Participants who triggered one or more risks (%)	16 (34.8%)	31 (68.9%)	0.01
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	5/12 (41.7%)	5/27 (18.5%)	0.13
	Risks triggered that were resolved/total # risks triggered	8/34 (23.5%)	7/64 (10.9%)	0.09
Health Conditions and Medicines Risks	Participants who triggered one or more risks (%)	28 (60.9%)	28 (62.2%)	0.89
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	12/22 (54.5%)	5/25 (20.0%)	0.01
	Risks triggered that were resolved/total # risks triggered	14/41 (34.1%)	8/36 (22.2%)	0.25
Immunizations and Vaccines Risks	Participants who triggered one or more risks (%)	38 (82.6%)	42 (93.3%)	0.12
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	17/30 (56.7%)	15/38 (39.5%)	0.16
	Risks triggered that were resolved/total # risks triggered	25/80 (31.3%)	21/111 (18.9%)	0.05
Infectious Diseases Risks	Participants who triggered one or more risks (%)	46 (100.0%)	45 (100.0%)	NA
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	25/36 (69.4%)	23/41 (56.1%)	0.23

		Gabby Group Baseline N=46, 6-Months N=36	Control Group: Baseline N=45, 6-Months N=41	p-value
	Risks triggered that were resolved/total # risks triggered	52/172 (30.2%)	44/182 (24.2%)	0.20
Men and Health Care Risks	Participants who triggered one or more risks (%)	31 (67.4%)	26 (57.8%)	0.34
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	5/25 (20.0%)	9/23 (39.1%)	0.15
	Risks triggered that were resolved/total # risks triggered	7/64 (10.9%)	14/39 (35.9%)	0.01
Nutrition and Activity Risks	Participants who triggered one or more risks (%)	46 (100.0%)	45 (100.0%)	NA
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	32/36 (88.9%)	29/41 (70.7%)	0.05
	Risks triggered that were resolved/total # risks triggered	101/292 (34%)	67/302 (22.2%)	0.01
Relationships Risks	Participants who triggered one or more risks (%)	21 (45.6%)	30 (66.7%)	0.04
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	5/16 (31.3%)	6/27 (22.2%)	0.51
	Risks triggered that were resolved/total # risks triggered	10/36 (27.8%)	9/53 (17.0%)	0.22
Reproductive Health Risks	Participants who triggered one or more risks (%)	40 (87.0%)	38 (84.4%)	0.73
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	10/31 (32.3%)	9/34 (26.5%)	0.61
	Risks triggered that were resolved/total # risks triggered	16/87 (18.4%)	12/62 (19.4%)	0.88
Substance Use Risks	Participants who triggered one or more risks (%)	27 (58.7%)	25 (55.6%)	0.76
	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	10/20 (50.0%)	11/22 (50.0%)	1.00
	Risks triggered that were resolved/total # risks triggered	17/36 (47.2%)	17/41 (41.5%)	0.61
Totals	Participants with at least one risk resolved/# participants reached at follow up who had triggered at least one risk (%)	36/36 (100.0%)	37/41 (90.0%)	
	Risks triggered that were resolved/total # risks triggered (%)	297/1067 (27.8%)	224/1091 (20.5%)	<0.01

Emotional and Mental Health: History of diagnosis of: depression, anxiety, bipolar disorder, or schizophrenia; Depression (PHQ-2 ≥ 3[28]); Stress (4-item Perceived Stress Scale score ≥ 8[29]); Family history psychiatric conditions (depression, anxiety, schizophrenia, bipolar disorder).

Environmental Issues: Exposure to lead; At risk for toxoplasmosis; Living near toxic waste or "superfund" site; Untested well water in the home; Frequently drinking from plastic water bottles; Frequently eating food from cans with a white plastic lining; Reported workplace exposure to chemicals or dangers; Reported exposure to potentially toxic household chemicals.

Genetic Health History: Ethnicity-based genetic health risk based on ancestry; Family history of a genetic health condition; Personal history of a genetic health condition; Need to learn family health history.

Health Care and Programs: Inadequate financial resources; Does not have health insurance; Inadequate health insurance; Does not have primary care physician; Not been to dentist in over a year.

Health Conditions and Medicines: History of diagnosis of: diabetes, pre-diabetes, gestational diabetes, hyper- or hypo-thyroidism, phenylketonuria, seizures, hypertension; rheumatoid arthritis; lupus; renal disease, cardiovascular disease, thrombophilia, asthma; History of diagnosis of a disability; History of diagnosis of cancer; Currently taking any prescription medications; Currently taking any over-the-counter medicines.

Immunizations and Vaccines: Need human papillomavirus vaccine; Need hepatitis B vaccine; Need hepatitis C vaccine; Need varicella vaccine; Need measles, mumps, and rubella vaccine; Need influenza vaccine; Need tetanus vaccine; Need tetanus-diphtheria-pertussis vaccine; Unsure of immunization record.

Infectious Diseases: At risk for sexually transmitted infection; Sexually active and not been tested for sexually transmitted infections; History of diagnosis of: human immunodeficiency virus, hepatitis C, tuberculosis, gonorrhea/chlamydia/syphilis, herpes simplex virus; At risk for: tuberculosis, malaria, cytomegalovirus; Not born in the United States.

Men and Healthcare: Partner has not been to doctor in >1 year; Partner does not have primary care physician; Partner not counseled on reproductive life plan.

Nutrition and Activity: Bad diet or food choices (< 5 daily servings of fruits and vegetables and/or regular intake of junk food); Possibly taking too much vitamin A; Not using multivitamin with folic acid or folic acid supplement; Use of herbal or weight loss supplements; Not taking supplements of: vitamin D, calcium, iron; Need more essential fatty acids in diet; At risk for toxic levels of mercury; At risk for listeriosis; Underweight (BMI <18.5); Overweight (BMI ≥ 30); Self-reported potential eating disorder; Use of caffeine; Not enough exercise (< 30 minutes per day, 5 days per week).

Relationships: History or current physical or sexual abuse; History or current emotional or verbal abuse; Does not feel safe.

Reproductive Health: Does not use birth control; Uses withdrawal method of birth control; Uses other less effective birth control method (Plan B, Rhythm/natural family planning method, or “Other”); History of preterm birth; History of infant born low or high birth weight; History of cesarean-section; History includes 1 or 2 miscarriage(s); History includes 3 or more miscarriages; History includes 2 or more miscarriages in second trimester; History of abortion; History of stillbirth; History of uterine anomalies; History of infant or child death; Less than 3 months between past pregnancies; History of vaginal bleeding late in pregnancy; History of infant in NICU; History of infant with a birth defect; Participant was born preterm or low birth weight; Participant’s mother born preterm or low birth weight.

Substance Use: Excessive alcohol (≥ 4 drinks in a day over the past year); Any current tobacco use; Any illicit substance use in the last year.