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ORIGINAL RESEARCH ARTICLE
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Addressing Digital Health Equity Through Diverse User Personas

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With patient portals emerging as a powerful digital health innovation, the work described in this manuscript strives to ensure that these innovations occur with health equity at the forefront. This work approaches this uniquely through the data-informed development of user personas. This will be particularly useful for developers and healthcare institutions when considering the diverse needs of potential patient portal users of historically marginalized backgrounds.

***Keywords**: Patient portals, User personas, Health equity, Digital Health, Health care innovation*

Introduction

There are numerous benefits to patient portal platforms including facilitation of provider-patient communication and improved patient health outcomes.[1] Research shows that patients who enroll in and use patient portal accounts have improved health outcomes and are more engaged in their health.[2, 3] However, patient portal usage data indicates significant disparities by patient subpopulations, specifically among elderly, racial and ethnic minorities, lower technology and health literate, and safety-net populations.[4,5,6] There is an urgent need for healthcare systems and developers to close these gaps in usage, so that patient portal platforms are accessible and approachable for these patient subpopulations. To facilitate the design and operation of inclusive patient portal platforms, we present user personas incorporating different patient subpopulations, and how to meet the technology and health needs of each persona. These user personas were developed based on research and a review of the literature to maximize patient portal usage across patient subpopulations.

Background

While designing these user personas, we have considered various barriers that influence patient portal usage. Low digital literacy has been evidenced as a strong barrier to patient portal usage, as navigating online systems can be arduous for those who are not adept in accessing digital resources.[7,8,9] Low health literacy serves as an additional barrier, as those with low health literacy are less likely to find health information technology useful due to limited understanding of the implications and best uses of these resources.[9] Limited access to computers, smart phones, or the Internet may also prevent full uptake to patient portals, as these tools are largely web-based. People with disabilities, low-income communities, older populations, and racial and ethnic minorities are the most at risk to being impacted by these barriers, as the marginalization of these groups have led to differing levels of education, health and digital literacy, internet access, and other determinants of health that shape their access to contemporary care resources such as patient portals.[10,11]

Methods

The user personas we designed are collectively informed by two patient portal studies performed by a medium academic healthcare system in the Mid-Atlantic region, which both contained data on patient portal users and non-users. We additionally developed these personas based on findings from an environmental scan of peer-reviewed and grey literature.

The first study we leveraged to inform our user personas aimed to examine demographic differences between patient portal users and non-users, as well as examine health literacy, patient self-efficacy, technology usage and media and technology attitudes between patient portal users and non-users.[12] This data was collected from an online survey completed by a sample of 489 Amazon Mechanical Turk (MTurk) workers from December 2021 to January 2022. Data were analyzed using latent class analysis (LCA) and multivariate logistic regression models. Among the most relevant findings for the current analysis on user personas were indications that patient portal usage was high among patients with health insurance, a primary care provider, and patients with comorbid disorders.[12]

The second study we used to inform our user persona designs aimed to examine patient portal usage from pre- to post-onset of the COVID-19 pandemic, as well as to assess differences in portal usage by chronic disorders from pre- to post-onset of the pandemic.[13] Patient portal data were extracted and analyzed from a sample of 153,628 unique patients with patient portal account receiving care in a medium, Mid-Atlantic-based academic healthcare system. Patient portal usage from pre-onset (March 2019-February 2020) to post-onset of the COVID-19 pandemic (March 2020-February 2021). A demographic analysis and a series of mixed effects models confirmed that patient portal usage was higher among these patient populations (insured, have primary care provider, have comorbidities of any type) and among patients with a disability, high levels of patient self-efficacy, and positive attitudes toward use of technology.[13] Other results relevant to our user personas evidenced in both studies include higher income and education levels among patient portal users, more users living in urban locations, and high health literacy among non-users.[12, 13]

An environmental scan of the peer-reviewed and grey literature aligned with the findings from these two studies. This scan also provided additional details on differences among patient portal users and non-users beyond the scope of the two studies. This scan included studies found using PubMed and Google Scholar, as well as other scholarly content found in standard Google search engine. This scan included a global array of studies, including research based out of the United States, Australia, Canada and the Netherlands. Our search terms, which were adapted depending on database or search engine type, included phrases such as: “user personas”; “patient portal users”; “patient portal non-users”; “patient portal characteristics”; “patient portal disparities”; “digital health equity” and others. The additional information we found included data suggesting that women more often identify as users when compared to men, and that average users are typically younger than non-users.[14,15] Racial differences have also been noted, as White and Asian-Americans are more likely to utilize patient portals than Hispanic/Latinx or African Americans.[10, 11, 16]

Use Personas

A total of three patient portal user personas were developed (Table 1). These personas are defined by health utilization patterns, technology barriers, and email and computer usage.

Table 1.
Use Personas

	User Persona 1	User Persona 2	User Persona 3
Healthcare Utilization	• No primary care provider • No health insurance • Low use of healthcare services	• Has primary care provider • Has health insurance • Inconsistent use of healthcare services	• Has primary care provider • Has health insurance • Regular use of healthcare services for preventative and/or screening appointments, and/or management of acute and chronic conditions
Technology Barriers	• None or limited access to technological devices • None or limited access to Internet • Limited comfort with use of technology ○ Prefers receiving physical copies of medical records or paperwork	• Moderate access to technological devices and Internet ○ Out-of-date or poor quality technological devices • Limited comfort with use of technology ○ Mixed preferences about modality of receiving medical records and paperwork	• No to minimal barriers
Email and Computer Usage	• No active email account	• Has active email account • Email account used inconsistently	• Has an active email account • Email account used regularly ○ Can access email via multiple devices (cellular device, computer, tablet, etc.)

Healthcare System Inputs	• Technology assessment of patient ○ Identify access barriers ○ Provide resources (internal and external) to address barriers • Technology support ○ Assistance with setting up email and patient portal accounts ○ Support for issues with patient portal accounts ○ Provide secure access to device for patients in provider waiting room/lobby/office
Developer Inputs	• Integrate accessibility features into patient portal accounts for patients with vision, hearing and other disabilities • Pilot test patient portal platform with patients from different backgrounds (low to high technology and health literacy; patients with vision, hearing, and other disabilities; low to high income; low to high education levels; diverse racial and ethnic backgrounds; diverse age groups; diverse gender/sexuality representation). • Survey potential users from different backgrounds regarding which features may be of most useful

Type #1

The first user persona is someone who faces significant barriers to accessing technology and healthcare services. Barriers to healthcare include lack of health insurance which severely limits use of healthcare services due to high out of pocket fees and patients typically do not have a primary care provider. Technology barriers include none to minimal access to devices needed for patient portal usage (e.g. computer, tablet, smart phone) and none to limited access to Internet. These technology barriers are shaped by structural factors, such as limited finances to purchase devices and pay for Internet services and contribute to low technology literacy and comfort with technology. The absence of an actively used email account is another barrier, which complicates enrollment and usage of patient portal platforms.

Type #2

The second user persona faces some barriers in accessing technology and healthcare services but has more points of access when compared to the first user. Though this user has both health insurance and a primary care provider, their healthcare utilization behaviors are inconsistent due to barriers such as lack of transportation, inability to take time off from work, and medical mistrust. These users have moderate access to technology including both Internet and personal internet-accessible devices for access to patient portals. However, their device is slow and outdated, which makes checking emails and using patient portals frustrating. Thus, these users tend to prefer printed copies of medical records and other health status updates.

Type #3

The third user persona faces minimal barriers to patient portal use. These users have a trusted primary care provider, as well as reliable health insurance. These users regularly use healthcare services for preventive and/or screening appointments to manage acute and chronic conditions. These users are well adjusted to technology use, with strong internet access and an up-to-date array of Internet-accessible devices (e.g. smartphone, computer, tablet). These users regularly monitor their emails and are open to downloading and using patient portal applications.

We also provide insights on critical healthcare systems and developer inputs for consideration of a maximally equitable patient portal design. On the healthcare system level, we posit that a technology assessment of patients, including identification of access barriers as well as provision of internal and external resources, should be performed. We also recommend technical support, including assistance with setting up both email and patient portal accounts, support for any issues with patient portal accounts and provision of secure devices for use in the waiting room, lobby, or office. Developer inputs should include integration of accessibility features within patient portal accounts for patients with vision, hearing and other disabilities. Specifically, these features could potentially include simple, effective text enlargement features and high-quality text-to-speech and voice typing capabilities. We recommend that developers pilot test the patient portal platform among a diverse sample of users, with intentional effort to include the following demographics; those with both low to high technology and health literacy; patients with vision, hearing, and other disabilities; patients with various income levels; patients with various education levels; diverse racial and ethnic backgrounds; diverse age groups and diverse gender/sexuality groups. Potential users from these groups should be surveyed regarding which particular patient portal features (i.e., admission summaries, records access, messaging provider, etc.) would be most useful to them. Centering feedback from a diverse group will allow for an equity-focused approach in the patient portal design.

