TECHNOLOGY AND ENGAGEMENT:

How Digital Tools are Reshaping Population Health

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Population Health ALLIANCE

ENGAGEMENT IN ONE'S HEALTH has been recognized as an effective mechanism for improving health and well-being within a population (Hibbard & Greene, 2013; James, 2013). According to the Population Health Alliance (PHA), "*Engagement in health is when an individual performs sustained actions towards achieving optimal health and well-being.*" Recently, PHA convened a group of thought leaders to identify how technology can drive engagement in health and the types of technology that are enhancing our reach and impact as we work to engage individuals in their health and healthcare. This paper outlines the types of technologies which may be used to support population health programs, provide guidance on how technology may be incorporated into an overall engagement strategy, identify ways to measure engagement using these tools, and list the practical considerations when incorporating technology into your engagement strategy.

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INTRODUCTION

Within population health, Technology has advanced at a blistering pace to provide tools that promise to reach members in entirely new ways. For example, the self-monitoring, goal setting and feedback capabilities of many fitness trackers can support users' fitness programs while at the same time providing valuable information which may be used by health coaches, care managers or other key stakeholders to enhance the care planning process.

From wearable fitness trackers to mobile smartphone and tablet applications, digital tools are being positioned as an integral part of a successful population health program. However, it is important to note that digital tools are not a panacea, and thoughtful consideration must be made about how, and with whom, these tools should be used. Technology can be a powerful addition to any successful population health program, as long as it's integrated into a larger engagement strategy that includes other mechanisms for user participation. Program designers should understand that technology should integrated seamlessly and not add complexity to the user experience. Users will become frustrated if digital tools function poorly, cost too much, are not user friendly, or add an unnecessary burden to program participation.

Finally, technology features must be aligned with consumer needs and program goals. What problem does technology solve for the user? Does it make access to information easier or improve the coaching experience? Failure to consider the consumers' perspective when developing features and designing technology will result in low adoption or lack of sustained participation. It is our intent to present up-to-date, relevant information to practitioners who are interested in optimizing technology to improve the health of their populations.

HISTORY

Some digital tools have been used in population programs for many years, while others are just now being incorporated. There have been a few watershed moments that have facilitated this expansion, they include: Development of the World Wide Web, launch of the first iPhone with its associated app store, and widespread deployment of affordable connected and wearable devices. Recent research from the National Business Group on Health (2015) suggests that organizations with an established culture of health tend to use technology for engagement in their programs more than those that do not, for instance: Online competitions (50% vs 25%), Activity tracking (40% vs 18%), Social networking (39% vs 10%), Game-like features (37% vs 13%), Mobile messaging (29% vs 9%), and Mobile apps (27% vs 7%). In this section we will explore how internet/web-based tools, wearable devices, video games and data tools may be used to support user engagement.

DEFINITIONS

Digital tools are proposed to extend the reach and efficacy of behavior change interventions across large populations with emerging data supporting their effectiveness (Fukuoka, Kamitani, Bonnet & Lindgren, 2011; Noar & Harrington, 2012; Sawesi, Rashrash, Phalakornkule, Carpenter & Jones, 2016). The rapidity with which new technologies are being developed and marketed for use in the healthcare industry can make it difficult to keep up. In order to understand technology and how it can be applied to population health programs, it is helpful to first define a few **key terms** often used to describe these tools as a group:

e-Health or Electronic Health

"The use of digital information and communication technologies to improve people's health and health care. The increasing use of technologies, especially the Internet and mobile devices, to manage health highlights the potential of e-Health tools to improve population health" *(Office of Disease Prevention and Health Promotion, 2015)*.

m-Health or Mobile Health

"The use of mobile and wireless devices to improve health outcomes, healthcare services and health research." (NIH Consensus *Group, 2012)*.

Connected Health

"Connected health encompasses terms such as wireless, digital, electronic, mobile, and tele-health and refers to a conceptual model for health management where devices, services or interventions are designed around the patient's needs, and health related data is shared, in such a way that the patient can receive care in the most proactive and efficient manner possible. All stakeholders in the process are 'connected' by means of timely sharing and presentation of accurate and pertinent information regarding patient status through smarter use of data, devices, communication platforms and people." *(Caulfield & Donnelly, 2013)*.

