

Assessing JoinLite – A Recruitment Tool for *All of Us Pennsylvania*

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Lauren Angela Winter, MPH

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Abstract

The goal of precision medicine is to identify the right intervention for the right patient at the right time. Genetic variation among individuals, as well as an individual's genotype by environment interactions, are important to predict therapeutic response, but historically research studies have not expanded beyond the Caucasian population. *All of Us* Research Program's goal is to include more people of various backgrounds into biomedical research in order to make a research database available that is reflective of human biological and lifestyle variation, which will influence our understanding of health, and effective preventative and therapeutic interventions. Studies using an inclusive database will make treatments more precise and appropriate for more types of people. In this essay, I assessed the effectiveness of one of the recruitment databases, called JoinLite, that was used by *All of Us Pennsylvania*. The current study provides information to researchers on a national level about the effectiveness of their recruitment initiatives to reach a broader population, especially underserved communities, such as rural communities.

Data were entered into the JoinLite participant management database to facilitate contact with individuals who were potentially interested in participating in *All of Us Pennsylvania*. For those who completed the initial study visit, I obtained data on location (i.e., zip code) and time to completion. Data were available from July 1 through October 31, 2018. Although the number of

prospective participants varied by month, the proportion who enrolled in *All of Us* was similar – approximately 70%. Of the enrollees, the expected completion rate was 75% on average, and was also similar across all four months. In particular, initial results indicate that the response rate in targeted rural counties in Pennsylvania was high (>80%). Furthermore, 40-60% of enrollees completed their appointments at a study clinical site within 1 week and 45-65% of those who completed their appointments lived within 5 miles of a study clinical site. These results indicate that scheduling a clinical appointment soon after enrollment and locating a clinical site within or near a community of interest, is beneficial for successful recruitment.

The public health significance of this study is to provide information regarding a few of the issues that need to be addressed to facilitate participation in research by various groups of people. My results indicate that locating clinical sites within a community of interest, such as rural communities, as well as scheduling clinical appointments within 1-2 weeks after enrollment, should facilitate participation of underrepresented groups.

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Preface

I would like to acknowledge the dedicated team at *All of Us* Pennsylvania and the Clinical and Translational Science Institute in Pittsburgh, Pennsylvania for their guidance and participation on this project. Thank you to Margaret Palumbo for her guidance and expertise in facilitating this project.

Thank you to my program advisors, Candy Kammerer and Andrea Durst, for your excellent and thoughtful design in the Public Health Genetics MPH Program. Through your mentorship, I have gained more valuable skills and lessons for my future career than I think I can concisely explain.

Lastly, thank you to my partner, Taylor, and my parents, Steve and Angie. The raised eyebrows I got when I said three years ago that I wanted to move to Pittsburgh seem a little less crazy now, don't they? I am forever grateful for your support and encouragement.

1.0 Introduction

All of Us Research Program is an initiative created by the National Institutes of Health (NIH) to fulfill the goal of Healthy People 2020 to prioritize precision medicine, and, in concordance with the Revitalization Act, recruit people that are considered underrepresented in biomedical research (*NIH Policy and Guidelines on The Inclusion of Women and Minorities as Subjects in Clinical Research | Grants.Nih.Gov*, 2017). This research program aims to recruit 1 million people from across the United States into a study of biological, lifestyle, and inherited contributions to health information. The resulting, highly inclusive database will enable researcher to more thoroughly investigate the impact of genetic, behavioral, lifestyle, environmental and other factors on health outcomes for people from various backgrounds. In addition, researchers will gain insight to how individuals' health is influenced by social, cultural, demographic, and media factors over time.

Precision medicine is an approach for disease treatment and prevention that incorporates information on each individual's genetic variants, environmental exposures, and lifestyle factors (*White House Precision Medicine Initiative*, 2016). This approach has historically been applied to blood transfusions, (recipient and donor matching by blood type) and prescription eyewear (accounting for near-and far-sightedness and various eye pathologies, age and shape of the eyes). Studies of human genetics amplifies the power of precision medicine by helping to pinpoint potential polymorphisms that, as a result of evolution and other genetic phenomena, contribute to health outcomes via disease susceptibility or immunity, drug tolerance, or therapeutic response. Though genotypes are not true biomarkers of ethnicity or race, these individual characteristics contribute to population data on genetic drift and disease frequency (Kohane, 2015). Recent

precision medicine initiatives strive to recruit cohorts that are more inclusive (Bonevski et al., 2014; Chen et al., 2015; *NIH Policy and Guidelines on The Inclusion of Women and Minorities as Subjects in Clinical Research* / *Grants.Nih.Gov*, 2017) to capture differences among groups and thus better model the differences present in the overall population.

Though individual variation is only present in 0.2-0.4% of the human genome (Tishkoff & Kidd, 2004), failure to include a genetically diverse spectrum of participants in precision medicine studies creates drastic oversimplifications in their results. In “Ten Things We Have to do to Achieve Precision Medicine,” Dr. Isaac Kohane writes,

“Representative precision medicine is not only the expression of hope for social justice, but it is mathematically necessary if we are to avoid making gross diagnostic and therapeutic mistakes. Individuals coming from different ethnicities have different frequencies of multiple characteristics from various factors – from genomic variants to diet. Capturing these differences will be at the core of precision medicine’s success in our multiethnic society. Failure to do so will result in over- and under-diagnosis – the antithesis of precision medicine.”

Diagnostic and therapeutic “mistakes” in precision medicine include extrapolation of data gathered from individuals of European ancestry (EA). According to the Out of Africa model of human evolution, the number of “private alleles” or population-specific genetic variants decreases with the population’s increasing physical distance from Africa (Tishkoff & Kidd, 2004). This paradigm in biomedical research illustrates that inclusion of more populations is imperative for the best understanding of human variation.