Discussion

Our work explores the development of equity-oriented user personas for patient portal use. This work intends to serve as a launchpad for development and innovation as digital health moves to the forefront of medical care. The development of user personas provides thoughtful insights of the situational details that may explain trends in patient portal usage. While user personas are unable to directly define the authentic lived experiences of potential users, they are pivotal in ensuring accessibility, diversity and inclusion are well embedded into the design of patient portals.

This study is uniquely informed by patient portal usage studies conducted out of a Mid-Atlantic based medical system, and a scan of the peer reviewed and grey literature. Insights from these sources provided comprehensive data on diverse patient subpopulations and healthcare needs related to technology. Our user personas speak to a multitude of both barriers and facilitators to engaging in patient portals, including access to Internet-accessible devices, insurance status and primary care. We contextualized this further by noting that psychosocial factors such as medical mistrust, inability to take time off of work and digital hesitancy or frustration in the characterization of these personas. In continued work, we encourage developers, alongside researchers and providers, to be intentional about amplifying the feedback of historically marginalized populations, including people with disabilities, racial and ethnic minorities, and LGBTQIA+ identifying individuals in the early design stages of patient portals. In doing so, patient portals and digital health at-large may evolve to be optimally inclusive and equity oriented.

The limitations of this analysis should be considered in future directions for this work. Our personas could certainly be improved with increased dimensionality to authentically speak to the complexities of health inequity. In future analysis, these user personas should be strengthened through use of driving factors, facilitated dialogue and modeling to extend their reach beyond surface-level variables we have centered, such as race, insurance status and income level. More dynamic, highly tailored preferences should also be included to make future persona designs maximally engaging, inclusive and rooted in advocacy and equity, including patient's personal care goals, occupational considerations, personality attributes and lived experiences with discrimination that shape a patient's journey in pursuing care. We also note that this work should be further grounded in other elements of innovative strategies for health technology research, including User Experience (UX) and Customer Experience (CX) research strategies. Lastly, these studies were partially informed by an environmental scan, which may not have produced as robust of a basis as a systematic literature review, for example. Future studies should aim to be more systematic in the grounding of literature to ensure that personas have a maximally strong foundation.

Conclusion

With digital health being increasingly adopted in healthcare, it is critical for inequalities to be considered in the design of tools like patient portals. Our data addresses this need through the development of uniquely informed user personas that highlight the diverse social, technological, and health related needs that many real patients may resound with. In this, we encourage developers, researchers and providers alike to center health equity in ongoing activities that contribute to the expansion of digital health and medicine.

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Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Statement of Contributions

These authors contributed equally to the writing of this manuscript. Asli McCullers played the primary role in developing this work into a publishable manuscript, and wrote the abstract, background, segments of the "User Persona" section, discussion and conclusion. Naheed Ahmed conceptualized the vision for this paper, and wrote the introduction, methods and segments of the "User Personas" section.

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Philadelphia Youth Photovoice: Opportunities for Nonprofit Hospitals to Integrate Photovoice as Part of the Iterative Process for Community Health Needs Assessments and Implementation Strategies

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Keywords: *Community Health Needs Assessment, Photovoice, Health Policy, Community Based Participatory Research, Community Engagement, Health Equity*

Background

Community Health Needs Assessments (CHNAs) as a Requirement Under the Patient Protection and Affordable Care Act (PPACA)

According to section 501(r)3 of the Patient Protection and Affordable Care Act (PPACA), in order for a 501(c)3 hospital to receive tax exemption, nonprofit hospitals in the United States must conduct a triennial community health needs assessment (CHNA) and adopt a community health implementation strategy (CHIP) to meet the community health needs identified through the assessment. According to this 2010 legislation, later revised in 2013, the needs assessment must account for input provided from representatives of the communities served by the hospital.[1,2] This legislation rose out of concern that nonprofit hospitals were not meeting the minimum standards of community benefit to gain tax exempt status.[3]

According to the IRS, for CHNAs to meet the requirements of PPACA section 501(r)3, they must take into account input received from persons who represent the broad interests of the communities served by the hospital, address needs of all patients in the hospital's catchment area regardless of their abilities to pay for healthcare, provide a prioritized list of significant health needs identified by the community, and describe resources available.[4] The United States Congressional Budget Office reports that non-profit hospitals serve communities with an average poverty rate of 11.4%, an uninsured rate of 14.6%, and an average income of $32,423.[5] This clearly indicates that nonprofit hospitals need to engage with under-resourced communities to meet the expectations of a CHNA.

In addition, the PPACA requirement for nonprofit hospitals was designed as a single iterative process where a CHNA is performed to inform a CHIP, the CHIP translates to measurable community benefit, which is then reported in the next CHNA and guides the next iteration.[1] However, a 2019 review of 500 randomly selected CHNAs from non-profit hospitals found that only 60.0% of these hospital had published both a CHNA and a CHIP. Of the CHNAs, 25.0% did not include resources available to communities, and 42.2% did not address the impact of their last CHNA.[6] This demonstrates that the PPACA's intention to generate an iterative process for assessing, planning, implementing, evaluating, and reassessing community benefit is not being reported by many hospital systems. Integration of methodologies across CHNAs, CHIPs, community benefit, and impact evaluations may improve interoperability between these components and ensure that the PPACA's CHNA requirement reaches the objectives for which it was intended.

Photovoice Research in CHNA

Photovoice is a community-based participatory action research method first described in 1997 by Wang and Burris, that emphasizes moving research methodology and subsequent results towards empowering social change within communities.[7] The roots of photovoice methodology are four-fold: 1) an intervention to empower individual self-efficacy as a community change agent, 2) an assessment of community strengths and weaknesses as identified and interpreted by community members, 3) a process for building community capacity to implement changes that positively impacts community health, and 4) a mode for influencing policy, systems, and environmental reform that improve sustainability of positive changes implemented.[8] Photovoice also has great utility in engaging and empowering individuals and under-resourced communities who have been historically marginalized by society and government, and excluded from previous research and advocacy efforts.[9]

There is a growing field of research on how hospital CHNAs and CHIPs are meeting the requirements and expectations outlined by the Internal Revenue Service (IRS) pertaining to the PPACA's section 501(r)3, but there is limited research detailing whether photovoice research is an effective CHNA component to meet these IRS requirements.[6] In this article, we describe a photovoice project involving Latino youth in Philadelphia and analyze whether it satisfied certain requirements of CHNAs required by the PPACA as described by the IRS. According to the 2019 US Census Bureau, there are currently 18.6 million Latinos under the age of 18 in the United States, which represents over 30% of the entire US Latino population.[10] In addition to higher rates of poverty, lack of health insurance, and lower educational attainment, Latino youth are disproportionately affected by obesity, asthma, and mental health conditions.[11] In Philadelphia, 15.2% of the population identifies as Hispanic or Latino, and when compared to the city, they have disproportionately higher rates of poverty (45.5% vs 24.6%), uninsured people (24.2% vs 12.9%), asthma (28.6% vs. 21.5%), diabetes (22.9% vs 13.8%), and mental health conditions (38.1% vs. 25.4%).[12]

Though this photovoice project was a component of a CHNA, this CHNA was not meant to fulfill a requirement for the PPACA and instead aimed to specifically partner with Latino youth to identify and interpret the highest priority health needs of a historically marginalized and under-resourced community in Philadelphia while evaluating the utility of the method in meeting PPACA CHNA requirements.[12]

Methods

Research Team

This study was conducted by a team consisting of a public health research fellow (C.D.), four medical students (V.P., M.A., M.H., and J.M.), and a population health and research expert with > 30 years of experience (R.B.) who trained the team and supervised data collection and analysis.

Participant Recruitment

Five zip codes were identified as having the highest Latino population density in North Philadelphia using Geographic Information Systems. A community advisory board composed of stakeholders from within these five zip codes was formed, and three organizations from this board volunteered to recruit up to 20 Latino youth participants, aged 14-18, from their existing programs: 1) a youth advocacy program at a primarily Latino community resource center, 2) an after school program for students with learning disabilities, and 3) a charter school managed by a Latino nonprofit organization.

Study Design

The research design was adapted from the Wang and Burris article first describing photovoice methodology.[7] Researchers met with participants in an introductory group session #1, followed by interviews and subsequent group sessions #2, #3, and #4. Group sessions #1-#3 and interviews were conducted separately at each of the three community partner sites in January-March 2019. Groups session #4 involved participants across all three sites at the end of March 2019.