Generally speaking digital tools have been used to support any or all of the following functions in order to positively impact user behavior and engagement with health, enhance consumerism, and increase value:

- Facilitate communication
- Improve health literacy
- Increase social interaction
- Create awareness of risk(s)
- Support condition management
- Enable user self-monitoring of behavior
- Generate actionable data which can be used to further refine both population-wide and individual interventions

TYPES OF TECHNOLOGY

Web-based / Internet

As one of the first types of digital tools used in population health, web-based platforms have become an expected component of most population health programs. Despite their ubiquity, there is tremendous variation in the services provided. Internet-based tools range from simple educational websites to complex platforms that include interactive tools, health assessments, educational libraries, online trackers and social challenges. Internet-based tools may be accessed via computers as well as mobile devices, however they are differentiated from mobile applications since they are not an application operating on the device itself but rather simply configured to render in the mobile device's browser. Because of this, an active data connection is required in order to access this type of tool.

Wearables

Wearables, also known as "Wearable Technology" or "Wearable Computers," are a category of connected devices integrating computers or other micro-circuitry that are intended to be worn or carried by users. These accessories serve myriad different functions, such as collecting vital statistics (heart rate and respiration), tracking activity (pedometers), or integrating with other devices and services for an enhanced offering such as sleep monitors that collect and wirelessly transmit data to cloud storage for access by clinicians.

While wearables have only recently begun to grab hold in the marketplace, largely in part to the Fitbit and launch of the Apple Watch, they are poised for explosive growth through the next several years (eMarketer, 2015; NPD Group, 2015). This gives health systems, health technology companies, and payers an incredible opportunity to capitalize on the growth of connectivity among consumers, especially those who use such devices to monitor their health status. As of the end of 2014, 11 million individuals were using a Fitbit to monitor their heart rate, steps taken, or sleep cycles.

Connected Devices

Many devices which have existed for a number of years are undergoing a digital Renaissance, with newer versions incorporating wireless sensors and internet connectivity. These devices may include fitness equipment that incorporates sensors for measuring heart rate and calories burned. Some models may connect to smartphone apps and cloud storage to preserve personal fitness data, allowing clinicians to access consumer exercise history.

Additionally, analytical software may provide personalized result summaries and recommendations based on performance over time. By storing personal data and making it accessible, this technology breaks through communication barriers between patient and clinician, and can provide a seamless method of incorporating collected data with electronic medical records systems.

Mobile Apps

As with "smart" devices, there has been explosive growth in "apps." Mobile, connected devices have created a secondary market for the software they run. A large portion of this market includes health and lifestyle apps to help individuals manage their health status. As such, 10% of app downloads from the iTunes store are from the health, medical, and lifestyle categories.

The ability of sensors in mobile devices to track our activity has fundamentally changed the way we interact with them. A simple example is the pedometer app, which is available from many vendors. The well-known "10,000 steps a day" fitness trend has encouraged many individuals to track their steps, making them more aware

of their daily activity levels. Other apps such as Google Health or Apple Health offer a secure environment for storing biometric data, enabling users to track cholesterol, blood pressure, and BMI.

While the majority of apps provide users the ability to track activity, some apps are enabling health systems to deliver preventive and therapeutic care. One example is the myBETAapp by Bayer, which provides useful information for MS patients on Betaseron therapy (Bayer, 2015). The app encourages medication adherence via injection scheduling and reminders, and allows users to share their injection schedule with health care professionals. New software technologies delivered via mobile apps are providing users the opportunity to be aware of their health status in real-time, empowering them to be proactive in managing their health.

Video Games

Popularizing engagement in health for all ages and demographics are a new generation of video games that promote movement, a departure from traditional hand-held devices played while sedentary. The most popular of these is the Wii Fit, a device that was designed "to get families exercising together." Widespread adoption has served a number of purposes, including in-home, health club, and nursing home use.

Data / Analytics

Another relatively new facet of development in health software is the analytical aspect that often operates behind the scenes. The collection and storage of personal health data is only marginally beneficial in managing overall health without predictive analytics that discover trends, make personal health recommendations, and assist with the diagnosis.

Although the analytic processes themselves do not necessarily promote engagement in health, their outputs do. By processing historical health data, for example, algorithms are able to predict within certain confidence intervals that patients will experience cardiovascular events. These predictions, coupled with clinician intervention, can provide patients the opportunity to make lifestyle adjustments that may decrease their risk level.

APPLICATION OF TECHNOLOGY IN PHM

Technology is having a significant effect upon population health management programs. Many of the advancements in technology, from those at the patient/consumer level to those involving data acquisition, data management, practice management, and hospital/health system management are also being leveraged for the purposes of population health management. In addition, new and disruptive technologies are being developed and tailored to evolve traditional population health management (PHM) programs (Christensen, 2009).