A 2014 study in the *Journal of the American Board of Family Medicine* reported that individuals participating in clinical research at academic health centers represented less than 1 in

1000 patients treated in the United States health care system (Spears et al., 2014). Subsequently, the external validity, or generalizability of clinical research conducted through these institutions is compromised. Racial and ethnic minorities contribute to approximately 40% of the United States population, but consistently make up less than 10% of participants in biomedical research (Oh et al., 2015). However, when approached, individuals from racial/ethnic minority groups are just as likely – if not more likely – to be receptive to research participation (Wendler et al., 2006). The National Institute of Health (NIH) protocol for the *All of Us* Research Study classifies a participant as part of an Underrepresented in Biomedical Research (UBR) population for a variety of reasons, including ethnic minority status, age, sex, gender, sexual orientation, income, education, geography, access to care, and disability minority status. *All of Us* considers ELSI (ethical, legal, and social issues) criteria to design its cohorts (Sankar & Parker, 2017) with the intention of including more United States demographic variation that accurately represents groups currently classified as UBR (Lyles et al., 2018). Table 1 shows populations that have drastic disparities between research representation and United States population percentage.

Table 1 U.S. Racial/Ethnic Distribution

Distribution of ethnic backgrounds in the United States population compared to their distribution of enrollment in biomedical research studies.

	US Population (US Census Data)	Clinical Trial Participants (U.S.) for Selected Oncology Drugs (Ramamoorthy et al., 2018)
White	76.6%	81.8%
Black/African American	13.4%	11%
American Indian/ Alaska Native	1.3%	0.5%
Asian	5.8%	3%
Native Hawaiian/ Pacific Islander	0.2%	0.2%
Hispanic or Latino	18.1%	6.7%
Two or more races	2.7%	0.1%

Underrepresentation in research can lead to crucial under or over-estimates of disease frequency in the general population. Further, molecular biology principles demand that an individual's physiology – diet, metabolism, drug tolerance, and gene expression, be considered when delivering therapies. For example, for genetic disease alone there are a plethora of monogenic conditions that occur at higher frequencies in certain populations. Incorporating knowledge of the variability in the human genome into our biomedical research is critical. Furthermore, the interactions of these genetic variations with lifestyle factors, such as diet and exercise (which are highly correlated with culture and geographic regions), is also required for the successful implementation of precision medicine. Increased representation of different groups in biomedical research will help us understand, from a population perspective, the clinical significance of many genetic variants, environmental factors, and their interactions across populations.

Minority group representation in research studies and clinical trials is critical for avoiding limitation bias, which occurs when too few people from a particular group are studied to gain a sufficient understanding of that group's similarities and differences to existing biomedical evidence (Lyles et al., 2018). Gaining empirical evidence about the biological variance in people will elucidate more effective treatment methods, such as identifying potential drug targets and therefore more effective drugs (Collins & Varmus, 2015). Further, improved understanding of underlying mechanisms of health disparities (Williams et al., 2016) is needed. This requires actively recruiting for and addressing the genetic, environmental, experiential, and gene-by-environment differences between people. Once this is accomplished, it can be used to bridge the

gap between acknowledgement of health disparities and the practice of treating people within the context of the differences they experience.

2.0 Issues in Obtaining Representation in Research

2.1 Lack of Information

Regardless of racial, ethnic, or geographical background, lack of information about research serves as a barrier to participation by minority groups (George et al., 2013). A study by Brown and Moyer used awareness of clinical trials as a predictor of feelings about using medical information for research. Using participants from the National Cancer Institute's Health Information National Trends Survey 2007, Brown and Moyer's group found that African American, Asian American, and Latino populations were less aware of clinical trials than White population. All three minority groups were also less positive about using medical information for research. Those participants, regardless of race, with lower incomes and education levels were less likely to have heard about clinical trials. In general, participants who were more aware of clinical trials viewed use of medical information for research more positively (Brown & Moyer, 2010).

Clinical trials help to advance public health and medical research. Tanner et al. surveyed clinical trial investigators in South Carolina to assess their perceptions of barriers to recruitment. Ninety-three of 119 respondents said that recruiting rural participants was the most difficult, with significant differences related to the general public and African American groups ($p < 0.01$) (Tanner et al., 2015). Clinical trial investigators in this study reported that perceived barriers to rural participation were (1) lack of information about available trials, (2) that local doctors were unaware of current clinical trials, and (3) participants had limited accessibility to trial sites (Tanner et al., 2015). These results were consistent with previous findings that rural communities are often

underrepresented in biomedical research where there is poorer accessibility to care and fewer clinical trials are available (Baquet et al., 2006; Guadagnolo et al., 2009; Shavers et al., 2002; Tanner et al., 2015).

Researchers can facilitate accessibility by eliminating “gatekeepers” – healthcare providers who do not approach minority participants for inclusion in research opportunities (Bonevski et al., 2014). This straightforward approach will be achieved by researchers actively practicing cultural considerations in how health information and research participation are communicated to the public and by consciously increasing transparency in their recruitment efforts.