Group Session #1

Participants brought consent forms signed by their parents or guardians. The researchers read the assent and the participants signed. A professional photographer was hired to provide a photography lesson to the participants and participants were offered a camera to use if desired. Researchers reviewed ethical and safety guidelines for taking photographs, and instructed participants to take photos in response to the research question "What helps and what prevents you from being healthy in your community?" Participants had at minimum one week before their individual interviews to take and select up to 10 photos that would best illustrate their responses to this question.

Interviews

Researchers interviewed individual participants about their 10 photos using the SHOWeD questioning strategy, a set of questions used to elicit a description of the photos, an explanation for their relevance to the research question, and a discussion on how to address issues identified.[13] Researchers chose to interview participants instead of discussing photos in small groups in this photovoice design due to the broad nature of the research question, which demanded additional time to address all photos taken. Due to the sensitive nature of some themes, interviews were also used to engage participants in selecting which photos to present in group sessions to highlight their points while protecting the individual participant's privacy and safety. Participants were permitted to opt-out of the interview. The interviews were audio recorded and transcribed verbatim. After the interview, each participant was asked to write phototexts for three photos they thought were the most important to the research question. Researchers provided assistance in writing phototexts when requested by participants.

Group Session #2

Researchers de-identified and compiled participant photos and phototexts. Photos and phototexts were projected one at a time for participants to view. Participants were asked to discuss how each photo may or may not relate to their own experiences. These sessions were audio recorded and transcribed verbatim.

Group Session #3

Researchers individually printed the photos and phototexts reviewed in group session #2 and instructed participants to sort the photos into common themes. Participants were instructed to name these themes and select which photos within each theme would be included in the final photo exhibit.

Group Session #4

This single session involved all participants from the three partner sites. Researchers printed the photos and phototexts selected during group session #3 and displayed them beneath the themes that the participants developed. Participants from each site presented the themes developed at their site to the entire group. Participants were provided time to review the photos independently. Then, researchers instructed participants to integrate photos and phototexts from similar themes across sites, create new themes as needed, and name the final themes. Researchers recorded the descriptions of each of the final themes as defined by the participants. Participants provided feedback on how they thought the exhibit and their individual photos and phototexts should be displayed.

Prioritization

During group session #4, researchers asked participants to identify specific health needs presented in the final photo exhibit across multiple themes. Each participant was permitted to vote three times on which of these health needs were the highest priority. The top five health needs by vote were considered the final ranked priorities.

Data-Analysis

Software

Interview transcripts, group session transcripts, and phototexts were uploaded into NVivo 12.0, a software program used to analyze qualitative data.[14]

Coding and Code-Book Development

The final 10 themes and respective names and definitions developed by participants during group session #4 were used as primary codes. Then, using line-by-line reading of the data, researchers met as a team to develop subcodes and their explicit definitions. Two members from the research team independently coded all interview transcripts, group session transcripts, and phototexts into codes. This process was repeated to code data from all codes into subcodes. Coding discrepancies were resolved by consensus during review sessions.

Reliability

Intercoder reliability and percentage of agreement was calculated in NVivo 12 using the mean $\varkappa$ coefficient, which can be interpreted as moderate agreement ($\varkappa = 0.41$ to 0.60), substantial agreement ($\varkappa = 0.61$ to 0.80), or near-perfect agreement ($\varkappa = 0.81$ to 0.99).[15]

Conceptual Model

Researchers utilized the World Health Organization's Framework on the Social Determinants of Health to categorize subcodes as 1) a structural determinant of health, defined as factors that contribute to inequitable social stratification, 2) an intermediary determinant of health, defined as factors that directly protect or put individuals at risk of health-compromising conditions, or 3) a proposed solution.[16]

This study received Institutional Review Board approval, involving written parent or guardian consent and youth assent to participate. Participants received $60 and a framed photo of their choosing for completing the project.

Results

A total of 34 participants completed the photovoice across the three community partner sites as displayed in table 1, producing a final photo exhibit consisting of 76 photos and phototexts across 10 codes. Combined findings from interview transcripts, group session transcripts, and photos/phototexts are summarized below for each of the ten codes, presented in alphabetical order by the names assigned by participants to each code, followed by prioritization and a conceptual model. Analysis revealed near perfect agreement in this study (mean $\varkappa = 0.94$), and 96.5% agreement.

Table 1.
Participant Demographics. This table summarizes the demographics of participants in this photovoice including age, gender identity (M= Male, F= Female), and their distribution across the three community partner sites. All participants identified as Latino and gender binary.

	Age	Frequency (Male, Female)
	14 Years	5 (3M, 2F)
	15 Years	7 (5M, 2F)
	16 Years	7 (3M, 4F)
	17 Years	8 (4M, 4F)
	18 Years	7 (6M, 1F)
	Location	Frequency (Male, Female)
	Site 1	5 (4M, 1F)
	Site 2	14 (10M, 4F)
	Site 3	15 (8M, 7F)
Total		34 (21M, 13F)

Beauty of the Natural Beast

Participants found beauty in the "beastly" green spaces in their neighborhoods, represented by photos of unkept lots, parks, and gardens. Participants reported that the government invests in green space upkeep in other neighborhoods more than their own. They reported associating green spaces with feeling safe, saying, "since there are more trees in the area…you will feel safer," and that engaging in activities in these outdoor spaces improves mental health. Participants said that trees provided clean air which they linked to decreased instances of asthma and respiratory disease. They suggested that planting more trees and having frequent neighborhood cleanups would improve their health.

Hope

Participants highlighted a wide variety of factors that improved their health and gave them hope. Participants remarked that participation and self-expression through sports, the arts, and volunteering improved their mental health. Participants reported that the support they received from their friends, family, mentors, and teachers through these activities helped them be "spiritually healthy" and "keep them out of gangs, fights, cutting school, and smoking weed," but not many youth in their community have a trusted adult in their lives. They suggested that increasing access and visibility of these efforts would benefit their communities.

Mindfulness is Power

Participants frequently emphasized the power they found in taking control of their mental health, but they shared that there are several factors that negatively impact their collective mental health. They reported that their community experiences higher rates of stress, especially in lower income areas. Some participants explained that their peers rely on alcohol and marijuana to self-medicate; however, the majority of participants reported using self-care techniques as a means to overcome stress.

One Life = Game Over

Participants remarked on their understanding of life's fragility through their exposure to a myriad of dangerous situations and poor health behavior practices. They reported an "increase in mental illnesses" that they associate with increasing exposure to gun violence, traumatic death, and the resulting memorials found frequently throughout their neighborhoods. Some participants said this creates barriers to leaving their homes. They reported attributing these violence to easy access to guns, tobacco, marijuana, and alcohol through local business or illegal markets in their community. They remarked that "We gotta stop taking each other's lives," and, "People should be more strict about who they are giving guns to."

The Code of Urban Art

Most participants identified a dichotomy in how art in their community can be either productive or destructive. The majority of participants stated that graffiti for gang or drug-related activity, was common but unwelcomed in their community. They embraced how the presence of colorful and culturally inspired mural arts improved individual and collective mental health, promoted tourism, and increased community pride, but that these murals were less common in their neighborhood community. Like in Photo 1, they recommended that more funds be invested in creating culturally grounded murals in lower income communities, which may also improve the sustainability and upkeep of such displays.

Photo 1. Graffiti for Art. "We want the community to change to something better. We need to change the graffiti to cultural art. The art needs to mean something important for the community so that they like it, respect it, and take care of it."

The Unseen World

Participants frequently noted that the subpopulation of individuals experiencing homelessness and opioid addiction residing in their neighborhoods were neglected, or left unseen, by everyone else. Participants recounted frequently witnessing people injecting drugs and finding needles in public spaces, which they report negatively impacts mental health and safety for the rest of the community. However, many participants discussed that "people don't see them as a person, which is another big problem… but they don't have the resources to get help." They suggested increasing access to food, shelter, and opportunities to recover for these individuals, and increasing availability of sharps disposals to help improve the safety of the community.

Trash Effects. Trash Affects.

A large majority of participants discussed how the effects of high rates of litter and illegal disposal of trash have negatively affected the health of their community, posing a critical safety hazard, particularly for young children. Participants reported feeling neglected by their neighbors who litter, by the city sanitation workers who are supposed to pick it up, and by short dumpers who come from outside the community and dump trash in empty lots. One participant stated, "It's depressing because there's trash everywhere, and when people come to Philly to see that, that's what they think represents us." Some stated that the negative perceptions of their community had a negative impact on their self-worth. Participants expressed frustration regarding the lack of sustainability of the community cleanups and want better accountability for litterers and short dumpers.

