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Perspectives on Precision Medicine in a Tribally Managed Primary Care Setting

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Abstract

Background: Precision medicine (PM) research and clinical application is moving forward at a rapid pace. To ensure ethical inclusion of all populations in PM, in-depth understanding of diverse communities' views of PM research and PM implementation is necessary.

Methods: Semi-structured interviews were conducted to explore perspectives on PM in a tribally managed healthcare organization. Thematic analysis was used to analyze data from 46 interviews.

Results: Participants described gains in diagnostic efficiency, risk identification for preventable disease, and the advancement of population-specific biomedical research as key benefits of PM. Concerns expressed related to privacy risks associated with data-sharing, overpromising on PM, and managing patient expectations related to PM. Stakeholders encouraged PM implementation to be preceded by health education activities that leverage a range of communication strategies.

Conclusion: Perspectives described in this study may aid in and should be considered prior to implementation of PM in this and other healthcare systems, especially those serving diverse populations.

Keywords

Precision medicine; community views; American Indian; Alaska Native; healthcare system

Introduction

Precision medicine (PM) is an approach to disease prevention and treatment based on individual differences in environment, genes, and lifestyle (Sankar and Parker 2017). PM has

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Author contributions

Drs. Hiratsuka and Spicer conceived of, secured funding, and designed this work. Ms. Beans and Mr. Woodbury collected the data. Dr. Hiratsuka, Ms. Beans, Mr. Woodbury, and Mr. Wark analyzed the data. All authors contributed to data interpretation, drafting, and approved the final manuscript.

Conflicts of interest

No potential conflicts of interests were disclosed.

Ethical approval

This protocol was reviewed and approved by the Alaska Area Institutional Review Board (AAIRB# 2016-;09-037). In addition, Southcentral Foundation Research Review Committees and Board of Directors reviewed and approved this study protocol as well as a draft of this manuscript prior to journal submission.

the potential to contribute to efforts that mitigate health disparities for diverse populations, if these groups are included in research on PM. Diverse populations have long been underrepresented in biomedical research generally and specifically in genomic research (Popejoy and Fullerton 2016; Spratt et al. 2016; Sirugo, Williams, and Tishkoff 2019). In response to criticism about the lack of diversity in biomedical research, recent investigations into the clinical utility of PM emphasized the need to involve cohorts that reflect the racial and ethnic diversity of the US population (Sankar and Parker 2017).

For example, the National Institutes of Health (NIH) is actively seeking to enroll one million Americans into its flagship PM research endeavor, the *All of Us* research program (Sankar and Parker 2017; All of Us Research Program Investigators 2019). Participants enrolled in the *All of Us* research program will represent the diversity of the US population and will contribute electronic health records; clinical and behavioral assessments; DNA samples and other biological specimens; and mobile health data regularly and longitudinally (Sankar and Parker 2017; All of Us Research Program Investigators 2019). These data will be made available for public use by academic and commercial researchers, as well as scientists lacking institutional affiliation, with the long-term goal that the research will contribute to improved healthcare for everyone (Sankar and Parker 2017; All of Us Research Program Investigators 2019). The goals of the *All of Us* research program include focusing on cohort diversity, health disparities, and participant engagement (Sankar and Parker 2017; All of Us Research Program Investigators 2019).

Despite efforts to engage diverse people and groups in genomic research, including 25 years of NIH mandates to increase representation of minority groups in clinical research, the cohorts on which the findings of genomic research are based continue to lack diversity (Taylor 2009; Bentley, Callier, and Rotimi 2017; Popejoy and Fullerton 2016; National Institutes of Health, Office of Extramural Research 2001; Sirugo, Williams, and Tishkoff 2019). Barriers that contribute to limited enrollment in genomic research by underrepresented groups include: the absence of diverse scientific personnel, limited or no community engagement, the small sample size of diverse communities, and the lack of benefit for participants and communities to participate in research (Bentley, Callier, and Rotimi 2017; Bardill and Garrison 2015). Perhaps the most significant identified barrier is mistrust of research (Smirnoff et al. 2018). Within Alaska Native and American Indian (ANAI) communities, both historical and recent examples of research misconduct contribute to mistrust (Hodge 2012; Mello and Wolf 2010). Members of these communities have stressed that building trust and achieving representative inclusion of ANAI communities in genomic research will require mutually beneficial partnerships and complete transparency between investigators and communities (Claw et al. 2018; James et al. 2014).