2.2 Community Involvement – Creating Trust

The Primary care MultiEthnic Network (PRIME Net) is a national consortium of practice-based research networks (PRBNs) that prioritize bringing research to underrepresented and underserved communities. To gather data on how PRBNs can help achieve inclusion of diverse racial/ethnic groups in clinical research, Getrich et al. sought to identify strategies for recruitment and retention, examine them from both researcher and participant perspectives, and evaluate their efficacy. They chose five of the racial/ethnic communities involved in PRIME Net to observe for their study. Through individual interviews and focus groups from these racial ethnic groups (African American, Arab/Chaldean, Chinese, Hispanic, and Navajo), they identified common elements that lead to successful recruitment and retention, and developed a model called the “Cycle of Trust” for researchers. The four stages of the cycle are (1) before the study, (2) during recruitment, (3) throughout study conduct, and (4) after study completion (Getrich et al., 2013). In general, groups agreed that seven strategies were important: Creating trust with targeted

partners, creating relevant topics and feasible study designs, devising a competent research team, designing tailored recruitments strategies, proper study implementation, tailoring retention strategies, and providing a solid groundwork for future studies/ furthering the relationship (Getrich et al., 2013).

Getrich and colleagues highlight the importance of thoughtful study design to develop trust between racial/ethnic minority groups and researchers. They further discuss that it is not necessarily an unwillingness to participate in research that is the barrier to overcome with underrepresented populations (Getrich et al., 2013), but the lack of trust in research establishments that dissuades individuals from participating in research in general.

2.3 Representation in Research

Different, specific barriers to participation can be experienced by different underrepresented groups. African American children with autism spectrum disorder are seriously under-represented in existing genetic registries and biomedical research studies of autism (Hilton et al., 2010). An initiative to recruit African American children into national genetic autism registries used Centers for Disease Control and Prevention (CDC) surveillance data to contact families in the St. Louis (Missouri) region and assess interest in participation. All contacted families expressed a willingness to participate, but 67% were disqualified solely due to family structure (Hilton et al., 2010). This outcome denotes a lack of cultural understanding of the ways in which barriers can be addressed, and a lack of action to circumvent the extant issues with recruiting African Americans into family studies. Family structures that were considered ineligible were: lack of one or both parents due to lack of contact with the family, geographical distance,

incarceration, death, and divorce; adoptive parents that had no contact with the child's biological parents, a child being raised by a grandparent, or a sibling that was outside of a certain age range (Hilton et al., 2010).

With these exclusion criteria, researchers failed to include many willing participants on the basis that there were not two consenting biological parents and a similarly aged full sibling in the household. Female-only householders with children made up more than 15 million responses on the 2010 United States Census, representing approximately 13% of US households at that time (U.S. Census Bureau, 2010). At the same time, nuclear families (husband-wife households with related children) made up approximately 33% of all households. Seeing that two-parent, multi-biological-sibling households make up only one-third of all households in the U.S., it is necessary for human subjects research to adapt to cultural shifts. Excluding participants on the basis of criteria that reflects only one-third of the population falls short of increasing diversity in biomedical research.

Lack of health insurance is a more significant barrier to participation in medical research and care in Hispanics than in African Americans (Williams et al., 2016). Differences in health insurance and access to healthcare services in general may contribute to differences in rural and ethnic populations' willingness and ability to participate in biomedical research, and is an example of a systemic concern that researchers will only understand by gaining the trust of the community and involving them in the question of why they are not interested in research.

Older people are generally underrepresented in research and health intervention studies (Cusack et al., 2013; Mody et al., 2008; Townsley et al., 2005). The ELDERMET project consists of 500 participants 65 years or older across a range of health states who have participated in an extensive biomedical protocol and submitted multiple biological sample types for research on

healthy aging. An analysis of reasons that older people were and were not interested in participating in the ELDERMET study was performed. Older people said that they were interested in participation because they wanted to contribute for others and had a sense of altruism in retirement, had previous associations with science and academia and were thus inclined, had increased health awareness, had assumption of control of their health and were driven by strong social connections in retirement communities (Cusack et al., 2013). However, reasons that older people were not interested in participation relied more on study design and protocol, which illustrate how aging can be a barrier to participation. These reasons included having comorbidities/ too many health concerns, could not sustain attention for lengthy consultations, had dependent responsibilities (to a spouse, parent, or child), lack of accessible transportation, specific mobility or physiological challenges to completing study protocol, social isolation or lack of social support (if not in community living) and anxiety about addressing questions/ completing study protocol without a support person (Cusack et al., 2013).

3.0 Recruiting Participants to Join *All of Us*

To recruit in Western Pennsylvania, *All of Us* Pennsylvania partners with many local healthcare providers, community leaders, and cultural events. The researchers work with physicians to gain trust of their patients and recruit from within a variety of clinics. Engagement (recruitment) events are also held at community locations, for example, the farmers' market or sporting events. While varying the places and times at which people are being recruited for the study decreases sampling bias, these events are busy occasions at which most people are not thinking about the potential to participate in research. Although these events are valuable opportunities for *All of Us* to show its support for the community and reach people who might not otherwise seek out participation in the study, they necessitate infrastructure for follow-up contact to avoid potentially high numbers of cancelled or unkept appointments.

3.1 Community Based Participatory Research

Community Based Participatory Research (CBPR) is one of several approaches to research that are better suited to accommodate systemic barriers for marginalized groups. CBPR can help address health disparities among minority groups in the United States by evaluating said disparities within the context of the lifestyle of those experiencing them and partnering with participants to inform researchers of the best practices. This process is well-researched and documented. CBPR asserts that research participants should be involved as active partners in the research, which incorporates social context into the research questions (Faridi et al., 2007). Research participants,

defined as partners, contribute their experience as expertise to the phenomenon in question (A. Israel, Amy J. Schulz, Edith Par, 2001; Holkup et al., 2004).