Verses of Adversity

Participants recounted experiencing various forms of adversity, which sometimes were motivators to improve their circumstances, but at other times led to negative coping mechanisms. Participants identified factors that improved their ability to overcome stressors such as strong family relationships, religious practice, and community social support. Some participants cited The Broken Window Effect,[17] stating "The Broken Window Effect to me is if you don't really give a f*** about it and if other people don't give a f***, then you're just going to feel… worthless." Many participants reported feeling they had exhausted their efforts to improve their community, claiming that the government keeps the wealthier areas clean and safe, while under-resourcing their communities, which added to feelings of neglect and hopelessness.

Wasted Spaces

Participants identified innumerable empty buildings and lots they described as a waste of space. Participants explained that abandoned sites festered drug use, illegal dumping, and other criminal activities causing safety concerns and health risks throughout their neighborhoods. Participants reported feeling neglected by the city and property owners for letting abandoned buildings and lots deteriorate, as displayed in Photo 2. They agreed that these abandoned spaces should be repurposed as parks, community gardens, health centers, or daycares to meet the community's needs, saying, "They could make it into something positive for the community…like a shelter for the homeless."

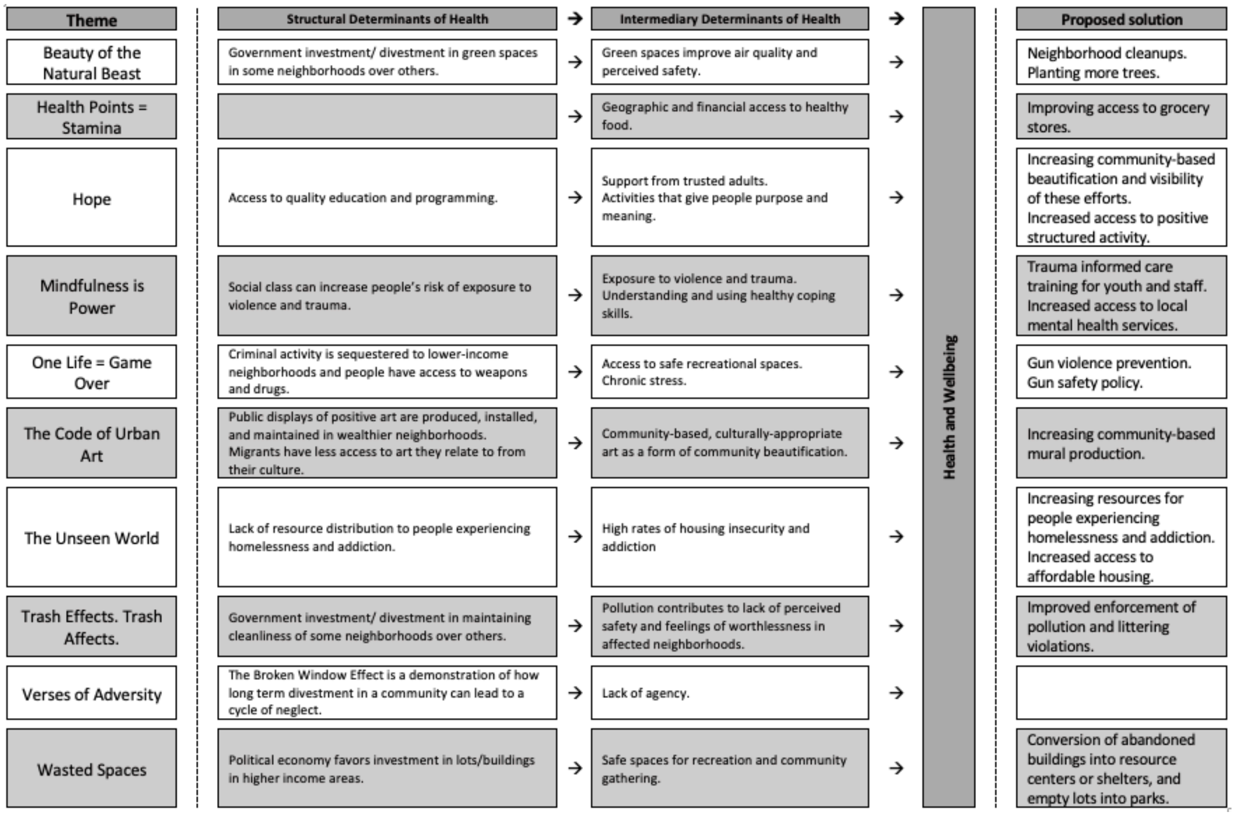
Photo 2. Abandonment. "In this picture there are abandoned buildings. This building has been there like this since I was a little boy. I am now 18 years old. These buildings used to be owned by manufacturing companies. These companies left while still owning the building. The city does not want people to fix these buildings for their own reasons. This is not okay."

Prioritization

The participants determined the highest priority health needs of their community based on health needs represented across multiple themes. In order, the priorities are 1) mental health, 2) trauma, safety, and violence, 3) built environment, 4) health behavior and health education, and 5) physical health.

Conceptual Model

Researchers found that within each code identified and defined by participants, subcodes spanned across structural determinants, intermediary determinants, health and wellbeing, and proposed solutions for eight out of the ten themes. The remaining two codes spanned three of these four constructs. Figure 1 summarizes these findings.



Theme	Structural Determinants of Health	→	Intermediary Determinants of Health	→		Proposed solution
Beauty of the Natural Beast	Government investment/ divestment in green spaces in some neighborhoods over others.	→	Green spaces improve air quality and perceived safety.	→	Health and Wellbeing	Neighborhood cleanups. Planting more trees.
Health Points = Stamina		→	Geographic and financial access to healthy food.	→		Improving access to grocery stores.
Hope	Access to quality education and programming.	→	Support from trusted adults. Activities that give people purpose and meaning.	→		Increasing community-based beautification and visibility of these efforts. Increased access to positive structured activity.
Mindfulness is Power	Social class can increase people's risk of exposure to violence and trauma.	→	Exposure to violence and trauma. Understanding and using healthy coping skills.	→		Trauma informed care training for youth and staff. Increased access to local mental health services.
One Life = Game Over	Criminal activity is sequestered to lower-income neighborhoods and people have access to weapons and drugs.	→	Access to safe recreational spaces. Chronic stress.	→		Gun violence prevention. Gun safety policy.
The Code of Urban Art	Public displays of positive art are produced, installed, and maintained in wealthier neighborhoods. Migrants have less access to art they relate to from their culture.	→	Community-based, culturally-appropriate art as a form of community beautification.	→		Increasing community-based mural production.
The Unseen World	Lack of resource distribution to people experiencing homelessness and addiction.	→	High rates of housing insecurity and addiction	→		Increasing resources for people experiencing homelessness and addiction. Increased access to affordable housing.
Trash Effects. Trash Affects.	Government investment/ divestment in maintaining cleanliness of some neighborhoods over others.	→	Pollution contributes to lack of perceived safety and feelings of worthlessness in affected neighborhoods.	→		Improved enforcement of pollution and littering violations.
Verses of Adversity	The Broken Window Effect is a demonstration of how long term divestment in a community can lead to a cycle of neglect.	→	Lack of agency.	→		
Wasted Spaces	Political economy favors investment in lots/buildings in higher income areas.	→	Safe spaces for recreation and community gathering.	→		Conversion of abandoned buildings into resource centers or shelters, and empty lots into parks.

Figure 1. The World Health Organization's Framework on the Social Determinants of Health. This conceptual model lists the ten codes named and defined by participants in the left column. Researchers mapped concepts from subcodes, defined by researchers, as "Structural Determinants of Health" or "Intermediary Determinants of Health" as defined by this framework and illustrated how participants suggested they affect health and wellbeing. Solutions proposed by participants are listed in the right column. Empty boxes indicate fields that were not addressed by participants in their respective themes.

Discussion

As demonstrated in Figure 1, photovoice methodology proved successful in engaging Latino youth to span a breadth of ten codes and the depth of conversation within each of these codes connecting structural determinants of health to intermediary determinants of health to health and wellbeing, and proposing feasible solutions. Our results also demonstrate the ability of photovoice to produce a prioritized list of community health needs and a description of resources available to the community, as required for a CHNA.

