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PRECISION HEALTH: A PERSONALIZED APPROACH TO ACTIVE HEALTH MANAGEMENT

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LAY ABSTRACT

"Precision Health" is a proactive approach to healthcare management that starts from conception to end of life. It takes into consideration how lifestyle choices such as nutrition, smoking habits, exercise frequency, and stress management affects our lives. This extends to how social determinants of health such as biology and genetic endowment, income and social status, social support networks, education and literacy, employment working conditions, social environments, physical environments contribute to a person's wellness. Additional determinants such as personal health practices, coping skills, healthy child-hood development, access health service, gender and culture all impact health outcomes and well-being.

"Precision Health" relies on the collection and analysis of life experience information, clinical information and biological data such as proteins found in the blood from healthy and persons who are not well. This information can be used to follow patterns of health, well-being and the onset of diseases such as diabetes, cancer, mental health disorders, heart disease, frailty and neurological conditions. A "Precision Health" strategy would allow us for example to detect early warning signs of mental health distress before diseases such as post-traumatic stress or depression arise. This strategy can be used to proactively maintain health with the goal of preventing disease.

"Precision Health" requires a collaborative approach between health care providers, citizens, researchers, engineers and policy makers to integrate research, clinical and demographic information. "Precision Health" facilitates the identification and monitoring of suspect patterns of being that can keep our population healthy. This practice will take real data and align best practice and research to develop preventative and ongoing strategies for living, monitoring wellness and delivering precision care.

INTRODUCTION

According to the National Institute of Health (NIH), precision medicine is "an emerging approach for disease treatment and prevention that takes into account individual variability in genes, environment and lifestyle for each person" (1). The precision medicine approach has delivered effective personalized treatment strategies tailored for the individual. In the field of pharmacogenetics, computer algorithms that integrate an individual's unique genetic code and clinical information are used to calculate more precisely warfarin dosage (2). This innovation prevents under-dosing or over-dosing, which can result in clotting or bleeding in patients respectively. However, the term precision medicine has strong connotations as a reactive treatment for existing health conditions in *patients* and is limiting as a term for representing a more prominent focus on disease prevention in healthy persons. In contrast the term precision health better reflects an emphasis on proactive health management in *individuals* (3). Precision health still has at its foundation a tailored approach, but emphasizes proactive versus reactive health care and focuses on how lifestyle and environmental conditions can be modified to extend well-being including health across the lifespan (4). This paper will present concepts on how key determinants such as person/client engagement, biological research including "omics", information technology research, and translational health research can establish precision health as the gold standard in active health care management. Mechanisms to facilitate the operationalization of precision health are discussed.

COMPONENTS OF PRECISION HEATH

Essential components of precision health include the support of **ongoing biological, technological and translational health research** for developing a personal health database that is constantly populated with research, clinical, lifestyle and demographic information, the **setting of personal life goals** as a mechanism for person/client engagement, **proactive health care management** based on healthcare provider engagement and coordination, and the **active integration** of these three domains to ensure that person/clients receive the resources required to meet their health goals (Figure 1).

Setting Personal Life Goals

An essential component to developing a tailored health maintenance plan for the lifespan is assuring that people are given the opportunity to express life goals, are health literate (understand the impact of lifestyle choices on health) and are able to articulate SMART goals that are Specific, Measurable, Attainable, Relevant and Time-bound, and that can be adjusted throughout the lifespan (5). These factors will ensure that persons/clients are at the center of making lifestyle choices that will help them to achieve their life goals (6). Some clients may have aspirations for a competitive athletic career; others may seek to maintain fitness for everyday life, while others may make choices to have the best quality of life despite the exacerbation of an existing health condition. Actively seeking client input is essential for developing a tailored health management strategy.

