Youth-led development of a Chatbot to Increase Early Prenatal Care Utilization in Santa Cruz County, Arizona

A TECHNICAL BRIEF on the Arizona Initiative of the Border States CoIIN

Why is First Trimester Prenatal Care Important?

Accessing early and ongoing prenatal care is critical for ensuring healthy moms and babies. Prenatal care initiated in the first trimester has been linked to a decrease in several negative birth outcomes, including preterm births, low birth weight and infant mortality. [1]

High quality, respectful prenatal care obtained throughout pregnancy – at a time when many women have more frequent contact with health care than any other time in their lives – can also help to establish a strong relationship of trust with a health care provider that can benefit both mother and baby well beyond the pregnancy. Moreover, frequent contact with the health care system during pregnancy and the perinatal period offers important opportunities to identify and address other health factors and related social determinants of health that can impact the health and well-being of the entire family across the life course. For this reason, reducing disparities in prenatal care access and utilization is of critical importance for mitigating life-long inequalities in the social determinants of health.

Prenatal Care Disparities & User Experiences: Santa Cruz County, Arizona

Studies show that women in the US - Mexico border region have higher fertility rates, higher rates of late or no prenatal care and higher rates of teen and unintended pregnancies.[1,2] In Santa Cruz County, Arizona, U.S. which lies at the southern border with Mexico, young people aged 14-24 are the group with the lowest rates of early prenatal care when compared to all other groups. According to 2017-2018 data from Arizona Department of Health Services' Bureau of Women and Children's Health, only 45% of women aged 14-24 years began prenatal care in the first trimester in Santa Cruz County, compared to 54% of women of all other ages in the county, and 63% of women 14-24 in the State of Arizona as a whole. Similarly, only 31% of women aged 14-24 years in Santa Cruz County received adequate or adequate plus prenatal care (a national benchmark that measures timing and frequency of prenatal visits)[3], compared to 69% of women of all ages in the state who received adequate or more prenatal care.

Between 2017 and 2020, the **Border States CoIIN** (Collaborative Improvement & Innovation Network), led by PCI, worked with cross-sectoral teams across four U.S. states between 2017 and 2020 to achieve a common aim: to increase early prenatal care utilization by 10% among women in targeted impact areas of California, Arizona, New Mexico and Texas through the development of place-based improvement strategies that address the social determinants of health.

The Border States Collaborative Improvement and Innovation Network (CoIIN; see inset) Arizona team sought to better understand barriers associated with the initiation of first trimester prenatal care among youth in Santa Cruz County to inform the design of innovative solutions to help overcome these barriers. As part of that effort, the team spoke with over 50 teens and young adults and learned that lack of knowledge about pregnancy status, stigma, fear and shame were primary reasons for not utilizing prenatal services. Several studies support these findings. For example, Selchau et al (2017) found that women in the border region were often unaware of their pregnancy status and therefore did not seek services until later in the pregnancy, especially early prenatal care services. Other reasons include fear and shame associated with unwanted pregnancies, especially for teen mothers; lack of health insurance, work and transportation issues; and, a lack of trust in providers or the health care system.[1,2]

Defining Success & Designing for Results

To guide the development of innovative solutions around increasing timely prenatal care among youth, the Arizona CoIIN team collaboratively developed a theory of change (see Figure 1), based on input from young people in the target area and data gathered around barriers to care.

The team hypothesized that by providing a safe, low-tech way to gain knowledge about their health through individualized, confidential and culturally appropriate sexual and reproductive health messaging for primarily Hispanic young people in Santa Cruz County, they would feel reassured and empowered to seek out trusted information and clinical preventive care before they become pregnant. This, in turn, will improve their health and access to timely, quality early care if and when they do become pregnant, and ultimately result in increased early and ongoing prenatal care utilization among young people in Santa Cruz County.