Part of this photovoice was a CHIP that included a photovoice exhibition in community sites and City Hall, youth policy and advocacy training, and $600,000 in community catalyst grants, which has previously been described by Dafilou et. al. 2022.[18] Many of the photovoice participants and associated community organizations were involved in this CHIP through proposed solutions presented in our results and Figure 1. It has been well established that taking an intentionally moral, strategic, and pragmatic approach to stakeholder engagement is essential to health needs assessments and success in developing and implementing collaborative interventions and solutions.[19] When photovoice researchers adapt this approach to incorporate intentional action planning into their engagement with participants, results can lead to community mobilization towards positive, sustainable change.[20] This photovoice demonstrates how investing in the engagement of participants, in particular from under-resourced communities, and including them in action planning through photovoice led to a series of community benefit initiatives co-led by community members and organizations with the hospital as an anchor institution. This embodies the purpose that the PPACA envisioned for CHNAs, CHIPs, and community benefit.

What is notably lacking from many CHNAs and CHIPs is an understanding of the iterative process for which they are intended. Figure 2 demonstrates how CHNAs are meant to inform CHIPs, which should then be implemented for community benefit purposes. We have demonstrated, using our photovoice project, that photovoice is an effective method at engaging community members longitudinally across these three components. While our claims may be limited by illustrating these points using a single initiative, the benefits described are common findings of photovoice research when utilized for needs assessments.[21,22]

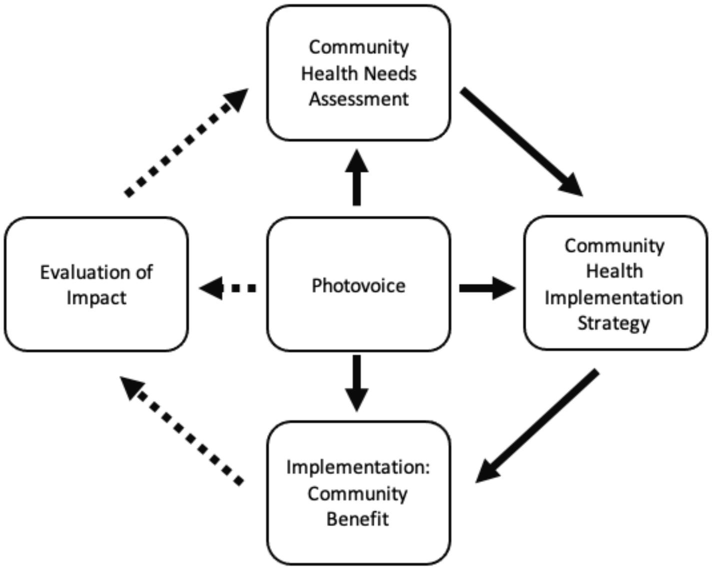


Figure 2. Strengths and Opportunities for Photovoice in taking Community Health Needs Assessment to Community Benefit to Reassessment. Researchers developed this figure to illustrate the iterative process for community health needs assessments to translate to community health implementation strategy, implementation of community benefit, impact evaluation, and reassessment to inform future iterations of this process as intended by the Patient Protection and Affordable Care Act. This figure shows how photovoice can play a role throughout this process. Solid lines indicate strengths that were demonstrated in this research study and dotted lines indicate opportunities for future research.

However, a notable weakness of this photovoice project is the lack of evaluation of the CHIP described in Dafilou et. al. 2022, and the photovoice process itself as a single iterative process that supports community benefit while informing re-assessments.[23] This has been a well-documented shortcoming of both photovoice research and of CHNAs and CHIPs historically, and is thus represented by a dotted line in Figure 2.[21,24] Future research should target opportunities for photovoice to extend beyond the intergradation CHNAs, CHIPs, and community benefit, to also include impact evaluations and re-assessment. This may demonstrate further utility for photovoice to play a role in each component displayed in Figure 2 as part of a single process to inform future assessments, implementation strategies, and community benefit initiatives.

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Conflicts of Interest

The authors have no known conflict of interest to disclose.

Statement of Contributions

All listed authors were involved in conducting the photovoice research, analysis of data, and development of the final manuscript. Caleb Dafilou served as the project manager and Rickie Brawer served as the Principal Investigator.

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AnnoTS: An Annotation Tool for Sensor-Acquired Movement Data

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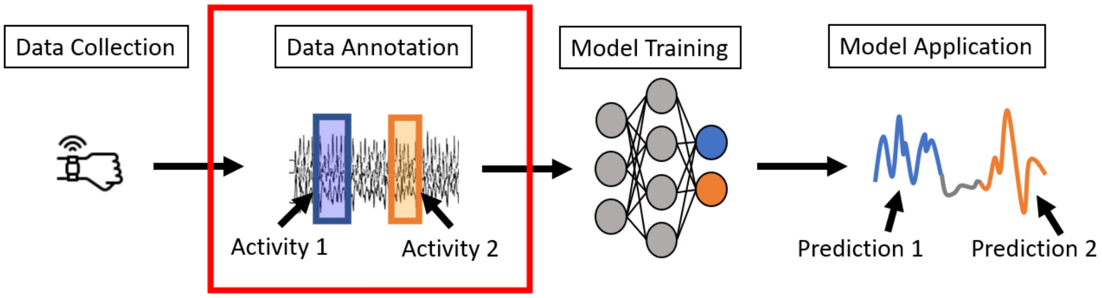
Objective: Developing machine learning and deep learning models to detect aspects of human movement activity in naturalistic environments requires labeled datasets. AnnoTS aims to provide researchers with a software tool to annotate human movement data collected from wearable inertial measurement unit sensors. Methods: AnnoTS is a graphical user interface-based data annotation software created with Python libraries (PyQT5, PyQtGraph, and Pandas). Conclusion: AnnoTS facilitates the annotation of sensor-acquired movement data and is available as a standalone research software through an open-source code repository.

***Keywords**: Annotation, User interface, Human activity recognition, Machine learning*

Introduction

Advances in the field of wearable computing enable long-term monitoring of human movement in naturalistic environments. Accelerometers are the most common wearable sensors used to quantify human movement in clinical research and trials.[1,2] Accelerometer data is typically used to measure movement intensity and energy expenditure.[3] Although accelerometry-derived measures provide useful information regarding overall physical activity, they lack the ability to discriminate between different types of clinically relevant activities and movements.[4] Conversely, the combination of several inertial measurement unit (IMU) sensors, such as accelerometers combined with gyroscopes and magnetometers, can better inform the prediction of human activity.[5-7] Recent developments in machine learning and deep learning permit continuous monitoring of clinically relevant human movement activities over long periods of time.[5] However, continuous long-term monitoring generates large unlabeled time-series datasets that require appropriate data management techniques, including processes for annotating clinically important aspects of movement data.

Manual annotation of IMU data is necessary to develop supervised machine learning and deep learning models that can accurately predict human activity in naturalistic environments (see Fig. 1). Supervised machine learning and deep learning models require labeled data from the annotation process to teach models the correct labels to predict. Annotation is the process of attributing labels to events or sequences of raw data (i.e., data collected at large sampling rates such as 50 times a second or 50Hz) to provide context or meaning to the data.[8] Available data annotation software includes tools to label clinically relevant movement activities from, for example, video data capturing human behavior and gait patterns,[9] or physiological signals monitoring heart function (e.g., heart rate).[10] Two annotation tools are available to label IMU data: the Wearables Development Toolkit (WDK)[11] and Signaligner-Pro.[12] Both tools afford visualization, interaction, and manual segmentation of IMU sensor data; however, the WDK[11] requires users to understand and purchase MATLAB (i.e., programming software that requires a paid subscription), which may limit its usability. On the other hand, Signaligner-Pro[12] limits users to analyzing raw accelerometer data from Actigraph watches, thus excluding other types of sensor data such as gyroscope data and devices. Despite the wide availability of annotation software, there is a demand for open access (e.g., free software) and user-friendly annotation tools that can be used by researchers and clinicians who collect IMU data from multiple sensors (e.g., x-axis, y-axis, and z-axis accelerometer and gyroscope). Thus, we aim to address the limitations of previous IMU annotation software by creating Annotation Tool for Time Series Data (AnnoTS), which is a free standalone graphical user interface (GUI) software with modifiable code to annotate IMU data from multiple sensors. AnnoTS has the potential to allow researchers and clinicians to build robust labeled datasets, which are required to develop machine learning and deep learning applications.



AnnoTS-generated annotations (highlighted in red) are used to identify activities from sensor-based movement. Activities identified during the data annotation phase are later used to train models that predict activities during model application.

Figure 1: Example of human activity machine learning and deep learning model training and application procedures.