All of Us adheres to several facets of CBPR that are beneficial to the model of community-based recruitment practices. These include: (1) recognizing that there is identity in a community, (2) incorporating communities' strengths into the research process, (3) promoting a co-learning approach to benefit both researchers and partners, (4) creating a mutually beneficial approach in both action and research, (5) prioritizing needs of the community, (6) using a "cyclical and iterative process" through which the partnership can be maintained, (7) sharing results with the community, and (8) requiring long-term participation from partners (A. Israel, Amy J. Schulz, Edith Par, 2001; Faridi et al., 2007; Holkup et al., 2004). The specific methods and success of these approaches in other research studies is knowledge that *All of Us* researchers are able to use in their efforts to represent many underrepresented groups in one study.

Utilizing this approach allows researchers to adapt their existing resources, explore local knowledge and perceptions, and empower people to participate and promote the initiative (Breda, 1997; Faridi et al., 2007; Holkup et al., 2004; Stevens & Hall, 1998). Additionally, research done in communities by CBPR will enhance its usefulness to the community by aligning the outcomes with what the community perceives as its goals for social and health equity (A. Israel, Amy J. Schulz, Edith Par, 2001; Holkup et al., 2004; Stevens & Hall, 1998). CBPRs have further been shown to minimize lack of trust that communities may display toward "outside" research initiatives (A. Israel, Amy J. Schulz, Edith Par, 2001; Holkup et al., 2004).

CBPR has been used in other studies that emphasize family history and screening and prevention measures. Li et al. (2019) utilized CBPR to develop a customized program for colorectal cancer (CRC) prevention in Chinese Americans that accounts for cultural and linguistic

considerations in obtaining family health history (FHH) information. They noted that there was a need for this program as CRC is a leading cause of mortality in Chinese men and women (Miller et al., 2008), and that culturally-specific FHH-based cancer prevention programs exist for other U.S. ethnic groups (Caucasians, African Americans, and Hispanics), but not Chinese Americans (Bodurtha et al., 2014; Murthy et al., 2011; Petruccio et al., 2008; Ruffin et al., 2011). Through the CBPR approach, the investigators learned that the majority of Chinese Americans who participated acknowledged the importance of FHH, but very few had sought it from their families or reported it to their physicians (Li et al., 2019). Through community partners, community-based workshops on the importance of FHH were designed that emphasized values important to Chinese American culture, such as collectivism and family structures (Li et al., 2019).

One of the evaluation criteria of CBPR that *All of Us* will most benefit from using is evaluation based on location. Research on evaluating CBPRs states that observers have the benefit of increased accuracy in interpretations if they are geographically close to the people they study (Holkup et al., 2004). In addition, the more varied types of events the observer witnesses, the more confident an observer can be in their findings (Holkup et al., 2004). The CBPR principles employed by *All of Us* Pennsylvania will benefit from varying the locations they choose to engage with the public about their research initiative.

3.2 JoinLite

All of Us Pennsylvania has implemented JoinLite to retain contact information of potentially interested persons and perhaps reduce the number of canceled or unkept appointments. This tool is a work queue that allows call center staff to reach out to individuals that sign up for

more information on the research initiative. JoinLite creates a profile for each person and automatically generates alerts at timed intervals at which the person should be contacted regarding their interest in participation. The goal of this process is to reduce the number of appointments cancelled by giving individuals more time to familiarize themselves with study details (and their personal schedules) prior to scheduling an appointment.

JoinLite can also help address the goals of UBR enrollment. An *All of Us* recruiter (engagement team member) can customize the URL of the JoinLite profile generator. Because JoinLite enables the user to indicate a specific event where the participant profile was created, analyzing data from JoinLite will inform *All of Us* Pennsylvania of the effectiveness of recruiting efforts in different communities. This feature eliminates the assumption that a “one size fits all” approach to ending enrollment disparities will work for all groups that *All of Us* intends to include. The event profiling feature of JoinLite will allow the engagement team to analyze their efforts in all different populations and personalize their recruitment efforts. My study is the first assessment of the utility of the JoinLite tool to improve recruitment and retention overall, and provide an initial assessment of its utility in a rural community.

3.3 Goal of Study

3.3.1 Study Aims

The overall goal of this project will be to assess the utility of a computerized system, JoinLite, that is used for tracking individuals who are interested in participating in the *All of Us* Research Study. The specific aims of the project were:

1. Determine the study visit completion rate of individuals enrolled in the research study via JoinLite, including an initial assessment of completion rates in a rural community.
2. Determine the location of enrollees' visit site relative to the participants' home.
3. Determine the distance traveled by individuals to complete an appointment.

3.3.2 Methods

The data used in this study were metrics recorded by JoinLite, a computer program developed to optimize workflow for recruitment and retention in *All of Us* Pennsylvania. The data gathered were obtained from individuals who provided their contact information to the study.

JoinLite provides documentation of the attempts to contact an individual and their enrollment status in the study. De-identified data were collected from the JoinLite database for these analyses. Data were gathered from participants between August 1 and November 1, 2018.

Enrollment information was collected about each individual in the data set. A unique participant identifier was randomly assigned by the computer program so that personal identifiers were never associated with their data for the analyses. Table 2 includes the categories of information collected and the description of the data points collected. For the current study, I was provided access to enrollment date, enrollment location, zip code, appointment date, visit location, and status. Assessment of recruitment by sex and ethnic identity is also critical to assess the utility of the JoinLite tool, but I did not have access to this information.