Historically traditional PHM included telephonic or face to face interactions with patients that may have been third-party based, for example from an insurance company or other vendor specializing in PHM. More and more these activities are also moving to the practice level, in the PCMH/ACO world particularly, as the value of these services at the point of care is being recognized. Large payers, such as CMS, are bringing about this recognition of population management as a valuable, practice-based activity as reflected in available payments to providers for these services (DHHS Centers for Medicare & Medicaid Services, 2014).

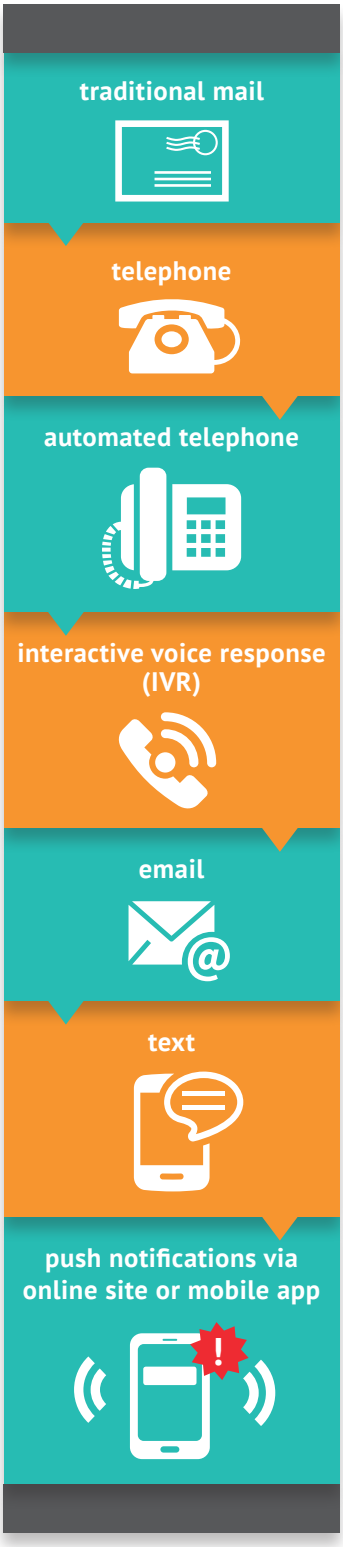
PHM programs are usually thought to consist of care management (e.g. disease management and case management and, in some instances, wellness coaching activities), conducted by telephone with patients and/or caregivers. There are many models of PHM but most involve some use of patient data to identify an at risk pool for outreach for program engagement. As technology has evolved, so have the underlying systems that support such programs.

Communications

Processes such as mail merges, telephonic databases, and auto dialers underlie most population health outreach to patients today. Mail and telephone calls are now the "old tech" of communications strategies. The ability to outreach to an identified population used to be limited by the number of telephone calls a staff could make within a day. Mail campaigns and the "robocalls" we all love to hate, are now generated by technology enabled database management and telephony solutions, exponentially increasing the volume of contacts potentially made in any given period of time.

The ubiquitous presence of newer electronic and mobile communications has opened new avenues of outreach to populations around their health and offerings available to help them manage it. Each new technology brings with it a potential efficiency in communicating to ever larger (and targeting more specific) numbers or groups of patients.

Consider the economies of scale generated in moving along this one progression in the technologic spectrum.



The Institute for Health Technology Transformation speaks to the requirement for automation in PHM noting that bringing technology to bear on these tasks saves time, money, and makes PHM economically feasible (Institute for Health Technology Transformation, 2012).

The common usage of computing technology and mobile devices, and the very connectedness of patients themselves, forms a feedback loop creating ever increasing volumes of available data about the users. As patients use these technologies and devices, more information is collected about them based upon that use and their preferences within the larger consumer culture. Consumer data is now a key component in developing any patient profile and can inform a population health manager about that person's communication habits and preferences. This is data which can, in theory, be leveraged for a targeted, individualized communications strategy hopefully increasing the likelihood that a connection can be made with the patient and that the desired engagement with a program or programs, and with their health, will ensue.

Technologic advancements in communication are not limited to patients and care managers alone. As important in a connected care environment is communication within the care network and management of communications between parties. This is particularly true with PHM activities occurring at the practice or group level however, interoperability, data exchange and capture, and communication beyond the EHR and across all stakeholders is required to maintain and improve the health of populations. HIEs are one emerging technologic resource that can provide this important connection.