Precisely because these barriers exist where ANAI people have not historically been involved in the early stages of research and because mistrust of health research continues to persist, it is important to consider and address ANAI concerns about the conduct of research prior to widespread implementation of PM. In addition to privacy and confidentiality concerns (Rodriguez et al. 2013; Prince and Berkman 2018), ANAI-specific concerns relate to respect for tribal sovereignty, acknowledgement of historical transgressions, engagement

with urban ANAI leaders, and the need for continued multi-level engagement (The Tribal Collaboration Working Group 2018).

As PM advances on a national level, inquiry into the preferences and understandings of ANAI people regarding PM must also move forward. To respect tribal sovereignty and acknowledge the interplay of historical transgression with current healthcare delivery we sought to understand perspectives on PM among urban ANAI healthcare leaders, patients, and providers. This manuscript provides an overview of these stakeholder perspectives and discusses potential implications for implementation of PM in a tribal healthcare system.

Methods

Semi-structured individual interviews were conducted to explore perspectives on PM and health priorities among stakeholders in a tribal primary healthcare setting. The Alaska Area Institutional Review Board and Southcentral Foundation (SCF) Research Review Committees and Executive Board approved this study protocol (Hiratsuka et al. 2017).

Setting

SCF is a tribally owned and operated healthcare organization that provides a wide range of health and human services to more than 65,000 ANAI people in the Indian Health Service Anchorage Service Unit, including both urban and rural populations (Gottlieb 2013; Eby 2007; Gottlieb and Tierney 2015). SCF employs a culturally grounded patient-centered medical home model that is team-based and focused on quality and safety (Driscoll et al. 2013). Under this model, called the SCF Nuka System of Care, the chief responsibility of each staff member is to establish a trusting, accountable, long-term relationship with each patient (Gottlieb 2013; Gottlieb and Tierney 2015).

SCF operates primary care centers located in Anchorage and Wasilla, Alaska, as well as several regional clinics in rural areas of south central Alaska. The primary care clinics are staffed by 35 integrated care teams (Driscoll et al. 2013). Over half of SCF's 2,200+ employees, which includes healthcare providers and health system leaders, are of ANAI heritage and receive services within the tribal health system. As an improvement-focused organization, SCF measures its progress through robust data collection efforts; benchmarks with other healthcare organizations; and tracks health data at the local, state, and national levels, as well as health delivery data at the provider level (Gottlieb and Tierney 2015). The input of health systems administrators, providers, and patients is thus vital to the successful integration of PM into healthcare delivery at SCF (Shaibi et al. 2018; Pritchard et al. 2017).

Sample

This sample included three populations of interest within the SCF healthcare system: patients, integrated care team members, and health system leadership. The patient sample inclusion criteria were 18 years or older, ANAI heritage, and had been seen by an SCF primary care provider at least once in the prior three years. The provider sample inclusion criteria were integrated care team members who regularly provided services in primary care to individuals age 18 or older at SCF, or who received SCF specialty care referrals. Provider credentials included medical and osteopathic medicine doctors, nurse practitioners,

behavioral health counselors, and clinical nutritionists. The leader sample inclusion criteria were: individuals who directed primary care administration or developed policies impacting healthcare delivery and/or health research at SCF. The leader sample included: medical directors, administrative directors, and division vice presidents. It is important to note that many ANAI providers and leaders also receive healthcare at SCF.

Recruitment

Patients were recruited at the SCF Anchorage Native Primary Care Center lobby. SCF leaders and providers were sent an invitation to participate via email. All potential participants were screened to determine if they met the inclusion criteria. Eligible individuals who expressed interest in participating were scheduled for an individual interview with a member of the research team. Participants provided verbal consent to participate in the interviews. Patient participants received a \$25 gift card for their time; leaders and providers were not compensated for their time.

Data collection

Interviews occurred from January 2017 to August 2017 in SCF facilities located in Anchorage, Alaska. A semi-structured interview guide included a core set of questions utilized across the three sample groups (Table 1). The interview guide, developed by an American Indian researcher (VYH), reviewed by an ANAI researcher (JAB), and approved by SCF research review approval boards, was designed to elicit descriptions of participants' familiarity with genetic tests and to introduce PM and the data collection methods of the *All of Us* research program to garner views on data collection methods used in PM. Participants were provided a definition of PM and a handout from the *All of Us* research program. Three study staff trained in qualitative methods (VYH, JAB, RBW) conducted the interviews, which covered the following thematic categories: tribal health priorities, recommendations for PM use within the SCF setting, and perspectives on outreach to the SCF patient population on PM. Participants were recruited and interviewed until theoretical saturation of these categories was achieved within each stakeholder group (Hennink, Kaiser, and Marconi 2017).