Billboard developed by MYAB to advertise YoSShi and MCHC services (July, 2020)
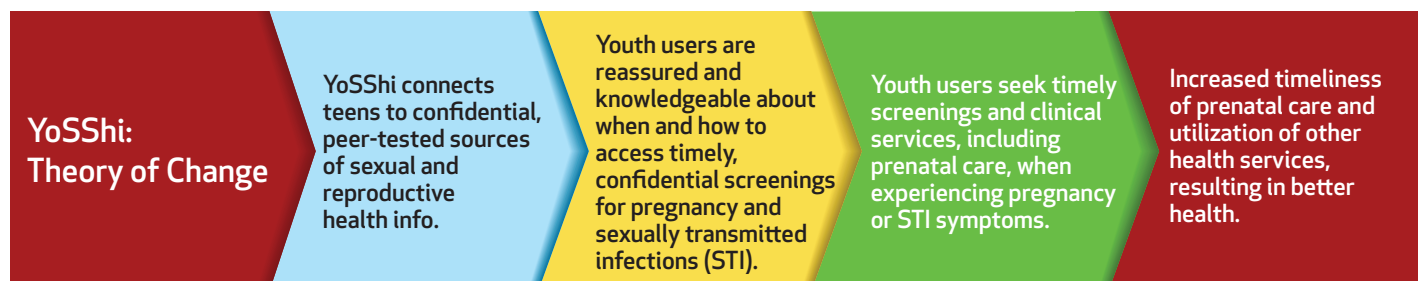

Figure 1: Theory of change illustrating YoSShi intervention to increase entry into timely prenatal care and other health services by initiating a cascade resulting in improved health outcomes

Based on the theory of change, the Arizona CoIIN team, under the leadership of state lead organization Mariposa Community Health Centers (MCHC), established a team goal to develop an approach that incorporates digital technology to educate, inform and remind consumers from preconception through first prenatal visit with the outcome of increasing first trimester prenatal care by 10% by 2020.

Over an 18-month period beginning in March 2018, the team utilized human centered design methods to develop and pilot test an interactive chatbot named YoSShi (Youth Seeking Sexual Health Information), a technological solution to help young people in Santa Cruz County overcome barriers to accessing timely care and, by extension, reduce their risk for poor outcomes.

Arizona CoIIN Team Goal:

Develop an approach that incorporates digital technology to educate, inform and remind consumers from preconception through first prenatal visit with the outcome of increasing first trimester prenatal care by 10% by 2020.

A chatbot is an internet-based technological platform used to initiate and conduct text conversations instead of having direct contact with an agent. YoSShi allows users to privately ask questions related to reproductive health issues, and receive tailored, peer-tested info about sexual and reproductive services and options for avoiding an unwanted pregnancy, highlighting free and confidential services available at MCHC.

The tool was prototyped and validated through a rapid user simulation at a clinic site during a one-week design sprint in May 2018, then tested and refined through 2019 with over 20 cohorts of local youth and stakeholders who provided direction and feedback on every aspect of its development.

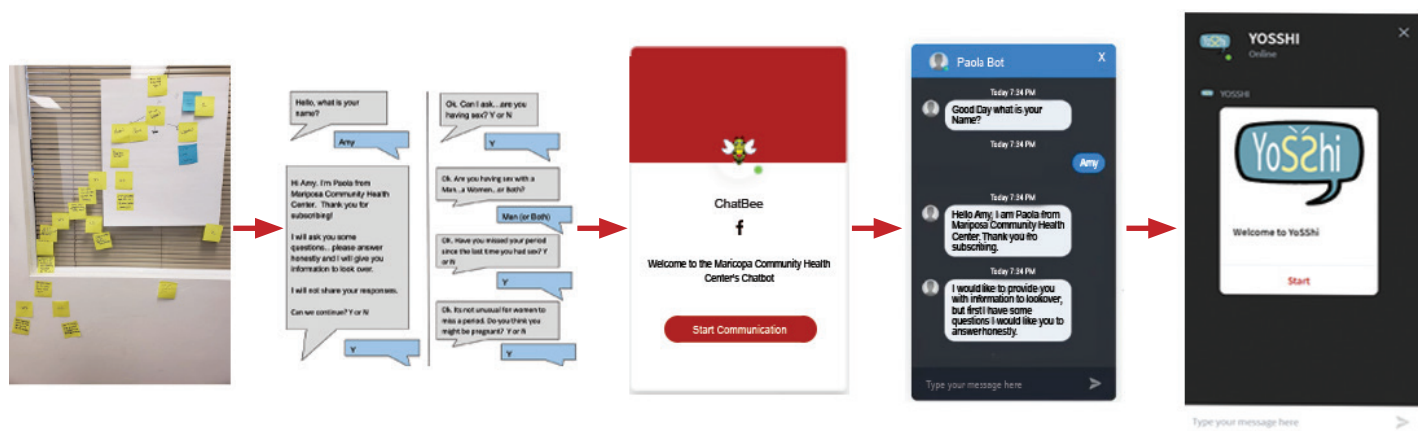*Santa Cruz county youth offer suggestions for improving YoSShi during a focus group discussion.*