Patient Identification

Many population health managers are now able to ingest large volumes of patient data frequently supplied by a practice group, health plan, health system or insurer. These data may include medical, pharmacy and lab claims, clinical data from HIEs or EMRs, and patient sourced data. Systems are now able to aggregate this large volume of information in a longitudinal, patient specific way to create patient profiles of health and wellness.

Technology has also enabled the marriage of this patient specific data to clinical standards of care and the available medical evidence base to identify where the opportunities may lie for the benefit of the individual patient. As a result an aggregate clinical picture of the individual can be

created with individual specific congruence or deviation from a particular standard or groups of standards of care. Here technology is employed to not only identify patients with opportunities but to also risk stratify those opportunities, facilitating a directed and prioritized strategy for communication and engagement.

Additional items supported by patient identification using advanced analytic technologies include the identification and resolution of gaps in care, utilization assessment and management, referral tracking and "leakage" management, risk administration within the population and subpopulations even down to the provider level, and research management.

Clinical Decision Support

Clinical decision support is a health IT component used in PHM to generate and present helpful information to clinicians as care is being delivered with the goal of enabling the user to make informed decisions resulting in improved quality and enhanced health outcomes. Clinical quality improvement and the provision of quality value-based care is the new paradigm for provider organizations and healthcare systems alike. The Dept. of Health and Human Services has set a goal of tying 30% of all traditional fee-for-service Medicare payments to quality or value by 2016 (U.S. Dept. of Health and Human Services, 2015). As health information technologies expand, clinical decision support tools are becoming an integral part of the supports for quality value-based care delivery.

In population health clinical decision support often leverages evidence-based guidelines applied to patient registries or data sets providing continual surveillance of a population, identifying opportunities as they arise. In turn, many platforms that support PHM will generate custom "alerts" or notifications to patients and or providers or other care team members about those opportunities to improve or maintain health. Similarly, reminders about preventive care can be generated and messaged, ideally at the point of care, when PHM is integrated with the provider workflow.

Patient Decision Support

For certain medical conditions, there is not a clear, evidence-based, best treatment recommendation and treatment decisions are often the result of provider or patient preference. Preference-sensitive conditions and their treatments figure prominently in unfavorable cost trends across the US due to early adoption of newer healthcare technologies, often without demonstrable quality of care and cost-benefit data (The National Academies Press, 2001). There also exist large geographic variations in utilization and the cost of care across the US with physicians in high-cost areas more likely to recommend high-cost procedures (The Dartmouth Institute for Health Policy and Clinical Practice, 2012). Analytic technology supports not only the identification of patients with these conditions, but also the prediction of developing conditions, some of which may be preference-sensitive.

Patient decision support resources help patients make decisions about treatments available for conditions where legitimate treatment options exist. Patients are informed about the various treatment options including the risks, benefits and alternatives and are thereby empowered to partner with their providers to make better, more informed health care decisions that reflect their personal values and preferences (The Dartmouth Institute for Health Policy and Clinical Practice, 2012).

Patient decision support can help improve the patient experience by increasing satisfaction with the provider or health plan, providing a personal touch, increasing satisfaction with treatment, and helping to achieve concordance with treatment decisions. It provides the potential for avoided costs (from avoided surgeries or procedures, associated adverse events, and surgical complications), and reduced practice variation, as well as the ability to provide steerage or shift to preferred providers/networks and centers of excellence and known quality (Wennberg, 2004).

For all these reasons, patient decision support has become a differentiating product area within PHM as newer technologies support identification and the platforms that provide information back to the patient. Many examples exist of effective technology-based decision aids employed to educate patients and their caregivers about multiple treatment options that may exist for a condition (Stacey, Legare, Nananda, & et al., 2014).

Health Coaching

PHM programs almost universally use a technology-enabled platform upon which traditional coaching programs such as disease and case management and others are administered. Evidence supports the use

of these platforms as tools for health risk reduction (Loeppke, Edington, Bender & Reynolds, 2013). In the past these could be standalone platforms or in many instances dependent upon or built upon existing claims management systems. Newer iterations of care management systems are linking to ingested population data, analytic output that identifies and stratifies a population, and predictive modeling, as well as technologic solutions for delivering and documenting patient interactions, providing education and fulfilling collateral distribution to patients and providers.

Models for delivering health coaching to patients using these platforms may include live/telephonic coaching, digital coaching—self-serve, web-based, group coaching (live or on-line) that is instructor led, as well as email and chat. The most robust of these would share clinical underpinnings across coaching modalities, leveraging the same content, so that a patient could access content in a preference congruent way that assures consistency.