Biological, Technological and Translational Health Research

Precision health is heavily reliant on the ability to monitor individual health status and to provide direct feedback to clients. Its aims are to detect the onset of disease before symptoms manifest and to monitor the effects of evidence-based interventions in order to constantly maintain health. This model of care requires the development of large-scale databases, which contain individualized health records that include life goals, demographics, life experiences, biological ("big data"), clinical and psychological information. For example Quanterix, Lexington, MA has developed a digital enzyme-linked immunosorbent technology that can be used to measure circulating protein biomarkers in the blood that are relevant for determining cardiology, neurology, inflammatory oncology and infectious status (7, 8). This data can be combined with clinical data to develop a health status dashboard that can inform the development of personalized recommendations for maintaining health such as specific diet or fitness intervention to prevent frailty. Key to the utility of this information is the development of technology with the capacity and capability to integrate this non-structured information and to present it in a manner that is readily accessible and useful for servicing clients and their health care providers. This information is critical to support the development of a health management plan and to actively monitor health status. Technology surrounding the maintenance of client privacy is also an essential for successful implementation.

Proactive Health Care Provision

Proactive health care provision involves empowering clients to become active participants in their health care management and providing evidence-based options to assist with health management. Aspects of this care may include client-focused health education to promote health literacy, client coaching to set SMART health goals, and service navigation to support clients in achieving these goals. In order to facilitate this process, healthcare providers, primary care physicians, and provincial health authorities will need resources to facilitate the monitoring of key indicators of health status, and will need access to ongoing education on available evidence-based interventions for health maintenance in a physician-driven services model (9). For example using technology such as electronic health records integrated with health services program information, physicians can have access to information regarding services that are relevant to individual client needs in helping them to maintain their health. For example a client needing a smoking cessation intervention could be directed to health services such as a smokers' helpline and have access to subsidies and counseling supplied by addiction services such as QuitCare® (10). Equally impactful is that physicians can highlight the unmet needs to health authorities to identify gaps in health services, and to support the development of new health promotion programs, through the same information management system.

Collaborative Integration

Central to the success of precision health is the integration of health care provision, policy making, and research and person/client engagement. The Canadian Institute for Health Research (CIHR) has developed Strategies for Patient-Oriented Research (SPOR) that promotes the integration of these sectors as part of the Primary and Integrated Healthcare Innovations Network (PIHcIN) Initiative, which has a mandate to conduct evidence-based research with the goals of developing novel healthcare solutions that are relevant to patients, and that can be readily adopted into the health care system (11). Precision health

proposes to build on and to expand the vision of SPOR from *patient*-centered to *person*-centered health research and health care, by emphasizing the maintenance of well-being including health versus the treatment of disease. It relies on the central tenants of SPOR in terms of an integrated vision of health care delivery, policy, research, and client focus, but expands the focus from treating "the right patients with the right interventions at the right time", to providing services to healthy persons to promote ongoing well-being including health.

MECHANISMS TO OPERATIONALIZE PRECISION HEALTH

Engagement

Person/client engagement must move beyond a tokenistic or dismissive attitude toward recognition that decisions, regarding well-being including health are best decided by a person/client. Recognizing the value of clients'/persons' lived experiences and life goals is critical for providing effective coaching to develop SMART health management goals. The role of health care providers in promoting engagement is to assist clients/patients in developing, managing and monitoring their goals (diagnostic methods etc.), and to assist clients/patients in navigating the resources that are available to them for attaining their goals. The role of researchers is to provide support to healthcare providers in developing new models of care, new technologies and continuing education materials to support precision health. In addition researchers must also consult with persons/clients to ensure that technologies and models of care developed are relevant and impactful, and must support health authorities in evaluating the new models of care for effectiveness and person/client satisfaction.

Collaborative Healthcare Management & Research

Integrated collaboration between healthcare providers, researchers, health policy makers and persons/clients and policy makers is essential for operationalization of precision health strategies. As one mechanism to support this movement, translational health research should be formalized and become a recognized entity that is based on collaboration between the health authority, clinicians and Universities. Establishing a center, department or institute supported by web resources where researchers, physicians and persons/clients can intersect to conduct and participate in relevant research initiatives is crucial as a conduit to translate more research into practice. One example is the CanChild research center at McMaster University, where translation research for children with complex care needs is a focus (12). More support could be directed toward the development of researcher – clinician – client collaborative research programs to address the upstream prevention of disease. For example researchers can collaborate with clinicians to identify biomarkers in select cohorts to develop indicators for health status such as preclinical states of diabetes before onset of chronic disease. Clients can receive health education and coaching to set SMART objectives to change their trajectory for improved outcomes. Researchers can collaborate with health service providers to evaluate the effectiveness of education programs and to develop new programs with direction from persons/clients. This collaborative method of healthcare management and research will ensure that the circle of care is expanded to include research in a new era of citizen science.