Data analysis

Interviews were audio-recorded and transcribed verbatim. Transcripts were validated for accuracy, de-identified, and uploaded to Atlas.ti 8.3.20.0 (Scientific Software Development GmbH, Berlin, Germany). The data analysis team consisted of researchers placed and employed within a tribal health setting (JAB, RBW, KAW, VYH) as well as ANAI researchers (VYH, JAB, KAW). We conducted a thematic analysis in five iterative steps: (1) reviewed and became familiar with the data; (2) applied *a priori* codes and generated emergent codes; (3) searched for thematic patterns; (4) grouped thematic patterns; and (5) summarized thematic pattern groups. *A priori* codes were developed based on the interview guide. Inter-coder reliability was maintained through a shared codebook and team coding of selected transcripts. A second review was conducted on all coded transcripts to ensure inter-coder reliability. Coded data were examined for themes and patterns (Attride-Stirling 2001).

Results

Results of this study were reviewed and approved by SCF Research Review Committees prior to peer-reviewed journal submission (Hiratsuka et al. 2017). The overall sample consisted of 46 interviews: 21 adult ANAI patients (15 female, 6 male), 12 SCF healthcare providers (6 males, 6 females; 5 of 12 providers self-identified as ANAI), and 13 SCF healthcare leaders (11 females, 2 males; 11 of 13 leaders self-identified as ANAI). Themes presented here were endorsed by all three sample groups and areas of divergence are highlighted within each theme. Participants rarely distinguished between the research and clinical applications of precision medicine. For this reason, the results do not make this distinction except where allowed by explicit participant comments. PM was discussed within the context of healthcare delivery at SCF. Four overarching themes were identified:

1. *The SCF Context.* Each group discussed their experience either delivering care, working with patients, or receiving care within the SCF healthcare setting and reflected areas of concern with PM.
2. *Expectations and PM at SCF.* Groups then discussed their expectations of where PM could help in the SCF patient-population journey to wellness.
3. *PM as a tool for Population Healthcare.* The discussion then led to how PM could supplement SCF's current healthcare delivery framework.
4. *PM in Action at SCF.* Finally, stakeholder groups described process steps related to inclusion of all healthcare users and communication to those groups should PM be implemented in this health system.

The SCF context

Each group discussed their experience either delivering care, working with patients, or receiving care within the SCF healthcare setting. Although there has been a positive shift in addressing past gaps in healthcare delivery and research misconduct in the ANAI community served by SCF, members of the community continue to be wary of research.

You know. I don't want to be anybody's guinea pig. And I don't want people to be using anything that comes from me unless I understand what it's gonna be used for and how it's gonna help people. And that would be the concern that I have is that I don't know if there's a way to ensure that doesn't happen ... I just know, I've heard people talk about the studies that was done without their consent and the first part of this, 1900s. And so I'm just scared without really understanding why I'm scared.

–Patient 19.

All three sample groups encouraged the acknowledgement of past research misconduct and described the necessity for transparency in research aims, methods, and outcomes in order to move forward with health research and with the integration of new healthcare delivery approaches like PM. All sample groups underscored the need to include the voice of AN people throughout the state, in the planning of PM implementation.

The concerns I have just with anything that's being rolled out with the Alaskan Native and American Indian people is, how involved are the stakeholders. Like,

where is their voice in this. And in making sure that there is the interest, that it's explained well, and that there isn't a risk for them personally, you know?

–Provider 4

What I do believe is ... much of precision medicine, probably, would be really good for us, as customer-owners [patients]. Probably, something that would really lead to maybe better health outcomes or predictive health outcomes so that we could watch where we're going and maybe detour from where we could be going and change the direction. Maybe. But I don't know because it's so new on the thought process of it that I'm not sure about - I would not come right down on a "Yes" or "No" on it. I'm right at the place of saying, "Hmm, I'd be really curious about what our customer-owners [patients] would think and how they would think about us attempting to implement what we're calling 'precision medicine' or a 'precision medicine initiative.'"