Connected Health & Personal Health IT

IT has mainstreamed into the everyday life of patients and adoption is accelerating due to a convergence of social and economic forces, both within healthcare and without. PHM is already leveraging this convergence to engage patients to support behavior change and to improve health outcomes. As noted previously, connected health encompasses a variety of modalities by which patients and their care teams can access and communicate health data. Personal health IT refers to the growing number of patients who are engaging in their own health and health care through engagement with various forms of technology (HIMSS Connected Patient Committee Sarasohn-Kahn, Jane; Ed., 2013).

Beyond web resources, email and text messaging with a provider or system, examples of connected health that are live today include patient portals, health kiosks, smart monitoring systems for medications or other connected devices (e.g. scales, BP monitors, and glucometers), wearables, smartphones and more. For example, in one study participants kept daily entries of their asthma symptoms, asthma medication usage, peak flow readings and peak flow variability on their mobile phone, from which their level of asthma control was calculated remotely and displayed together with the corresponding asthma self-management recommendations (Liu, Huang, & al., 2011).

PHM is leveraging these technologies for many purposes that include:

- Data ingestion, including biometric screening and other physiologic measurement
- Incorporation into identification and risk stratification
- Customized bi-directional messaging and education
- Identification and closure of care gaps
- Support for reporting and analysis at the population, registry, provider & member levels
- Trending of population health data
- Use in predictive modeling and machine learning

The strength of connected health in PHM is keeping the patient and their care team at the center of the ecosystem of which all of these technologies are a part and using the output to effect and support desired changes in patient outcomes.

EVALUATING TECHNOLOGY SOLUTIONS TO MEET PROGRAM GOALS

With such a dizzying array of available technologies marketed to support population health programs, it can be difficult deciding which tools will be the best fit for a given group. Consider that there are now over 165,000 health related applications available in the app stores, countless website/portal vendors, and wearable devices that are capturing user data in increasing numbers (Mottl, 2015a).

Sorting through these tools to find ones that are effective and constructed so that they actually impact health behavior can be a daunting task. Fortunately, there are ways to evaluate technology to determine whether it's evidence-based from either a health behavior or clinical outcomes perspective, is appropriate for your population, will help achieve your goals, and, once deployed, that your members are actually using the tools you provide.

Prompting User Behavior

The key to successful evaluation of technology is the identification of the intended behaviors the tool is expected to support. For some programs, this may mean tracking physical activity or keeping a food log, while for others it could be information-seeking, completing assessments or conducting transactions.

While engagement is often described as a state of being, the PHA defines engagement as a state of action, where an individual is intentionally participating in behaviors over time with the intent of achieving optimal health and well-being. Since a principal component of engagement is behavior, it makes sense to evaluate technology through the lens of behavior change (Reynolds, 2013).

There are many reasons why it is critical to evaluate the technology provided to a population, especially if the intent is to prompt user action. The barrier to entry for developers to produce tools that are marketed for health behaviors is quite low. This means that the market has been flooded with tools that have been created without an understanding of the underlying mechanisms of health behavior change (Mottl, 2015b). While the FDA has provided guidance about the types of tools that fall under its regulations, there are still many grey areas where developers may be able to produce tools with questionable foundations.

In 2008, Abraham & Michie described 26 different evidence-based behavior change techniques *(Table 1, page 10)*. By evaluating the capabilities within a proposed solution, programs can determine whether or not the technology is evidence-based. By using these interventions as a guide, PH programs can evaluate whether or not the technology they are reviewing contains one or more of these behavioral techniques.

KEY ENGAGEMENT METRICS FOR TECHNOLOGY

The addition of technology to population health programs offers a tremendous opportunity to measure engagement. This section will focus on measuring engagement with technology rather than the typical outcomes (i.e. risk reductions), or task-based engagement metrics (i.e. Registration rate or HRA completion rate) that have been described before. Instead, it will focus on the types of measurements that are unique to technology and how they fit into an overall measurement strategy.

Technology is unique in its ability to objectively track user interactions. This is very different from other types of Population interventions which may be difficult to track, such as mailings. For instance, you may be able to track how many educational letters were sent to users about mammograms, but you cannot measure how many were opened or read. In addition, technology has the capability to measure when a user interacts with it, which can then be used to determine how engaged a user is with that particular tool *(Table 2, page 11)*.

Take a website for example, using readily available analytics tools, you can measure how many users access your site on a daily basis (average daily users), where they spend their time when they are logged in (screen views) and how many complete a call to action (click rate on educational module).