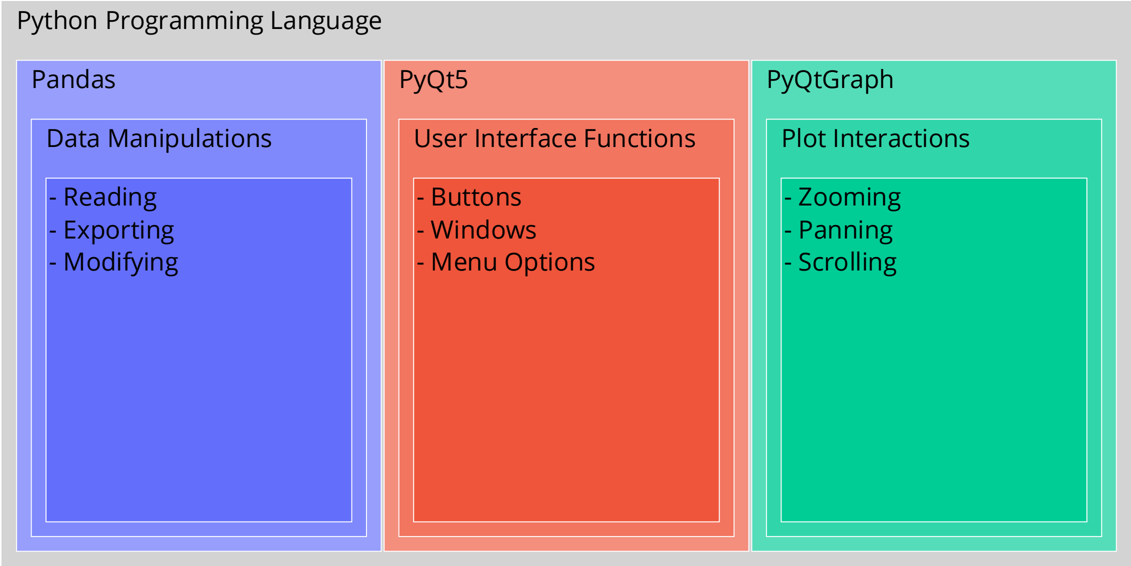
Materials and Methods

Software requirements

Data annotation software must satisfy various user requirements. First, the tool should operate with similar functionality for different data sources (e.g., accelerometer, gyroscope).[10] Also, the tool should support the loading of a variety of unique datasets with multiple IMU sensors. Further, the tool should take the form of a GUI to promote user accessibility, facilitate annotations in a short period of time, and reduce potential errors through the visualization of data.[10] Finally, the tool should allow users to seamlessly navigate their dataset (using multiple features such as zooming and scrolling) and visualize labeled data overlying time-series signals.[10]

Software architecture

All software architecture was conceptualized and designed by researchers in the Personal Health Informatics and Rehabilitation Engineering Lab at Temple University. Python programming language (Version 3.8)[13] and three Python libraries were implemented to enable specific functions within the GUI (see Fig. 2), including PyQT5, Pandas, and PyQtGraph. PyQT5 includes functions to create desktop applications. Pandas has functions to manipulate data structures and efficiently store and analyze data. PyQTGraph includes functions to visualize high-quality graphics on PyQt5 desktop applications with tools to create interactive plots. PyQT5, was used to enable user interaction, including all buttons, windows, and menu options within the AnnoTS GUI.[14] Second, Pandas was used to implement functions to read comma separated values (CSV) files, manipulate columns and rows of data, and export CSV files, including files of annotated and original data within AnnoTS.[15] Finally, PyQtGraph was used to generate a plot canvas that permits user interactions with the data plots and annotations (www.pyqtgraph.org) within AnnoTS.

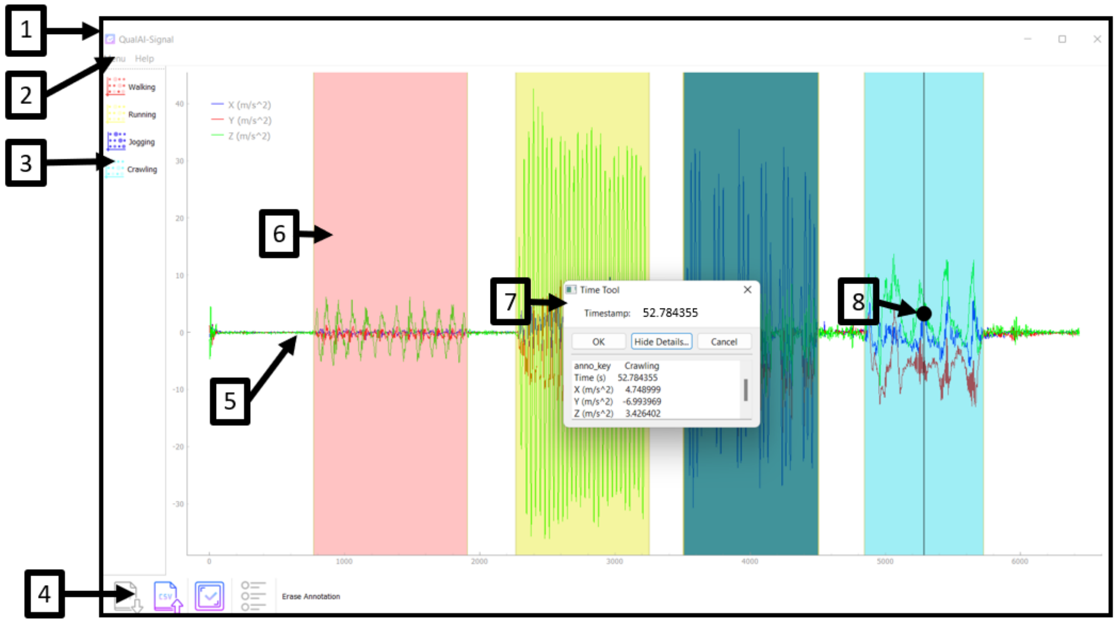


All software was built with the python programming language (highlighted in gray). PyQt5 (highlighted in blue) was responsible for user interactions. Pandas (highlighted in red) was responsible for data manipulation. PyQtGraph (highlighted in green) was used for plot interactions.

Figure 2: Software architecture and user interface functions

User interface

The user interface displays a large plot canvas to visualize IMU data and annotations (see Fig. 3). Signals from IMU sensor data, including a 3-axis accelerometer and 3-axis gyroscope, may be selected to display on the canvas. After importing IMU signals, the plot canvas allows multiple interactions, such as zooming and scrolling, manipulating annotation windows (creating, adjusting, and deleting), and exporting the resultant annotation data. The buttons at the bottom pane of the GUI contain options for importing files, configuring the number of annotations, confirming annotation window locations, deleting annotation locations, identifying indexed data (e.g., timestamps, specific accelerometer values, annotation labels), and exporting annotation data. The left pane of the GUI populates buttons corresponding to the number of annotations the user selects. For example, in the case of three annotations, three buttons will appear on the left pane of the GUI. Each button allocates an original label that symbolizes its encoding in the dataset (e.g., class one, class two, class three). Annotation labels may be modified to align with the type of activity or movement being annotated (e.g., running, pushing).



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Main components of user interface: 1) Main window containing all user interface tools and windows. 2) Menu options for importing previously saved annotation files, saving progress on current annotation files, help, and launching a web browser for learning more about AnnoTS. 3) Customizable annotation labels used to add annotation windows to the plot canvas. 4) Buttons for importing CSV files, exporting CSV files, confirming annotation windows, erasing annotation windows, and adding new annotation labels. 5) Line plot of all imported IMU sensor data. 6) Annotation window color coded to correct customized label. 7) Window displaying raw IMU sensor data at a specified time stamp. 8) Slidable time tool to indicate time stamp for raw IMU sensor data viewing.

Figure 3: Components of the user interface

Use-Case

Prior work from our team used AnnoTS-generated annotations to train and test machine learning and deep learning models to classify sensor-acquired upper extremity activity (e.g., fine motor versus gross motor actions) from neurotypical individuals (see Fig 3.).[16] In the scope of this exploratory project, AnnoTS handled CSV files that ranged in size from 300,000-600,000 rows and seven columns, which consisted of one to two hours of IMU data collection. The data files, which contained six degrees of freedom, including three-axis acceleration and three-axes of angular velocity data from x, y, and z planes, along with timestamps from an ActiGraph GT9X Link watch, were imported into AnnoTS. For this project, our team was interested in accelerometer data and selected accelerometer signals in the x, y, and z planes to display on the primary plot canvas. Following this, we designated six task-based annotation categories (e.g., reaching, lifting, pushing and pulling, desktop activities, finger actions, and isometric actions); however, AnnoTS users may designate up to 17 annotation categories and name them to represent specific movement task events of interest (e.g., reaching, grasping). The primary plot canvas, which affords zooming and scrolling, allowed us to annotate the exact onset and offset times of task-based actions. The data were then exported to a CSV file format. While AnnoTS does not possess the capability to train machine learning and deep learning models, the annotation files were later used to train models to detect the different movement tasks.