Computing Infrastructure

Innovative information technology solutions are critical to facilitate the development of secure, university-driven, research database repositories and analytics services such as the New Brunswick Institute for Research, Data and Training (13) and the Secure Island Data Repository at University of Prince Edward Island (UPEI) (14) that can service health authorities in analyzing data to assess population health needs, to evaluate programming and in the future support the integration of non-structured information that can support precision health. This collaboration will provide health authorities with access to highly qualified personnel to assess the current status health status of the population and to identify gaps in services to provide the best service to citizens. Researchers will benefit by having access to de-identified data that can be used to conduct research that is relevant to the Canadian population. Persons/clients will benefit by having direct access to their health information, which they can use to proactively manage their health. Healthcare providers will benefit by having a direct conduit for information transfer to health authorities, access to resource information to support person/client health management, and a forum to coordinate care (15).

For full utility, these databases will require enabling to integrate lifestyle, demographic, clinical and research data in multiple formats so that the information can be assessable by clients/persons and health care providers in a user-friendly interface to support the development of individualized health programming for well-being including better health. Databases developed can be used to support secured local area networks and client portals that can be accessed through web-based programming and applications on personal computers or mobile devices

such as smart phones, making individualized information both relevant and accessible to clients. This data can also be linked to databases such as provincial electronic health records to allow for the centralization and integration of client data. Collaboration between persons/clients, researchers, engineers, health care providers and health policy makers will be required to develop this technology in an impactful way.

Education

Education modules in person/client engagement, precision health, health policy, health literacy and new technologies for health services should be developed to support inter-sectorial communication, continued learning and easy adaptation of new technologies. Currently the Maritime SPOR Support Unit (MSSU) has been a conduit in the Maritimes for disseminating CIHR-developed modules in patient engagement (16). The MSSU mandate could be expanded to supporting education for the development of personalized health management plans for the Maritime population. Increasing the health, policy and research literacy of all stakeholders will support improved communication, increased participation and innovation around health research and the development of impactful models of healthcare and services.

FIGURE AND TABLES

Figure 1: Four Essential Components of Precision Health

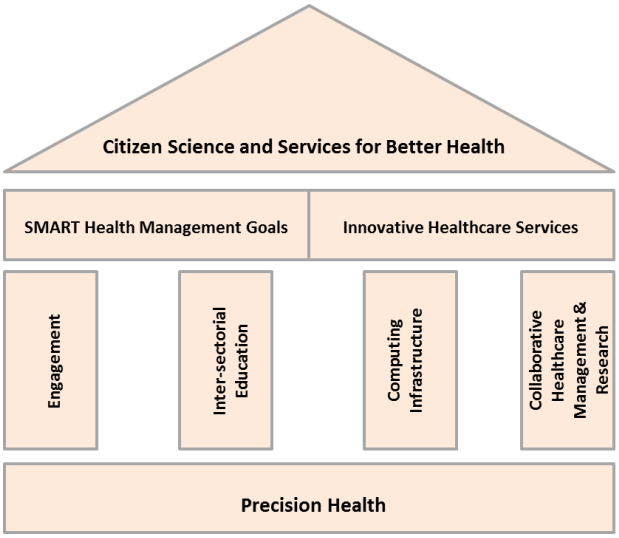

Figure 2: Pillars for Operationalizing Precision Health

CONCLUSION

We propose that the term *Precision Health* emphasizes the need for health service interventions to assist clients in maintaining and improving their health status to prevent the onset of chronic disease conditions. Plausible benefits of precision health include preventing sickness to allow for improved quality of life, increased productivity and a reduced burden on the health care system. Precision health tools such as biological indicators of health status can be used to monitor the effectiveness of health service interventions, ensuring that persons/clients are receiving the most beneficial services for their individual health needs. Interactive health care and the development of individualized SMART goals developed by persons/clients with support from healthcare providers and delivered in the form of a person/client web interface, for accessing health status, can lead to increased accountability for individual health, increased adherence to individualized health programming and to increased health literacy. Furthermore increased collaboration between researchers, engineers, health care providers and persons/clients can lead to increased translation of research into health care services and an increase in the availability of impactful technologies that can support persons/clients in achieving their health goals.

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