With the advent of outcomes based incentive programs, technology can provide objective data on user behavior when integrated with wearable devices. For instance, wearable device data can track physical activity which can be used to support an incentive program rather than relying on self-reported data for compliance.

PRACTICAL CONSIDERATIONS WHEN USING HEALTH TECHNOLOGY

Adding technology to a population health program takes thoughtful planning in order to ensure that the right tools are being leveraged within the population, and that they enhance the user experience with the program rather than complicate it. Adoption and use of technology for health varies within diverse populations. It is by understanding the characteristics of intended users and how they use and access technology, their intended use, and how these tools are to be integrated into existing programs that an appropriate ecosystem of tools can be constructed. Furthermore, as new technologies are being developed and marketed as health solutions, it is imperative that the privacy and security of member data is protected.

Privacy

Protecting health information has become second nature to most population health programs. Federal laws, combined with state regulations and various accreditation bodies have advanced the concept of Protected Health Information quite far. However, the rapid emergence of new mobile technologies and their adoption within the health management model pose significant challenges and in some instances, well-known regulations such as HIPAA have failed to keep up.

TABLE 1. Definitions of 26 Behavior Change Techniques and Illustrative Theoretical Frameworks

Technique (theoretical framework)	Definition
1. Provide information about behavior-health link. (IMB)	General information about behavioral risk, for example, susceptibility to poor health outcomes or mortality risk in relation to the behavior
2. Provide information on consequences. (TRA, TPB, SCogT, IMB)	Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behavior
3. Provide information about others' approval. (TRA, TPB, IMB)	Information about what others think about the person's behavior and whether others will approve or disapprove of any proposed behavior change
4. Prompt intention formation. (TRA, TPB, SCogT, IMB)	Encouraging the person to decide to act or set a general goal, for example, to make a behavioral resolution such as "I will take more exercise next week"
5. Prompt barrier identification. (SCogT)	Identify barriers to performing the behavior and plan ways of overcoming them
6. Provide general encouragement. (SCogT)	Praising or rewarding the person for effort or performance without this being contingent on specified behaviors or standards of performance
7. Set graded tasks. (SCogT)	Set easy tasks, and increase difficulty until target behavior is performed.
8. Provide instruction. (SCogT)	Telling the person how to perform a behavior and/or preparatory behaviors
9. Model or demonstrate the behavior. (SCogT)	An expert shows the person how to correctly perform a behavior, for example, in class or on video
10. Prompt specific goal setting. (CT)	Involves detailed planning of what the person will do, including a definition of the behavior specifying frequency, intensity, or duration and specification of at least one context, that is, where, when, how, or with whom
11. Prompt review of behavioral goals. (CT)	Review and/or reconsideration of previously set goals or intentions
12. Prompt self-monitoring of behavior. (CT)	The person is asked to keep a record of specified behavior(s) (e.g., in a diary)
13. Provide feedback on performance. (CT)	Providing data about recorded behavior or evaluating performance in relation to a set standard or others' performance, i.e., the person received feedback on their behavior.
14. Provide contingent rewards. (OC)	Praise, encouragement, or material rewards that are explicitly linked to the achievement of specified behaviors
15. Teach to use prompts or cues. (OC)	Teach the person to identify environmental cues that can be used to remind them to perform a behavior, including times of day or elements of contexts.
16. Agree on behavioral contract. (OC)	Agreement (e.g., signing) of a contract specifying behavior to be performed so that there is a written record of the person's resolution witnessed by another
17. Prompt practice. (OC)	Prompt the person to rehearse and repeat the behavior or preparatory behaviors
18. Use follow-up prompts.	Contacting the person again after the main part of the intervention is complete
19. Provide opportunities for social comparison. (SCompT)	Facilitate observation of nonexpert others' performance for example, in a group class or using video or case study
20. Plan social support or social change. (social support theories)	Prompting consideration of how others could change their behavior to offer the person help or (instrumental) social support, including "buddy" systems and/or providing social support
21. Prompt identification as a role model.	Indicating how the person may be an example to others and influence their behavior or provide an opportunity for the person to set a good example
22. Prompt self-talk.	Encourage use of self-instruction and self-encouragement (aloud or silently) to support action
23. Relapse prevention. (relapse prevention therapy)	Following initial change, help identify situations likely to result in readopting risk behaviors or failure to maintain new behaviors and help the person plan to avoid or manage these situations
24. Stress management (stress theories)	May involve a variety of specific techniques (e.g., progressive relaxation) that do not target the behavior but seek to reduce anxiety and stress
25. Motivational interviewing	Prompting the person to provide self-motivating statements and evaluations of their own behavior to minimize resistance to change
26. Time management	Helping the person make time for the behavior (e.g., to fit it into a daily schedule)

Note: IMB _ information-motivation-behavioral skills model; TRA _ theory of reasoned action; TPB _ theory of planned behavior; SCogT _social-cognitive theory; CT _ control theory; OC _ operant conditioning.