Figure 2: YoSShi's development process from conception to a finished product

Content development

Input from end users both on content development and marketing/branding of the chatbot was prioritized through iterative cycles of testing and feedback. Testing cycles were structured using a quality improvement approach known as Plan, Do, Study, Act (PDSA). At the initial design sprint, test users helped the team validate the usefulness of the concept and gave feedback that allowed the team to decide on a messaging platform, such as a chatbot, as the most appropriate mode for information delivery among youth (as opposed to an app or text messaging). Through two focus group discussions with 21 participants and over 16 testing cycles with youth test users, the initial five scenarios tested at the design sprint were expanded to 17 diverse scenarios with multiple possibilities for conversation flow.

Over 70 youth participated in user testing and feedback on the chatbot, recruited through local university classes, Mariposa-based teams of peer health educators, and youth patients. The need for ongoing, systematic user feedback resulted in the development of the Mariposa Youth Advisory Board (MYAB), a group of five high school seniors who together worked to ensure youth and target population voices were elevated during YoSShi's development and launch (see inset). Ongoing end-user feedback resulted in more youth-friendly wording, the addition of detailed information about clinic services, provider contact first names, development of new and more diverse scenarios, and the evolution of the chatbot name and branding (from Paola bot, to Chatbee, and finally YoSShi).

Mariposa Youth Advisory Board (MYAB):

MYAB member engagement is a crucial component in content development, marketing and social media campaigns to promote YoSShi. Members participated in user testing and focus group discussions to edit existing content and develop new conversations. They also named, determined the color scheme and developed the logo for YoSShi. Moreover, they developed materials including posters, radio/newspaper ads and Instagram posts. The long-term goal is to empower MYAB members to take control of content, outcome measures and continued promotion of YoSShi.
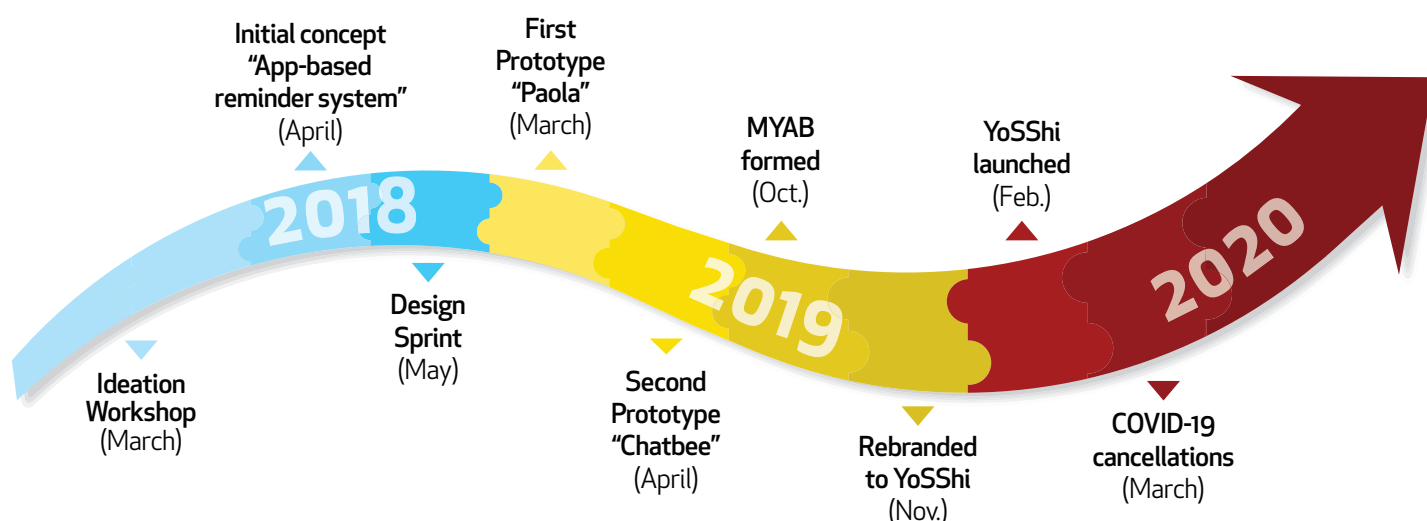
Figure 3: Timeline of activities and process milestones in YoSShi's development process from 2018 to 2020.