Discussion and Conclusion

AnnoTS facilitates the manual annotation of large datasets with IMU sensors via a user-friendly GUI and is freely available as a standalone software application or code (https://github.com/chags1313/AnnoTS). While other annotation software exist, AnnoTS differs from previous IMU labeling software by offering open-source Python code and a free GUI that can handle multiple IMU signals. Users of AnnoTS can assign custom labels and implement unlimited annotations to segment any duration of IMU data on a large graphical display. Users can implement and edit annotations with manual input (i.e., time index of sensor data) or a modifiable annotation window. Moveable widgets further allow users to customize the GUI display. All data can be saved to a CSV format with annotations corresponding to timestamps of IMU data. The main graphical display provides several export options (e.g., .png, .jpg, .sav) for images of signal data with annotation windows.

AnnoTS has limitations to consider. First, AnnoTS has not been tested with datasets larger than 600,000 rows and more than seven columns of IMU sensor data. These data consisted of one to two hours of IMU data collection, which may vary widely among different research paradigms. Researchers should consider testing larger datasets in the future to identify specific limitations related to computational resources (e.g., operating system, random access memory, etc.). Second, AnnoTS limits users to CSV file formats for importing and exporting files. Depending on the IMU device used for data collection, file formats may include tabular separated values, excel files, text files, and others. Future work with AnnoTS should identify code modifications to accommodate for multiple file formats. Third, AnnoTS offers a maximum of 17 total label options. For research requiring more label options, it is possible to modify the code to accommodate for the specific number of labels needed. However, future work with AnnoTS should adjust the software architecture to enable more labeling options.

AnnoTS is a GUI-based data annotation software incorporating Python libraries (PyQT5, PyQtGraph, and Pandas) to label IMU sensor datasets for the subsequent prediction of human activity. AnnoTS is easy-to-use standalone open-source research software and modifiable code. Researchers and clinicians may benefit from using AnnoTS in their data pipeline to label data that is required for subsequent development and evaluation of new digital biomarkers in various populations of interest.

Conflicts of Interest

There are no conflicts of interest to disclose.

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Statement of Contributions

Mr. Hagen designed the software and wrote the paper. Ms. Johnson tested and contributed to the software and paper. Dr. Hiremath conceptualized the primary study, reviewed the software, and contributed to the paper.

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Clinical Social Work in a Public Health Future

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Social and ecological changes after the onset of the COVID-19 pandemic have surfaced the need to change how clinical interventions are administered to extend the reach and impact. The public health prevention approach presents a framework to organize intervention efforts, and clinical social work can benefit from integrating this approach formally into its clinical education programs. This paper presents the current need for a population-based approach to clinical service, a primer for social workers from the public health perspective. It offers key areas to focus on integrating this public health prevention approach more fully into clinical social work practice.

The Need for the Public Health Prevention Approach in Clinical Social Work Practice

The COVID-19 pandemic has increased the general understanding and value of a public health approach to planning and implementing social and health services. Historically, the US has addressed social and public health issues using a treatment model that focuses on assessing and addressing *individual* health problems. A public health approach focuses on the health, safety, and well-being of the whole population, using health promotion and disease prevention interventions to reduce the impact of illness and social problems on the greatest number of people.[1]

The social work perspective rests in ecological systems theory that emphasizes the interconnections between individuals and their environment.[2] When applied to social work, this theory recognizes the profound impact of various systems, from the micro-level (such as families and communities) to the macro-level (including societal and cultural influences) on individuals and their well-being. Social workers employing this perspective strive to understand how these systems interact and shape a person's development, behavior, and access to resources. By comprehending the intricate web of relationships and environments surrounding individuals, social workers can design interventions that address the complex factors affecting their clients, foster resilience, and promote social justice within the broader ecological context.[3]

Within this perspective though, clinical social work training programs often employ the treatment model in their clinical practice curricula and teach how to treat individuals, groups, and families after the onset of a problem. A treatment model can allow customization of intervention planning to clients' needs; however, treating individuals for individual problems can set up the care delivery system in an inefficient way that creates its own access and treatment disparities, on top of the gap related to social, economic, and cultural inequities. The application of treatment for individuals by individual providers can have high variability – and variability in care settings can increase the cost of care and outcomes for service recipients.[4,5] For example, of the estimated 7.7 million children and adolescents with at least one mental health diagnosis, 50% did not receive treatment in 2016.[6] Children experiencing poverty and those from ethnic and racial minority populations are even less likely to access care, especially after the COVID-19 pandemic[7,8] Furthermore, if children get treatment, they may not receive evidence-based, quality care[9] as a result of the high variability in care.[6]

There is an opportunity for clinical social work to reduce this gap. To best serve recipients of clinical social work services, clinical social work education programs should train students using a public health prevention lens to further align the social work perspective with its populations' pressing needs. This paper outlines the benefits of approaching social work with a public health prevention model and why social work education should more fully integrate this perspective in its training of students. Additionally, methods of integrating this perspective into social work practice and recommendations for social work training and professional development are presented.

Social Work and Public Health

Social work has a history of adopting the prevention framework of public health.[10,11] Natural synergy already occurs between public health and social work, especially within the field of social work itself [10]. Social work houses distinct foci worth mentioning here -clinical and public health social work. Both sub-disciplines play essential roles in addressing the complex issues affecting individuals and communities, with clinical social work attending to immediate personal needs and public health social work addressing systemic issues to create healthier and more equitable societies[11,12]. Both share common understandings of how the systemic forces can impact human behavior and wellbeing and the strategies they use differ because of the level of practice they work in.

Clinical social work and public health social work are complementary branches within the field of social work, each with its unique focus and objectives. Public health social work concentrates on utilizing strategies to improve the health and well-being of entire populations and communities,[10] and these strategies have a top-down approach to change (i.e., strategies at the population level can impact individuals). Public health social workers engage in activities that address social determinants of health, including poverty, education, housing, and access to healthcare. [10,11] They collaborate with community organizations, government agencies, and healthcare providers to develop and implement initiatives aimed at disease prevention, health promotion, and health policy advocacy. [10,11] Public health social workers conduct research, assess community needs, design and evaluate interventions, and engage in community organizing and education. Their efforts are directed towards reducing health disparities, enhancing access to healthcare services, and promoting social justice within the broader population[10, 13].

Clinical social work primarily deals with providing direct services to individuals, families, and small groups using clinical strategies to address personal and psychological challenges. These strategies that aim to improve health and wellness have a bottom-up approach to change (i.e., strategies at the individual level can impact the population). Clinical social workers often work in healthcare settings, mental health clinics, or private practices, providing therapy, counseling, and case management services. They assess clients' emotional, behavioral, and mental health needs, develop treatment plans, and offer individualized support to enhance their overall well-being. Clinical social workers work closely with clients to explore their personal experiences, emotions, and thought patterns, helping them develop coping mechanisms and promoting self-empowerment.[14] Clinical social work interventions are targeted toward promoting mental health, improving relationships, and resolving individual-level challenges.

While clinical social work focuses on individual-level interventions to address personal challenges, public health social work takes a broader perspective, targeting the social, economic, and environmental factors that influence population health. The prevention approach of public health has had some but minimal documented interest in the social work literature,[10] and a discussion of the public health prevention approach warrants attention.

Public Health Approach: A Primer for Social Workers

The American Public Health Association (APHA) describes public health as "promot[ing] and protect[ing] the health of people and the communities where they live, learn, work and play.[1] Such activities and efforts intended to prevent injury or illness and promote wellness. The public health approach is organized into three levels of prevention: primary, secondary, and tertiary. [1, 15, 16] Multi-tiered efforts to prevent depression illustrate this process.

Primary prevention, commonly known as *universal prevention,* attempts to prevent the onset of clinical risk factors for disease or illness by reducing risk behaviors or risk factors for disease.[15] Universal prevention practices include vaccine programs and school-based efforts to strengthen protective factors (e.g., community connection). Universal prevention occurs before screening or targeting members of a population who could be at risk for a given challenge. It can be implemented at the population level or target the highest-risk groups.[15] Consider the example of depression. Universal prevention programs would aim to prevent individuals from developing risk factors related to depression. Related activities include conducting social-emotional learning curricula in schools for all children, employer health programs that promote physical activity and behavioral activation, and programming for older adults to increase social connectedness.[17] Social workers can actively support such public health efforts by providing education, organizing, and advocating across system levels. Secondary prevention aims to identify and intervene with asymptomatic persons who have developed risk factors for an illness or disease that have not manifested with clinical significance.[16] Its efforts emphasize early and reliable identification, diagnosis, and access to effective and acceptable treatments. Considering depression, social workers could conduct screenings for depression in primary care settings, education settings, or other contexts, like community wellness fairs. For individuals "at-risk" for a depressive disorder, social workers could educate them about lifestyle changes that are not depression-promoting (e.g., social connection, proper sleep hygiene, and nutritional habits), provide brief interventions like behavioral activation planning, and refer to long-term treatment.[18] Secondary prevention begins to resemble more of the treatment-oriented approach in traditional clinical social work.