(Abraham & Michie, 2008)

For example, a web-based HRA with results that describe a user's risk profile and how their actions might impact their health might meet items 1, 2, 6 and 8, while a mobile smartphone application with a full-featured tracker that includes goal-setting, might include items 10, 12 and 13.

For instance, wearable devices or mobile apps may collect data from users that would be traditionally considered Protected Health Information (PHI) yet they are often not explicitly addressed in privacy rules.

The effort to capitalize on the rapidly emerging connected health market has resulted in a glut of digital tools that have not been constructed with the same demanding privacy standards that have been required of the population health industry for many years. In many instances, personal health data collected via mobile applications and wearable devices is poorly protected (Health Care Business Tech, 2014). By some estimates, there are now over 165 thousand mobile health apps available within the app stores and many of these fall short of providing users with even basic information about how their data will be used and stored (Mottl, 2015b). As evidenced by recent wearable device data breaches, more work is needed to improve privacy and security protections with emerging technologies (Mangan, 2016).

Older technologies, such as websites, have had more time to mature and establish privacy and security processes to protect patient data, however as data integration and exchange between systems, devices, website and wearables becomes the norm, care must be taken to re-examine connections, data flows, storage and monitoring to account for new risks.

When considering using these technology platforms, be sure your member data is encrypted. Find out where it is going to be stored. Will any data be kept natively on the devices or in the cloud? Make sure to ask who will have access to this data? What are their policies for breach notification? Ensure that they will not use patient-generated data for any purpose to which you have not agreed. Work with your compliance team to identify potential pitfalls when using these tools and screen digital health providers accordingly. Finally, be sure to include descriptions of this data, how it will be used and how it is protected in your member terms and privacy statements.

TABLE 2. Example Digital Tool Engagement Metrics

Metric	Description	Why Important
Overall Engagement		
Number of Users	The number of users who are interacting with the technology measured as average daily users, average weekly users or average monthly users.	This defines the user base and can be used to track overall engagement with technology over time
Session Interval	The average time between user logins/activity with the technology	Longer session intervals indicate the technology is being used less frequently.
Utilization Time	The average total time users spend actively using the technology (monthly, weekly, daily)	This can provide valuable insight about which segments of the population are using the technology more frequently
Time Since Last Activity	The average time since the technology last used	Longer periods indicate that utilization of the technology tool is lower
Websites and Apps		
Screen Views	Total number of page views	Where users are spending their time when using the tool
Screen Flow	The sequence of page views during a session	The path users take through the tool
Online/Mobile Trackers		
Online Trackers	Track physical activity, weight, nutrition, etc. — data includes average measurements for each tracker, goals met, highs/lows, tracking frequency, sustained use	Usually requires manual entry unless integrated with mobile device data
Mobile Trackers	Track physical activity, weight, nutrition, etc. — data includes average measurements for each tracker, goals met, highs/lows, tracking frequency, sustained use	Objective data from wearables, connected devices or smartphones can provide more accurate behavioral data than self-reported tracking

Digital Divide

The digital divide is term often used in reference to the gap between a population and their access to technology. While the technology included in this definition has evolved, the concept remains the same. There are some groups with diminished access to technology either through lack of availability (no technology infrastructure, i.e. lack of broadband internet connectivity in rural areas), or access (technology is available, yet groups don't possess the means to utilize it, i.e. lack of funds to obtain it). In addition, cultural differences within the population should be considered and adjustments made in tool design, language, imagery, figures, food items and unique habits in order to provide a user experience that is representative of your target population. While shrinking, the digital divide remains a concern, especially when deploying technology-supported population health programs in rural areas, or with older participants or lower those of lower socio-economic status.

Age-related Considerations

There are generational differences in the use of digital tools for health (Reynolds, 2013). Selecting digital tools for specific populations should include consideration of the intended users' age and technology tool preferences. Older technology users may not be as familiar or comfortable using certain tools. For example, some evidence suggests that older users prefer linear navigation and tablet-based programs over many smartphone apps or digital health games. In addition, they may not use text messaging or social networks as frequently as their younger counterparts, so these types programs may not be as helpful to this group (Reynolds, 2013).