Table 2 Data Categories Collected

Data Category	Description
Enrollment Date	Date that participant was entered in <i>JoinLite</i>
Enrollment Location	Location where profile was created, from a dropdown menu.
Heard About Us	Where the participant recalls first hearing about the <i>All of Us</i> study
Heard About Us Other	If a participant enters “other” from the Heard About Us dropdown menu, they have the option to type another location
Sex	Identity as Male, Female, or Other
Race/Ethnicity	Ethnic Identity
Zip Code	The participant’s home zip code
Appointment Date	Date Participant’s <i>All of Us</i> appointment is scheduled
Visit Location	<i>All of Us</i> Enrollment site where the participant’s visit is scheduled
Status	Status of the completion of an appointment, including cancellation and pending
Country	Participant’s country of residence
State	Participant’s state of residence

In my current study, I compared the percentage of completed appointments for the four months of database usage. The total number of completed appointments per month out of the total number of appointments made was calculated to obtain an enrollment rate for the month. This calculation was done for completed appointments, and for completed appointments plus pending appointments to obtain a potential monthly enrollment rate.

Completed appointments were also categorized by zip code. The Power BI data visualization tool was used to generate a heat map illustrating the frequencies of completed appointment by zip code in western Pennsylvania.

An estimate of the distance a participant traveled to their appointment was obtained using Google Maps from the participant’s home zip code to the appointment site. The proportion of completed appointments was categorized by zip code to assess whether there was a relationship between the distance traveled and the frequency of completed appointments.

3.3.3 Results

After data cleaning, 1045 JoinLite entries – representing individuals who were potentially interested in the study – were available for analysis. Individuals who subsequently responded to contacts by the *All of Us* staff and made an appointment for a clinic visit were called Responders. Responders were counted if the entry had an appointment status as described in Table 3. The interpretation for data collection is included and whether the category was included in the final data set.

Table 3 Data Categories and Their Descriptions

Appointment Status	Interpretation	Included in Analyses
Canceled	Appointment was scheduled through JoinLite and subsequently canceled	Yes
Visit Completed	Appointment was scheduled through JoinLite and completed.	Yes
No-Show	Appointment was scheduled through JoinLite and participant did not attend the visit.	Yes
Pending	Appointment is scheduled for a date beyond November 1, 2018.	Yes
Canceled and Rescheduled	Appointment was scheduled through JoinLite, canceled, and rescheduled for a date beyond November 1, 2018.	Yes
Attempted to contact	Online profile was completed but no contact could be made to the participant.	No
Specimen completed	At least part of the study visit was completed. Not enough information is available to determine enrollment status of the participant.	No
Confirmed	Not enough information is available to determine enrollment status of the participant.	No
Aborted	The visit was initiated but not completed. The participant did not enroll in the study.	No

Table 4 depicts the total number of potential participants, responders, and appointment completion rate per month and overall, from July 1 to November 1. As can be seen, the total

numbers of JoinLite participants and responders increased between July 1 (n=64 and 73, respectively) and November 1 (n=290 and 407, respectively). The response rate, that is, the number of responders divided by the number of potential participants ranged from 64.6 to 87.6%, with an average of 70%. However, not all responders (individuals who scheduled a clinical appointment) had completed their appointment and were officially entered into the study by November 1; overall, 56.4% of responders completed the study. However, many appointments scheduled in October were scheduled to occur after November 1st. The “Completion + Pending Rate” categories account for a hypothetical completion rate, including all appointments scheduled for a future date. When all pending appointments are included, the completion rate of respondents is 75% -- which is similar to the completion rate for responders enrolled in August and September who had greater than 12 and 8 weeks, respectively, in which to complete their appointments. The overall completed plus pending appointment rate for all potential participants was 52.5%.

Table 4 Enrollment Proportions from JoinLite Responders

	July	August	September	October	Total
Number of Respondents	64	197	181	290	732
Potential Participants	73	285	280	407	1045
Response Rate	87.67%	69.10%	64.64%	71.25%	70.05%
Completed Appointments	50	139	121	103	413
Rescheduled/ Pending Appointment	0	3	12	121	136
Completion Rate (from respondents)	78.10%	70.56%	66.85%	33.52%	56.42%
Completed + Pending Rate (from respondents)	78.10%	72.08%	73.48%	77.24%	75.00%
Completion Rate (all potential participants)	68.49%	48.77%	43.21%	25.31%	39.52%
Completed + Pending Rate (all potential participants)	68.49%	49.82%	47.50%	55.04%	52.54%

In addition to appointment completion, I also assessed the number of weeks to appointment completion from the time the individual was entered into JoinLite. Figure 1 shows the percentage of appointments completed by number of weeks from their initial JoinLite entry. These results indicate that 40-60% of individuals, who eventually enroll in *All of Us*, are fully enrolled within one week of engagement with *All of Us*. As can be seen, the number of completed appointments decreases as the number of weeks from initial contact increased. By 3-4 weeks after initial contact, almost all respondents, who are eventually fully enrolled, have completed their clinical appointments. These results indicate that appointments of responders should be scheduled within 1-4 weeks after initial contact, and preferably within 1-2 weeks. Moreover, data from August projects that 100% of scheduled visits are completed within 10 weeks of initial engagement. September and October data follow the same trend.