–Leader 4

Although the patient sample's current primary residence was Anchorage, many discussed how they still have close ties to their home communities in rural Alaska. The importance to include families and home communities throughout the state with PM efforts was expressed. Including the village-based, community-level health providers in education and training on PM was encouraged to ensure communities outside the Anchorage area would have awareness and access to PM. It was suggested that tribal health leaders around the state establish common goals and interests in the use of PM and to use shared methods of implementation across tribal healthcare systems. Access to and understanding of PM for Elders and children was also mentioned as a priority.

Participants recognized the intention of PM to collect data over years, along with the resources needed to manage and sustain these data, and stated that the investment needed to maintain such databases should not take away from current services. Last, providers and patients acknowledged the complexity and sheer volume of PM data and were concerned that PM involvement could be overwhelming and difficult for individuals to grasp, given the many potential but currently undetermined meanings and uses of PM data.

Expectations of PM at SCF

All three sample groups reflected on the potential impacts of PM and how PM could be integrated into healthcare delivery at SCF. Participants indicated that SCF currently provides excellent, comprehensive care to patients and that PM would fit in with the SCF Nuka System of Care. Providers talked through what PM might mean for their practice such as location of PM data in the medical record, what would be expected of them based on genetic findings, and the validity of the genetic tests. Patients described a trusting and open relationship with their providers; all patients said they would be comfortable asking their primary care provider about genetic testing and PM. Most patients expressed an expectation that their primary care provider would be responsible for introducing PM to them if this healthcare delivery approach were implemented into the SCF healthcare system.

Providers understood and anticipated this expectation of patients and put forth solutions, such as incorporating a PM specialist into the integrated care team. To this end, many patients acknowledged SCF's team-based approach to healthcare and stated that they were fine with providers sharing patient health information with one another since it's already a part of healthcare delivery at SCF. Providers inquired about other support roles such as case workers to help patients with comprehensive plans that included PM, patient follow-up (especially for complex plans involving both physical and behavioral interventions), and treatment plan mitigation for the event where the patient does not agree to the proposed plan. Providers considered whether genetic tests would change the course of treatment in some cases.

Many patients were very positive about the benefits PM could bring to the delivery of healthcare at SCF and stated that they trusted the care they receive and the judgment of those who have brought that care to SCF. Other patients acknowledged that although it sounded great, there had to be some downfalls to PM and wondered what those downfalls might be.

... while I am hopeful and can see the benefits, I worry that it goes wrong. You know, we don't have, while we have free will and while we have choice, we have no control over what happens when we take that—make that choice and take that action. I think that, while this [PM] has lots of potential for good, it's also got the potential to go awry. We might, in pursuit of preventive cancer—a cancer preventative measure—we might create a circumstance that does even more harm.

—Patient 11

Not really any concerns I can think of. I guess to know the negative side of it would be beneficial but just hearing all that [PM definition], I think it's wonderful. I would probably wonder what would be the negative effects of it. It's kind of hard to think about because those are such good things to utilize for prevention, just to specialize treatment. I think that's great.

—Patient 20

Many providers expressed concern that the messaging of PM may not resonate with some of the patients who would in turn feel as though PM was being pushed on them rather than being presented as a choice to complement their healthcare. To address this concern participants emphasized that PM needed to be put forth as an option providers and patients could choose to include in healthcare plans.

PM as a tool for population healthcare

All three sample groups recognized the efforts SCF primary care currently takes to address the needs of the patient population. Some providers and leaders acknowledged that SCF is doing well at addressing the complex needs of patients and were unsure how PM would fit in with healthcare delivery at SCF.

Enthusiasm for the potential of PM to aid in the generation of population-specific measures to enhance care delivery and improve the healthcare of the ANAI population was expressed.

Well, unfortunately all of this [current] data is based on people that usually are not Alaskan Native by genetic make-up. It's often based on white, European folks or people of white, European descent and that's not us. So, "we don't know exactly how this data applies to this population," is usually what I'm telling people.

–Provider 2

However, all groups focused on the volume of information being generated in PM such as electronic health record, biospecimen, and survey data and described how the security of these data need to be explicated in detail, so the individual and community are well informed and protected.

But the downside is anytime you get that kind of information, it depends on the security of that information because it always depends on what you are pulling the information for and how it is being used and if it could be misused. So it comes in the fact of ... I don't know; pre-judgments and stuff. Other than that, I think it's great. It's just there is always the dark side to everything.