Since its launch through MCHC clinic sites and on Instagram in February 2020, the MYAB has promoted YoSShi through Facebook Live shows, school newspapers, local billboards, and on phone magnets, shoe cards and stickers distributed at clinic sites and by MYAB members, as well as through word of mouth.

Stakeholder Engagement

The development of YoSShi required a collaborative effort by multiple stakeholders at the national, state and local levels—all of whom are listed below. Partners were uniquely qualified to play critical roles in developing the idea and content as well as building the chatbot as a solution to address the need to increase entry into first trimester prenatal care.

- **PCI, a Global Communities Partner:** Backbone organization and Health Resources and Services Administration (HRSA) awardee that provided technical assistance for the Border States CoIIN.

- **Mariposa Community Health Center (MCHC):** HRSA/PCI subawardee, intervention site, primary location for chatbot content and marketing material development, user testing, and monitoring of clinic level outcomes. MCHC also facilitated the Mariposa Youth Advisory Board meetings.

- **Mariposa Youth Advisory Board (MYAB):** Santa Cruz County high school seniors who worked to ensure youth voices were represented during YoSShi's launch and development.

- **Arizona Department of Health Services (AZDHS):** State partner; participated in development and technical assistance meetings and provided data using vital statistics and birth record data to measure project success at the country level.

- **Population Health Improvement Partners:** HRSA's CoIIN Technical Assistance (TA) contractor who, along with Abt Associates, provided data TA and evaluation support to the Arizona team.

- **House Trevethan:** Local technology company contracted to develop the chatbot and track user data.

- **Northern Arizona State University:** Participated in development meetings and user testing by conducting focus groups with youth and providing recommendations for message content development.

- **University Of Arizona Mel and Enid Zuckerman College of Public Health:** Engaged in user testing activities through its strong communiy-based participatory action research partnership with MCHC; institutional home for YoSShi's Project Coordinator.

Measuring Success

The Arizona ColIN team set out to achieve several key outcomes, including the modelling of an end-user driven, data-informed approach to prenatal care timeliness; and the prototyping of a technological solution (chatbot) to help overcome barriers related to the social determinants of health for youth accessing prenatal services in Santa Cruz County, Arizona. Successful achievement of these outcomes is anticipated to have measurable impact on key health care utilization measures at the population level.

To measure YoSShi's impact on target population health measures, the Arizona ColIN team developed a comprehensive monitoring plan to track chatbot user data and user experiences, as well as clinic and county-level data on utilization of key health care services being promoted by YoSShi.

Key measures to be monitored and data sources are presented in Figure 4. Report formats and data systems to track key measures were implemented to accompany project launch, and data will be collected continuously by clinic staff through internal reporting systems.