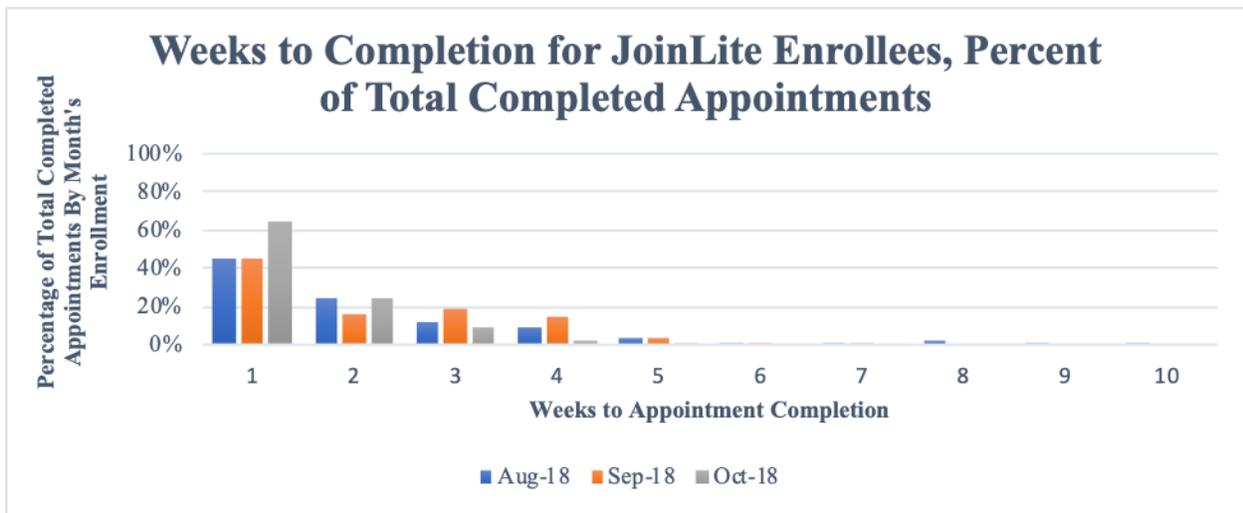


Figure 1 Weeks to Completion for JoinLite Responders

Finally, I assessed the distribution of residences among those who completed an appointment between July and October 2018 using zip code information. The following heat map

(Figure 2) shows this distribution relative to the sites where appointments were completed. The map's red stars indicate the locations of *All of Us* enrollment sites where an individual may complete a study visit. This map illustrates that there is an increased frequency in enrollment among people who reside in a zip code where there is an appointment site. The dark green color indicates the lowest frequency of enrollees. Frequency increases following the color spectrum to dark red having the highest frequency. In Pittsburgh, the five zip codes with the most participants are the five zip codes in which clinical visit sites are located. In the Altoona (Pennsylvania) area, most participants live in the zip code almost completely surrounding the appointment site.

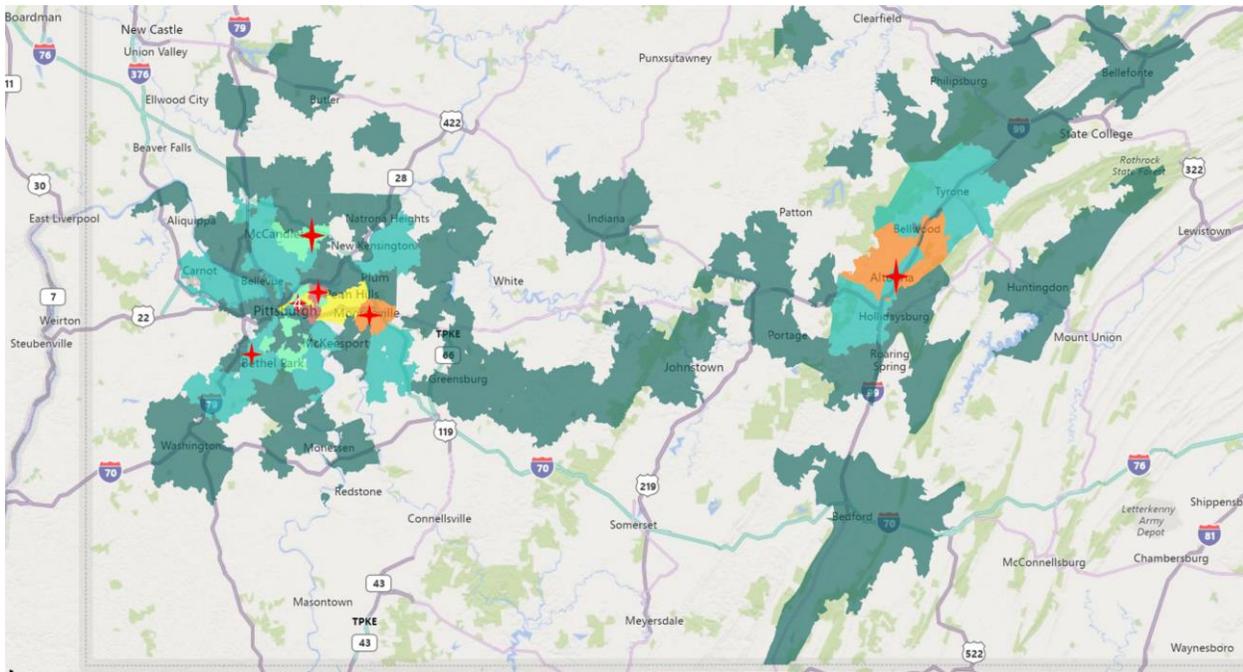


Figure 2 Frequency of Participation from Western Pennsylvania Zip Codes

Fifteen counties in Pennsylvania were represented by JoinLite responders in the data set. In Figure 3, it is clear that most counties in Pennsylvania are considered rural (The Center for Rural Pennsylvania, 2014). The starred counties are those where residents listed a home address

when they completed a study visit. We observed high rates of participation in rural counties. For example, in Cambria county, where one of the clinic sites was located (see Figure 2), 9 of 13 JoinLite responders had completed an appointment and an additional two were pending. Thus, the pending + completion rate was 84.6%, similar to the overall completion rate (75%).