Creating digital tools for an older user should account for age-related visual and cognitive changes so that the experience can be less overwhelming and more enjoyable. Keeping the user interface clean, without extraneous details and simple, concise instructions will aid usability for older adults. In addition, older adults' physical limitations such and mobility and balance may make some tools such as some exercise games difficult or uncomfortable to use. Having ergonomically designed controllers or games in which the player is able to set the difficulty or controller characteristics to suit their physical limitations would be beneficial (Reynolds, 2013).

The importance of usability cannot be overestimated. Be sure to test these tools with your intended user group, elicit feedback, monitor satisfaction, and participation. Establish mechanisms for user feedback and invite criticism. Make sure you involve your consumers as well as your internal staff who will be assisting or using these tools.

Cost

While many e-Health tools such as mobile applications are free and are being provided as part of existing condition support programs at no additional cost to the user, other technologies may be expensive, thereby reducing their appeal to those with limited incomes. Consideration for the target population's financial means is especially important to adoption. Unfortunately the groups who may benefit the most from technology tools (older, minorities, lower SES) are the ones least likely to be able to afford it. If you are going to require participation using a wearable device, how will you ensure that those who cannot afford one will still have an equal chance to be included in the program?

Remember that data is not always free for your customers. Make sure your technology doesn't consume great amounts of data, drains the user's batteries quickly or result in unwanted SMS charges. Be upfront about any costs for the program and whether or not there are alternatives to participation for those who cannot afford it.

Integration With Overall Engagement Strategy

Population health programs should think carefully about how new tools will fit into the organization's overall engagement strategy. Considering the intended actions or behaviors when using these tools, do they duplicate functionality in other areas? To illustrate, does a user complete an HRA on a website and are you including this capability in a mobile app? If so, how do the experiences differ? Are they integrated so that action in one informs the other?

Large organizations are often siloed, with limited data transfer between different stakeholders. Identify the tools already in use and consider what purpose they serve. You want to avoid creating another digital tool in an already established ecosystem that is not integrated or adding value to the user experience. Gather information from multiple departments within your organization when considering the addition of new tools. Marketing, clinical, human resources and quality improvement may all have different needs related to the tool being considered. Best practice is a multidisciplinary approach to design, implementation, communication and evaluation of health technology tools.

WHAT'S ON THE HORIZON?

Big Data

One of the most exciting areas of digital health is the use of big data. According to one author, big data is defined as: data sets so large and complex that conventional means of processing are insufficient. "Hallmark of big data is volume, velocity and variety" (Krall, 2014). Using tools such as Apache™ Hadoop® Software Project, researchers are using data to drive new knowledge (Raghupathi, 2014). Big data sets can now be used to do the following:

Machine learning/probabilistic modeling/predictive modeling

- Concurrent risk scores/intervention thresholds to detect changes in progression of disease in a population
- Finding emerging healthcare patterns
- Identifying "at risk populations" before they rise to the level of illness

Personalized medicine and '-omics' identification

- Many of the emerging fields of large-scale data-rich biology are designated by adding the suffix '-omics' onto previously used terms. (e.g. genomics, proteomics, metabolomics)
  - Genomic sequencing costs are decreasing, thereby improving accessibility. These tools will enable personalization of care delivery in new and exciting ways, such as: assessing for disease risk and individual level adjustment of treatment plan, pharmaceutical support and lifestyle support.
  - These fields are the result of disruptive technologies that have resulted in the ability to answer complex clinical questions at the protein level.
  - Personalized medicine is a growing field of study that explores approaches to calculating risk based on genetic, environmental, and other variables, and tailoring patient care/treatment to one's genotype.
    - For example, potential applications of genomics in obesity prevention and control are several. Genetic testing could be used to predict future obesity, and the most effective population health interventions could be targeted to those with higher genetic risk, including specific behaviorally based prevention approaches or specific pharmacologic therapies.

SUMMARY Traditionally, population health programs have been human resource intensive, leveraging multidisciplinary experts in various settings in order to deliver interventions to large groups. These types of interactions were often conducted telephonically or even face-to-face. Unfortunately, many of these efforts have not been scalable or financially sustainable. As program leaders attempt to reach ever-growing numbers of individuals who are constantly on the move, they have quickly discovered that new approaches must be used. Technology has a role to play in supporting the various individual actions needed to reach those goals, as long as it is constructed in an evidence-based way, is measurable and utilized by the target population. It is important to remember that technology can support, but not necessarily replace, key human interactions and care must be taken to ensure that it enhances existing programs rather than complicates them.

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