YoSShi Measurement Plan	Data Sources
Percent of births to women 14-24 in Santa Cruz County with prenatal care in the 1st trimester Percent of births to women 14-24 in Arizona with prenatal care in the 1st trimester	Birth certificate data
Number of women 14-24 seen for prenatal care in the 1st trimester at MCHC Number of women 14-24 who received contraceptives at MCHC Number of women 14-24 screened for STIs at MCHC Number of women 14-24 who took a pregnancy test at MCHC	Clinic insurance claims data
Number of chatbot users Number of conversations initiated in chatbot Busiest time (month, week, day, hour)	YoSShi user data
User satisfaction (user testimonials)	YoSShi user data

Figure 4: Using diverse data sources to monitor key measures for project success at the state and local level

Results

The Arizona ColIN team achieved an important breakthrough in successfully modeling an approach for end-user driven, data informed improvements in accessing timely care. YoSShi evolved from an idea on a post-it note to a branded and fully operational chatbot being utilized across an entire county and integrated system-wide into a clinic network. This achievement is a testament to the potential for ColIN's integrated strategies of innovation, quality improvement and collaborative learning to result in real change; and to the capacity and vision of the Arizona state team.

With the launch of the Mariposa Youth Advisory Board, the team has successfully sustained direct engagement – and a true sense of ownership – on the part of young people in the design and data-informed development of solutions that affect them. Data visualizations generated from chatbot data to track the number of users and conversations by month has allowed the MYAB to monitor the impact of launch activities and adjust where necessary (See Figure 5). When many launch activities were cancelled due to Covid-19 in March 2020, MYAB members worked together virtually to adjust plans to incorporate contactless marketing strategies.
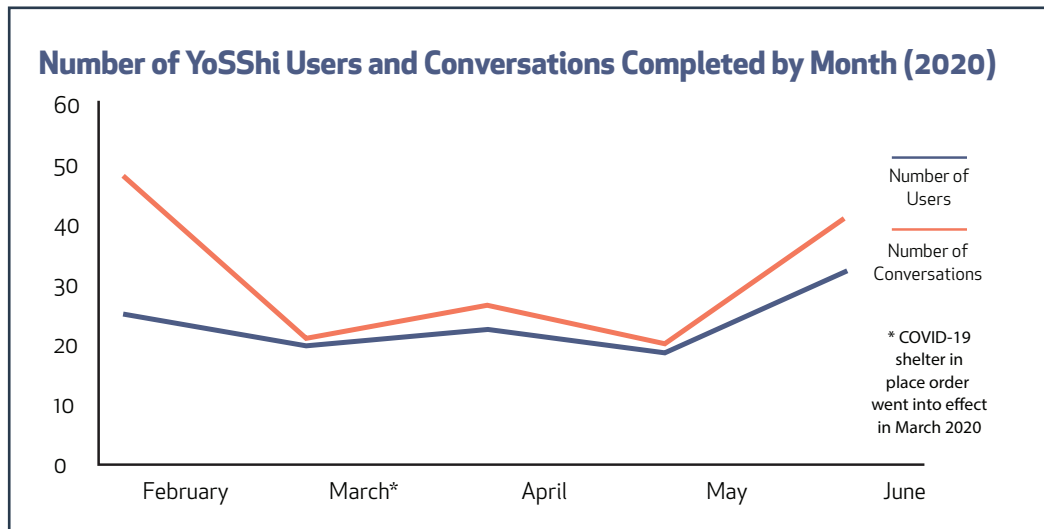
Number of YoSSHi Users and Conversations Completed by Month (2020)

Figure 5: Number of YoSSHi users and conversations completed post February 2020 launch.

Legend:
- Number of Users
- Number of Conversations
- * COVID-19 shelter in place order went into effect in March 2020

Chart x-axis: February, March*, April, May, June
Chart y-axis: 0 to 60

User Experiences

YoSSHi users consistently reported highly positive experiences. As part of measurement efforts, the CoIIN team collected qualitative data on user experiences throughout the development and launch process. Qualitative data, including quotes, online comments and testimonials, helped the team to understand if YoSSHi was seen as useful and valuable by youth. Preliminary qualitative data from users indicate a high level of satisfaction with YoSSHi. A 17-year-old user said, "It comes in handy especially during quarantine, it was like speaking to a person rather than a bot." Another said, "It was straightforward, and easy to use. I liked it." A third said, "YoSSHi helped me and my partner when we had questions. 10/10 would recommend." Instagram comments from those following YoSSHi via social media also confirmed satisfaction. A commenter said, "[YoSSHi is a] great tool for teens that are looking for answers." MYAB members promoting YoSSHi have received positive feedback from peers. One member stated, "I told one of my classmates about it since she was looking for info on birth control and I told her about YoSSHi and she said she really liked it." Other members echoed similar sentiments and said, "They liked it, it was easy to use and that they liked how at the end it gives all the resources one might need with the direct contact."