–Patient 15

And I think, so I would support using precision medicine here just as they would anywhere else, but it needs to be done with a certain amount of grace and communication and assuredness that genetic data will be kept at the individual level unless otherwise decided on. And I also think it's important, I mean labs in general, we get labs all the time. And it, we know that people I think understand that it's confidential information. The genetic data should be no different. And if there is a decision to use the data at a population level for other benefits, it should be made extremely clear who has that data, and what it's being used for.

–Provider 3

And I know that some of the questions and concerns that we've had is, one, "Who has access to the information? What is this going to be used for? Who's funding it?" Ensuring that ownership of any of the information and data and samples, et cetera, are owned by the tribal health system, Southcentral Foundation if it's for our people, and that someone isn't making money off it; someone can't patent our genes. And so those are kind of the concerns that I have as an individual and that our tribal leadership has expressed.

–Leader 6

All three groups expressed concern that information could be misinterpreted or misused to stigmatize individuals and/or groups.

I also think the other thing is just always the concern about labeling and being able to just kind of box people into this category or that category rather than looking at people who are individuals who are complex people and the context of their lives. And so, making sure we don't lose sight of that. And I think it sounds like that's the aim of precision medicine is to take all of that in context. But how that actually plays out, I think, would be part of the challenge.

–Leader 9

To address the hesitation of some stakeholder groups, some leaders suggested PM could be incorporated into the SCF delivery of healthcare as a tool that patients and providers could choose to include as a supplement to their healthcare plans. All groups supported the notion that efforts to implement PM in this healthcare system should seek to enhance healthcare delivery and benefit the health of the patient population.

Participants expressed a greater interest in the environment and lifestyle aspects of PM, rather than the genetic component.

I love the idea of genomic medicine, I think it will help us think about targeting chemotherapies or maybe seeing who might be sensitive to or not, or maybe even adversely affected by some of the drugs that we use. The reason I'm ambivalent about it is because the percent impact compared to social factors is tiny.

—Leader 1

I'm not sure how much of our wellness is impacted by our genetics that we start with compared to our lifestyle and behaviors. I think understanding our genetics and using that to better deliver healthcare is important, but I wouldn't want it to overshadow our behaviors and our lifestyles, what we eat, what we drink, how we parent, how we were parented, how we handle stress, how we handle anger, how we feel about ourselves, our self-confidence, our level of value that we place on ourselves, our level of empowerment.

—Leader 7

Providers further emphasized the need for increased access to services addressing the social determinants of health—including housing, transportation, food availability, etc.—so that patients facing these barriers can get to SCF and access optimal healthcare. Both leaders and providers talked about the “return on investment” from PM as a key consideration and described the need for a plan that lays out how PM would fit in with all the other treatment options within this health system.

Broadly, leaders and providers saw the potential of PM as a means to increase diagnostic efficiency. Specifically, providers and leaders suggested the pharmacogenetic component of PM as a potential way to reduce time in finding an appropriate medication for patients. Provider and leader groups discussed depression as an area in need of improvement and offered pharmacogenetics as a potential efficient and efficacious complement to current treatment options. Cancer diagnosis and treatment was specifically mentioned as an area that could benefit from PM. Additionally, providers saw the exposure of SCF staff to cutting edge forms of healthcare delivery as an ancillary benefit of PM.

PM in action at SCF

Reflecting on service delivery in this healthcare system, all three sample groups agreed there would be a need for PM at SCF to have buy-in from SCF healthcare leaders. Providers and patients discussed having the President/CEO of SCF give a brief talk on PM as a display of leadership support for PM. Clear and consistent communication about PM was stressed as an important aspect of introducing and implementing PM in the SCF healthcare system.

Although providers thought PM might be a good fit with the approach to healthcare delivery at SCF, they anticipated the need to present PM with clear and culturally-informed messaging. Many providers and patients described the need to thoroughly explain what PM is and isn't if the ANAI community were to be approached about PM. For example, patients identified the terminology as an opportunity for improvement.

In regards to precision medicine I don't fully understand it and I don't know what it means. And so I'm very uncomfortable in hearing that terminology.

–Patient 19

Providers further emphasized the need for addressing the terminology,

Even just the word “genetics” is too scary for people. ... the healthcare team needs to be very well-versed in it before it gets rolled out to the customer-owners so that we can answer questions. ... It can put up a barrier to care if a provider cannot fully explain what a procedure or test is for. [It is] important to have constant communication and training support prior to roll-out.