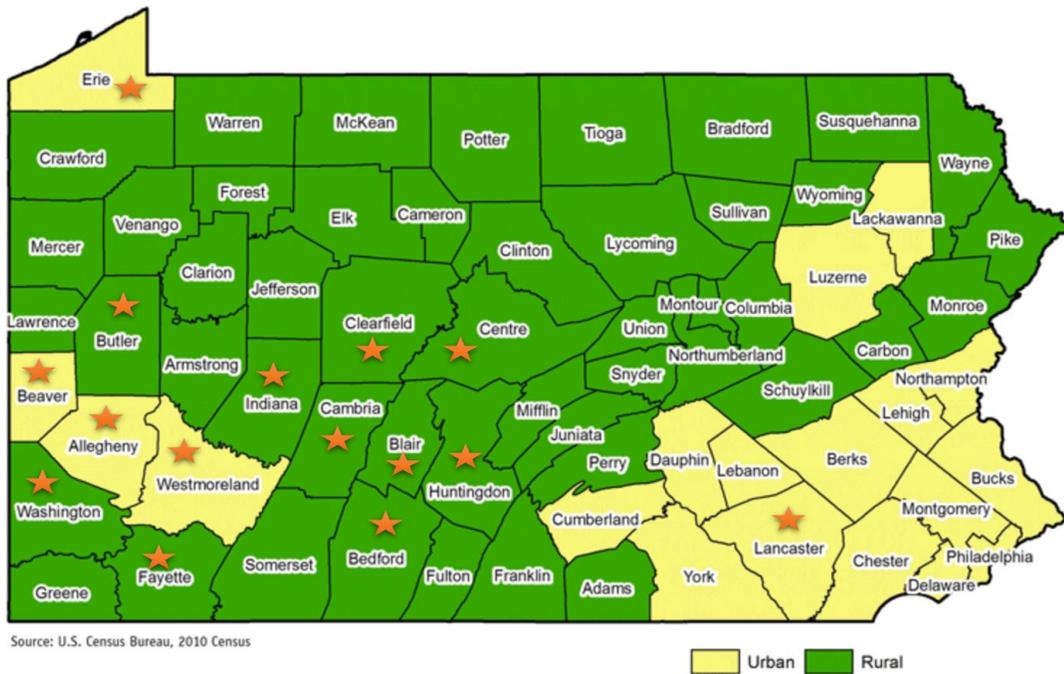


Figure 3 Rural and Urban Counties Represented in *All of Us* Pennsylvania

I also analyzed whether perceived convenience was a factor in appointment completion. The distance each individual traveled to complete their appointment was estimated from their home zip code to appointment location. The number of completed appointments based on the miles traveled to the appointment site from the participant’s home is shown in Figure 4. As can be seen, 40-58% of appointments were completed when participants had to travel fewer than five miles to the site. Furthermore, 70-76% of appointments were completed when participants traveled

less than 10 miles. These results indicate that study sites should be located within 10 miles of an individual’s residence.

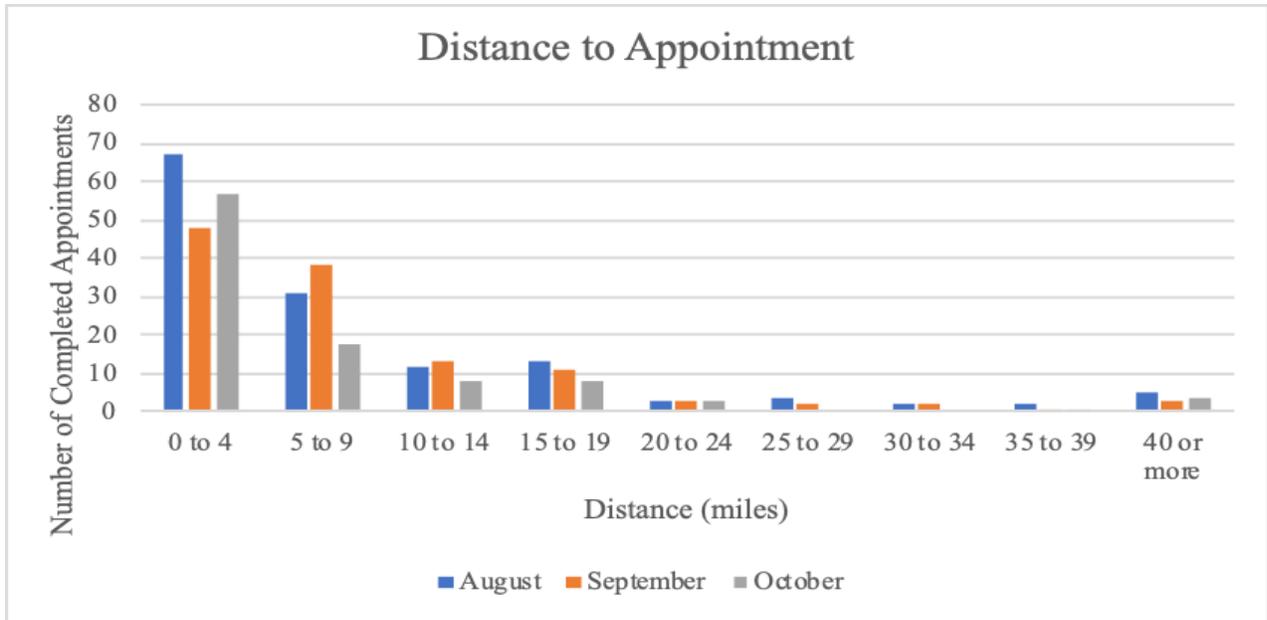


Figure 4 Distance To Appointment Site Traveled

3.4 Discussion

Overall, the response rate of individual entries per month of engagement was 70%, representing 732 individuals who responded to a follow-up contact out of 1045 individuals who were potentially interested in the *All of Us* Pennsylvania program. Thus, the JoinLite tool is facilitating the engagement process for hundreds of individuals per month. Furthermore, within four months (July 1 – November 1, 2018), 413 individuals had completed the full enrollment process in the *All of Us* study – and another 136 were pending completion – for an overall 75% completion rate of all participants who responded to follow-up contact through JoinLite. The completed plus pending appointment rate was 52.5% among individuals who were potentially

interested in *All of Us* and then entered into the JoinLite database tool. Thus, JoinLite is facilitating the process of enrollment for more than half of the people who were potentially interested and appears to be a useful tool in participant recruitment and retention that supports the efforts and analytics performed by the engagement staff.