"It (YoSSHi) is unique and has lots of information and says, 'Someone is here, they want to help you, you should contact them.'" — 16-year-old user

"YoSSHi helped me and my partner when we had questions. 10/10 would recommend." — Youth YoSSHi user

"It comes in handy especially during quarantine, it was like speaking to a person rather than a bot." — 17-year-old YoSSHi user

Lessons Learned

Youth stakeholders brought unique perspectives and were critical from the project's inception in driving ongoing development and enhancement of YoSShi. Engagement of youth end-users throughout the process allowed youth to feel ownership and responsibility for the final product and project outcomes. Youth were vocal about feedback for improvements. For example, during a PDSA cycle for content testing, a 15-year-old said, "This part sounds judgey…and when the chatbot says 'I am not going to tell anyone,' that felt sketchy…no one says that!" When discussing YoSShi's relevance with youth, a 19-year-old said, "I think people would take their time for something like this if they really think it's important. This would be important, pregnancy, it would affect their lives because they would have to make a lot of choices."

A key component of the Arizona CoIIN team's strategy for developing YoSShi was to design with sustainability in mind. Thus, mobilization and buy-in on the part of institutional stakeholders, including MCHC leadership as well as state and local partners, was critical to leverage institutional resources that enabled the team to translate youth-led visions into reality. By involving MCHC's senior leadership, including the MCHC Chief Operating Officer, through presentations and sharing of prototypes, the team was able to secure the needed time for staff participation in YoSShi's development, and gained support for making systems-level changes required for its launch. Clinic staff were also asked to provide opinions about YoSShi, reflect on how influxes of new patients may affect workflow, and to discuss strategies for making accommodations. Other aspects of sustainability included working with state partners who not only provided county-level data, but engaged in dialogue about continued technical assistance and the possibility of future funding from the state health department.

Finally, this project emphasized the importance of data-driven decision making. By conducting small tests and allowing the results to guide the development process, the Arizona CoIIN team was able to confidently and sustainably move forward during each phase of YoSShi's development.

MYAB and clinic-based AZ CoIIN team attend MYAB meeting

Future Directions

Given the binational and bicultural context of Santa Cruz County, and the importance of language as a key social determinant of health, a recommended next step is to offer a Spanish version of the information provided through YoSShi. The team will also develop more content to encompass a wider range of scenarios and user experiences as informed by outcome data, continuous user testing, and based on input from MYAB. For example, during focus group discussions, youth participants discussed the need to have more information in the chatbot related to gender and sexuality, further expanding on the current script. They also suggested offering age-specific information considering the diversity of life experiences for 14-24-year-olds. In addition, the Arizona CoIIN team would like to explore linking between the chatbot and the clinic system to allow re-occurring users to schedule and receive appointment reminders.

In order to capture the value of this intervention and its potential to impact intended health outcomes, it will be important going forward to capture data on YoSShi usage among clinic visitors over time in correlation with the number of 14-24-year-olds' encounters for sexual and reproductive services. The YoSShi team was unable to accomplish this during 2020 due to Covid-19 related diversion of clinic staff time. Continued use of data to further refine YoSShi, and to tailor it for different subgroups or topics will be an important way to increase its utilization, and sustain its relevance and impact over time.

The utilization of a technological platform to increase the timeliness of prenatal care and other clinic services is novel in the border region. The experience of the Arizona CoIIN team demonstrates the relevance of human centered design methods in mitigating social determinants of health related to care utilization, when solutions are driven by the needs and visions of end users and supported by strong institutional stakeholders and partners. Based on this, YoSShi has the potential to shift reproductive health conversations and behavior patterns for young people, resulting in improved family and child health outcomes over the life course.

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