–Provider 2

Leaders shared this concern and talked through the need to change language used to define and describe PM and the terms commonly used in genetics, including “susceptibility,” “predisposition,” and “risk.”

Nobody is gonna understand what you're talking about when you say precision medicine. It sounds like a surgery word or something ... we need to have a shared understanding of what that [precision medicine] means.

–Leader 7

All groups described the need for a multi-level broad approach to providing SCF stakeholders with information on PM. Patients and leaders encouraged culturally relevant and strength-based approaches to education on PM. Educating the rural community health aides as a means of disseminating PM information to rural residents was mentioned.

Discussion

This qualitative inquiry sought views from healthcare patients, providers, and leaders in a tribal healthcare setting on the topic of PM. Overall, PM was seen as a tool that could have a positive impact on the health of ANAI people but was often qualified by various concerns related to the socio-political history of ANAI people in the region and the associated evolution of the healthcare system serving ANAI people. Although SCF has provided quality healthcare to ANAI patients for over 20 years, negative experiences of care received from the chronically underfunded federally operated healthcare system continue to impact patient perspectives on healthcare and contribute to concern for rural family members who are outside the reach of the SCF Nuka System of Care. These findings show that SCF patients, providers, and leaders are aware of this reticence and thereby accentuate the need to clearly communicate the intentions of all aspects of PM to the ANAI community.

Little work focuses on ethical considerations of PM in primary care contexts, despite the vast number of primary care visits necessary to build PM data repositories. Our study is among the first to offer stakeholder perspectives on ethical challenges of PM in a primary care setting and strategies for how those challenges might be addressed in a culturally congruent manner. However, data in this study align with previous findings about PM research involving diverse groups. Regardless of racial or ethnic background, patients expect researchers to address: the history and experience of trust by the group with healthcare and research; concerns about potential group harm, cultural values, and communication barriers; and integration of patient values and expectations into oversight and governance structures (Kraft et al. 2018).

Additional ethical considerations identified in this study included the amount of data generated by genetic testing, uncertainties with data interpretation and disease associations, the informed consent process, returning results, and addressing privacy and confidentiality concerns. These results echo findings from previous research (Fiore and Goodman 2016). Further concerns with the implementation of PM within healthcare systems include limitations in integrating genomic data and clinical decision support tools into the electronic health record, physician reluctance toward genomic research participation and clinical implementation due to a limited evidence base, communication among and between investigators and clinicians, and lack of clinical leadership engagement (Zebrowski et al. 2019).

Since the clinical utility of genomics has yet to be realized, it may be more effective and financially feasible to focus on population precision health (Paneth and Vermund 2018), especially in historically under-funded healthcare systems. The proportion of the population that may benefit from PM may be quite small compared to the proportion of the population that could be positively impacted by investments in other areas (Paneth and Vermund 2018). As the PM Initiative moves forward on a national level, there has been an effort to leverage PM to address population health issues (Lyles et al. 2018; Khoury, Iademarco, and Riley 2016). However, respondents in this study expressed skepticism about the ability of PM, by means of genetic data, to meaningfully address population health issues prioritized by ANAI communities. While the scientific community privileges the role of genetics in PM, participants in this study noted that PM—as defined by the NIH—gives equal consideration to environment, lifestyle, and genetics. These results suggest that greater emphasis in PM on the health impacts of environmental and lifestyle factors may enable PM to more directly address ANAI community health concerns (Mitchell 2012).

These results confirm previous findings that genetic-related research involving ANAI communities must be carried out in a respectful and transparent manner to ensure individual and community protection from research harms (Blanchard et al. 2017; Boyer et al. 2007; Santos 2008). Consistent with earlier investigations, stakeholder groups in this project were concerned with Elder understanding, consistent and clear communication, and broad modes of communication (Beans et al. 2018; Claw et al. 2018). Communication of PM in culturally relevant modalities was discussed by participants as an important consideration which is in alignment with other research (Beans et al. 2018). To successfully integrate PM into a community-based health organization serving ANAI people like SCF, it would be necessary

to employ a multilevel engagement approach throughout the planning and implementation processes (Fohner et al. 2015).