Further assessment of data from JoinLite indicated that most individuals completed an appointment within five weeks of their initial JoinLite entry. Further research is needed to accurately assess what motivates individuals to contribute within this time frame, considering that 45-65% of individuals recruited per month completed an appointment within a week of their JoinLite entry. One explanation for this immediate turnaround may be the study incentive. Currently, *All of Us* study participants receive a grocery gift card for a local chain grocery store. Another possibility may include lack of information regarding enrollment location. No information was obtained on whether individuals whose enrollment location is denoted as “Online Scheduling” were engaged at an event or if they were recruited through another method, such as participant call-in. Data were coded such that the investigator would not be able to determine the location of each participant, thus timelines for engagement and scheduling may be skewed. Regardless, JoinLite is a system that enables the staff to contact a participant. All participants used in this analysis, regardless of their recruitment method, were scheduled and enrolled subsequent to a JoinLite entry.

The results of this study also indicate that people who live the closest to an appointment site are more likely to attend their appointment. The association between home zip code and appointment site was higher than that between home zip code and location of engagement event (data not shown). This result indicates that potential participants value convenience of appointment more than the convenience of the recruitment sites and staff. However, the number

of participants who traveled 40 miles or more was higher than those traveling 20-39 miles, although this result may be an artifact and needs further study. For example, this result may be due to differences between rural and urban population, reporting discrepancies for home address among university student participants, or other reasons.

3.4.1 Contribution of the Results

Results of the study have significant implications for designing recruitment initiatives, especially when analyzing potential sites for appointments. My results indicate that having enrollment sites within the desired communities will be a valuable recruitment and retention tool. Creation of a convenient and accessible study location has contributed to successful recruitment and retention (Cusack et al., 2013) of these groups who experience these particular barriers to participation. Previous studies have benefitted from this model, known as Community Based Participatory Research (Fregonese, 2018; Spears et al., 2014). Acknowledging that other studies have benefitted from models that incorporate community participation in research, *All of Us* will benefit from continuing to develop local partnerships. Community partners have been a critical component of developing research tools, disseminating study information, and serving as consultants for public health research (Fregonese, 2018).

Rural communities have been traditionally excluded from research (Baquet et al., 2006; Guadagnolo et al., 2009; Tanner et al., 2015). Inclusion of both rural and urban populations is important for understanding the impact of environment on health. Our findings demonstrate that CBPR practices can successfully facilitate research participation for rural residents in Pennsylvania. Data from our rural counties show successful rates of completion (e.g. Cambria county's completion rate is over 80% in three months). The findings from this study on the utility

of the JoinLite system indicate that individuals in UBR groups can be recruited by engaging within the community and employing CBPR principles.

3.4.2 Strengths and Limitations

Strengths of this study include the sample size; over 1100 individual entries were made in the first four months' use of JoinLite. Furthermore, I have been trained in *All of Us* Pennsylvania's recruiting measures – including use of the JoinLite system – as well as retention methods and goals. This knowledge was useful for identifying potential pitfalls and discrepancies in data collection, whereas staff members were trained in utilization of the system, which could be incorporated into data cleaning and analysis. The current study did not require obtaining any data directly from *All of Us* study participants and therefore was not subject to reporting bias.

One limitation was that data were subject to data entry errors and discrepancies because the JoinLite tool had just been implemented. Future studies would benefit from further investigation into the standardization of data entry by the study's engagement personnel. Additionally, participants in the JoinLite database who requested no further contact were not included when the data set was created for this study. Inclusion of this group in further analyses of response rate and appointment status is warranted. Data were not available for participants who enrolled by another recruitment tool. These individuals include those who were scheduled during face-to-face contact with enrollment team members. Future studies of the utility of JoinLite or similar methods would benefit from comparing data between face-to-face and online enrollment to further understand differences in barriers, motivation, successful enrollment, and retention. A final limitation was that I did not have access to data on sex or ethnic identity, and therefore could not assess the relative success of recruiting members of these groups.

3.4.3 Future Directions

We have shown that *All of Us* researchers can effectively recruit underserved populations such as those who live in rural areas. Further studies that aim to determine the effectiveness of recruiting measures for *All of Us* would benefit from obtaining demographic information for analysis. Data on sex, ethnicity, or age are important factors to consider in a more detailed evaluation of inclusivity and representation in research.

3.4.4 Conclusion

Overall, this study contributes to an understanding of the feasibility of recruiting participants into *All of Us* Pennsylvania using community-based enrollment practices. In addition, the JoinLite recruitment tool appears to facilitate recruitment overall, although additional analyses are necessary to determine if specific underrepresented groups, such as ethnic minorities, are participating. Results from the current study provide a framework for approaching desired communities about biomedical research, indicating that individuals across Western Pennsylvania who were approached about research participation share a similar inclination to participate soon after they learn about study details, especially if the clinical enrollment site is located within 10 miles of their residence.

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