The third tier of prevention is most similar to the treatment model. Tertiary prevention seeks to interrupt disease progression through disease management, symptom relief, and risk reduction for subsequent events or complications.[19] Activities include pharmacological therapy and outpatient mental health support. With depression, individuals receive treatment if their symptomatology impacts their daily functioning. Social workers could provide cognitive behavioral therapy (CBT) to help identify and challenge thought or behavioral patterns that maintain undesired behavior, or interpersonal therapies to foster relationships that are not depression-promoting. This approach could occur in a traditional outpatient clinic or through work-sponsored Employee Assistance Programs.[20]

Social work can accommodate the *tiers of support* model within its scope of clinical and macro practice, with the challenge of building capacity and attention to universal and selective tiers. The three tiers of prevention can be juxtaposed with social work's *ecological system rings of practice* – micro, mezzo, and macro. Intentional integration of the tiered approach can benefit social work. Public health approaches can improve patients' quality of life and increase life expectancy.[21] For providers, this approach can reduce disparities in treatment outcomes, with fewer patients experiencing the development of a disease or disorder. For payers, studies show that public health approaches can demonstrate cost-effectiveness.[22] They can bring added public value to the secondary effects on the future functioning of individuals (e.g., contribution to the public good through employment).[23] Social work education needs to become more streamlined to fully integrate the levels of practice and to advance social justice and health equity across these levels of practice. This streamlined approach can help to realize the foundational efforts of the profession that work across sectors and disciplines to improve health and social welfare together.[11]

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Roadmap for Social Work Education

Social work is primed to integrate the public health prevention approach more fully. Retooling education can prepare social workers more aptly for a post-COVID-19 world and build capacity for the rapidly expanding social work workforce[11] to meet the increasing demand for clinical services. Three areas organize this new framework: integrating tiered clinical social work skills at a population health level; reconceptualizing intervention by topical and tiered approach; and focusing on dissemination and implementation science.

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Clinical Skills at a Population Level

Clinical social workers are being deployed outside the mental health clinic, working in primary care, schools, needle exchange sites, and shelters. Their services must be tailored to each setting, embedding best practices in their work, as the public health approach views health in the context of where people live, work, and play. If clinical social work practice adopts a public health prevention approach, its implementation should be even more embedded in individuals' natural settings and out of the clinic or institutional setting. If clinical social work is taken out of the clinic or the walls of an institution and moved into these natural settings like the home or a park, the social worker can more fully participate in the environment of the person they are helping. Care should be less of a "push" into community treatment facilities and more about a "pull" into the natural settings of clients.

When developing health promotion programs, the environment and resources should be considered. Community-based organizations (CBOs) offer health promotion services where people are. As credible non-stigmatizing presences in a local area, CBOs can help support mental health promotion.[24] Accessibility and community support can increase acceptability and engagement with social services and public health programs. CBOs tend to have fewer structural barriers to participation like insurance status or immigration/citizenship status.[24] Instruction on a common elements approach[25] and understanding how to package these ingredients is an area ripe for improvement. Additionally, training could include consideration of practice in different settings and varying contexts (e.g., primary care).

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Reconceptualizing by Problem Area

In social work practice, clinical practice is often taught in a theory-driven manner, an approach that spans practice areas like medical social work, school social work, and mental health/psychotherapy services. Theories of practice are useful as they can be generalizable, but the way clinical social work occurs is problem-based. Our knowledge infrastructure should be reorganized with problems as the locus and theories informing the approach to the problem. The tiers of intervention model can serve as the organizational tool for clinical skills. Consider our depression example. Instead of focusing our attention on the top tier of intervention (e.g., learning and applying CBT to this problem) why not consider other forms of prevention, like at the population level (e.g., education)? For suicide prevention, why not learn the clinical practice, advocacy, *and* policy skills together to best address the clinical need and influence the ecological factors (e.g., social connection, housing stability, vocational opportunity) that increase suicidality? In clinical education, a multi-tiered approach can organize the application of clinical skills – where CBT can still be learned for the tertiary tier but the application of these skills can be more broadly administered through universal and selective tiers.

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The Role of Dissemination and Implementation Science

In the effort to integrate the public health prevention approach, a systematic approach to understanding the barriers and facilitators to implementation of this practice-based change. A change in practice can have many determinants- such as external factors (e.g., government policy, funding streams) or internal factors (e.g., organizational leadership, staffing patterns of an organization).[26] The scope of dissemination and implementation science can play a role in mapping such change. Dissemination and implementation science investigates the problem of why efficacious practices are not initiated and sustained, or even reach their intended targets.[27] The dissemination and implementation science approach offers fresh possibilities and a basic understanding of these factors that influence the conditions of clinical practice – namely knowing *what* practice to do (*i.e.,* dissemination) and *how* to do it (*i.e.,* implementation). [27] Within research, knowing what works is less of a problem than implementing what is established as effective.[25] Expansive social work policy and research continue to grow, but interventions that work do not reach people.

Dissemination and implementation are related but distinct concepts. Dissemination science carefully distributes information, knowledge, and intervention materials to specific audiences.[28] In contrast, implementation science uses strategies to adopt and integrate research evidence into practice.[16] Implementation science frameworks and behavior change theories articulate the need to consider the opportunities, capabilities, and motivation to change across multiple contexts,[27,29-31] a concept very similar to the person-in-environment and systems approach that defines the social work perspective. Implementation efforts are challenged by organizational contexts, financial resources, provider turnover, support following adoption, and acceptability from providers, also known as *lack of fit*.[32] Implementation studies of global health initiatives show that proper implementation can be cost-efficient compared to initiatives that did not plan for implementation[33]. Intervention setting fit is under-researched as an implementation factor.[32]

Clinical practice instruction should use implementation frameworks, considering the contexts of implementing different tiers of intervention. While dissemination and implementation science are not exclusive to public health, their inclusion with further integration of the public health perspective warrants attention. An implementation lens includes community engagement and organizing approaches. In research and planning, social workers/community partnerships build trust, respect, and understanding of challenges, strengths, and inequities. Through shared goals and innovation, valuable and feasible health and well-being promotion and intervention services can thrive. Continued communication, relationship building, and joint flexibility maximize the utility of collected data and research and help to inform program development and implementation. Clinical work can only be sustained by organizational leaders and managers with an awareness of organizational factors related to implementation practice.

With our depression example, a dissemination and implementation lens could start a quality improvement project about treatments for depression. The social worker could interview clinicians to understand the current practice in depression treatments at their clinic or conduct focus groups with patients to understand their needs from a mental health clinic to learn if services are tailored to their specific needs. Based on these findings, the social worker can map an implementation blueprint that can incorporate implementation strategies such as training, consultation, fidelity monitoring, giving clinicians reminders, identifying a clinician "champion" for the initiative, or restructuring the work environment (e.g., caseload reassignment, protected time for completing measures). The social worker then serves as a coach for implementation, setting regular intervals for implementation, evaluation, and refinement of the process until the best practice for depression has been sustained in practice.

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Conclusion: Implications for Social Work Education

This paper introduced a path to the cross-pollination of social work and public health disciplines, provided a social work primer on the public health prevention approach, and presented a roadmap for clinical social work education. The public health prevention model aligns with and can be incorporated naturally into social work practice and training. The full integration of the public health prevention perspective in macro and clinical social work education will foster a universal and unified approach in the future social work workforce.[34,35] Existing macro social work curricula on organizational planning, research, and implementation parallel the public health prevention approach. During the initial phases of social work programmatic development, focusing on population outcomes and health promotion and prevention ensures individuals and communities will be served thoughtfully, with efficacy, feasibility, and longevity in mind.

Social work programs should partner with intra-disciplinary departments (e.g., public health, medical, etc.) and community organizations and institutions, building relationships and sharing best practices and knowledge. [34] These collaborations will help align efforts to serve the community best and build resources. Common goals in education, research, and service provision will benefit individuals; support successful clinical social work program development, dissemination, and implementation; strengthen relationships in the community, and have a population impact. There is a natural synergy between social work and public health – it is now time to integrate the prevention approach more fully to advance social welfare and health in the post-COVID, public health-minded world.

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Conflicts of Interest

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