Within PM, pharmacogenetics was referenced by participants as an example of a useful integration of PM in this healthcare system. This preference for pharmacogenetics may be due, in part, to the introduction of pharmacogenetics through previous research projects in this healthcare system (Avey et al. 2016; Beans et al. 2018; Hiratsuka, Brown, and Dillard 2012; Hiratsuka, Brown, Hoeft et al. 2012; Hiratsuka et al. 2016; Shaw et al. 2013; Woodahl et al. 2014), which underscores the importance of early stage and continued engagement for successful community-based participatory research in biomedical research with diverse populations. Additionally, engagement in tribally driven biomedical research projects throughout the past 10 years with local oversight provides familiarity and trust that is enhanced by the tribally controlled delivery of healthcare at SCF (Hiratsuka et al. 2017).

Strengths and limitations

The generalizability of these study findings may be limited. This sample was majority female and other demographics were not collected as part of this study protocol. With a total sample of 46 these views may not be representative of each stakeholder group. Due to the recruitment strategy and the use of convenience sampling in SCF lobbies, the views described here may not fully encapsulate the views of the ANAI community served by SCF and could be biased by patients who are actively engaged with the healthcare system in a way other patients may not be. These results illustrate the range of considerations within SCF in south central Alaska; the generalizability of these findings to other tribal groups and other diverse groups may be limited. Providers and leaders may have had prior knowledge of the topic of PM which could have imposed assumptions and preconceptions independent of the information provided by investigators about PM and the *All of Us* program.

Conclusion

Ethical inclusion of ANAI people in PM is an apparent need, however the approach to accomplish this is less certain and entails many caveats. To move forward with PM in ANAI communities the research must benefit the health of ANAI people. Moreover, if PM is implemented in an ANAI health system, PM should supplement healthcare delivery while maintaining current services. Clear communication in PM education is vital as we move forward with PM endeavors that are inclusive of diverse groups. Further inquiry on PM education for health systems and patients is warranted and educational components of PM should begin during the research phase with community-based participatory research projects investigating aspects of PM, such as genetics, biospecimens, and data management.

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Table 1.

Interview guide.

Question	Patient	Provider	Leader
What do you think about when you hear the terms “genetics,” “genetic testing,” or “genetic medicine”?	X		
Tell me about any experience you or your family has had with genetic tests?	X		
Would you be comfortable talking with your provider about genetic tests?	X		
Precision medicine is a new approach to disease prevention and treatment based on people’s individual differences in environment, genes, and lifestyle.	X	X	X
<i>*Some examples of how Precision Medicine can be applied in clinic include: blood tests that can be used to assess if a person has an increased or decreased risk of developing common diseases, targeted cancer treatment, using a blood test to identify whether a specific medicine would work for an individual or a blood test that would identify what foods an individual’s body can break down easier than others.</i>			
What are your thoughts on the use of Precision Medicine for the SCF health system?	X	X	X
What are the benefits of Precision Medicine use for SCF?	X	X	X
What concerns would you have with Precision Medicine supporting your healthcare?	X	X	X
Thinking about existing care needs, tell me about those needs and the timeline of addressing those needs.		X	X
Where could Precision Medicine support or prevent the diseases and conditions of the SCF service population?		X	X
Would you be comfortable talking with your provider about Precision Medicine?	X		
<i>*The NIH Precision Medicine Initiative Cohort Program goal is to engage a group of 1 million or more US research participants who will have information in their medical record related to biological samples, genetic data, and diet/lifestyle information available for their healthcare provider.</i>			
What are your thoughts on the cohort?		X	X
Do you think it is important for AI/AN to be included in this type of research? Why or why not?	X		
What type of information should AI/AN people be given when being asked to be participate in this type of cohort?	X		
How should AI/AN people be approached for inclusion in the cohort?		X	X
What are your concerns about including and excluding AI/AN participants in the cohort?	X	X	X
How do you feel about the sharing of medical records related to biological samples? Genetic data? Diet/lifestyle information? These types of information being shared with a healthcare provider? These types of information being shared between healthcare providers?	X		
Thinking about primary care at SCF and specialty care through the Alaska tribal health system, how should AI/AN people be approached about Precision Medicine?	X	X	X
What do leaders/providers/clinical staff/ANAI people need to know?	X	X	X
What type of resources would you want to help you make decisions about including precision medicine in your healthcare at SCF?	X		

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Question	Leader	Provider	Patient
What materials would need to be developed by SCF?	X	X	X
Who should share the information?	X	X	X

* Interviewer read text aloud to participant.