How to implement a population health management programme

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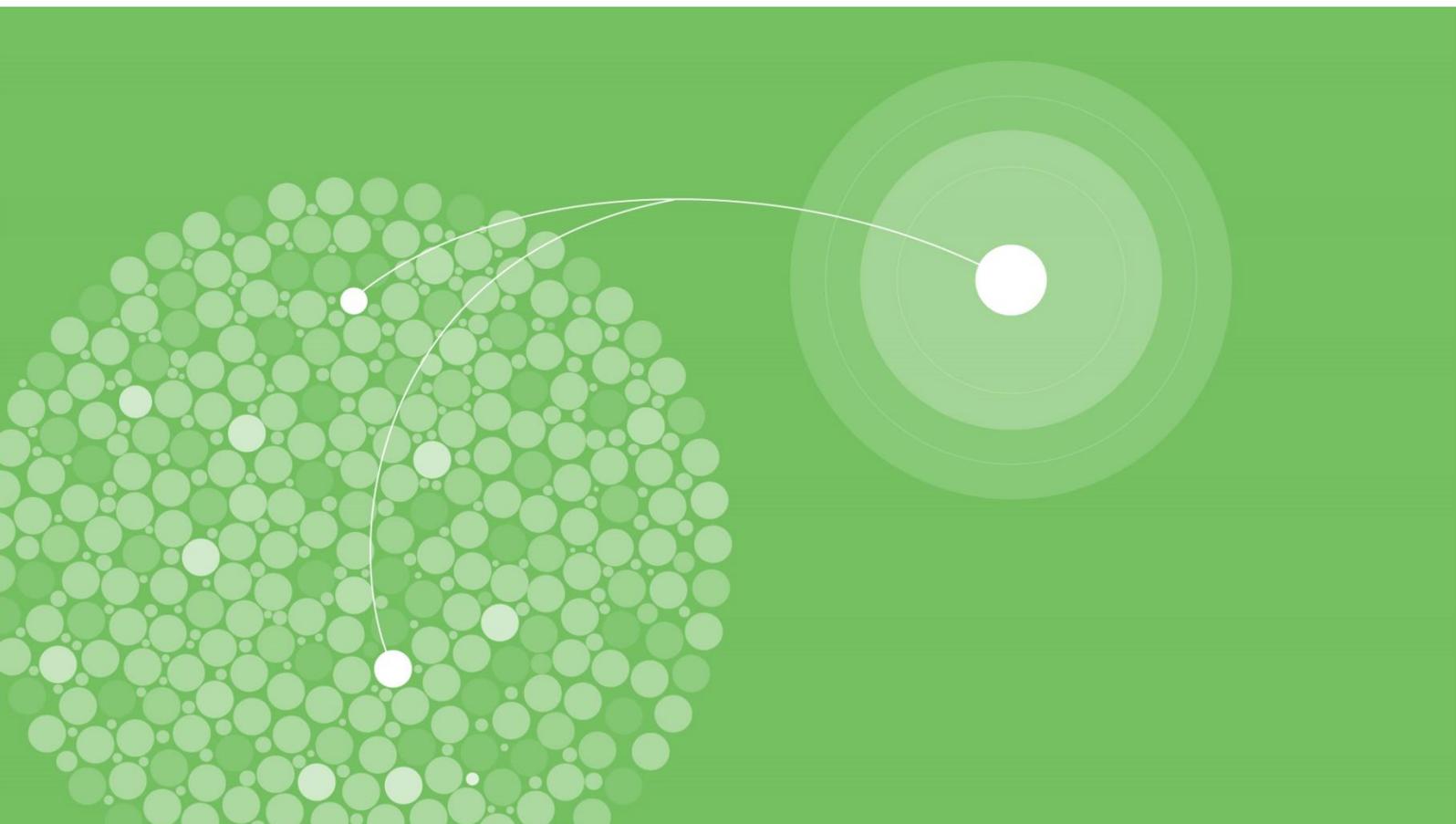Kevin Manning, FSAI
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1. Executive Summary

Population health management (PHM) is a hot topic in the healthcare industry, but it means many different things to different people, in different contexts. It is difficult to decide where to focus effort when developing PHM strategies and programmes without a clear policy framework and approach. We have written this guide to assist managers in thinking through the practical components of a PHM programme, from overall objectives and definitions, through to the people, processes and technology enablers that are so critical for success. Throughout, we have referenced real-world case studies and provided references for further reading. We hope our readers find this a useful and pragmatic addition to the literature.

PHM programmes are often aimed at improving the health of entire populations in a particular country, state or region. As such, government departments and policy makers are often behind the establishment of PHM programmes, working closely with healthcare providers and sometimes private sector payers such as insurers to analyse and implement such programmes.

PHM ensures that ways to improve health outcomes are considered objectively and with an open mind. Data and rigorous analysis can result in decisions regarding interventions that are not always intuitive or expected at first glance. For example, PHM analytics could indicate better value of direct spending on sectors other than healthcare, such as housing or sporting bodies, to drive improvements in health outcomes for specific segments of the population.

PHM experience is continuously evolving. The case studies illustrated in this paper aim to capture what is currently being done in this space and to prompt ideas for potential future programmes, even if many are still in the early stages of implementation and evaluation.

This paper outlines how to implement a PHM programme and is structured as follows:

- **Section 2** offers definitions of PHM and notes the importance of setting outcomes and guiding principles for the programme
- **Section 3** outlines the enablers required to successfully implement a PHM programme, broken down into:
    - People
    - Processes
    - Technology, data and analytics
- **Section 4** describes key elements of an effective evaluation framework
- **Section 5** contains our concluding comments
- **Appendix 1** includes a selection of PHM definitions from major organisations and healthcare systems

2. Defining PHM

There is no single, universally accepted definition of population health management (PHM). Different countries, health systems and organisations define population health and PHM in line with their own policy priorities and within their own healthcare and social-system contexts. Appendix 1 includes a selection of PHM definitions we have identified from major organisations and healthcare systems. Below are two examples of such definitions:

NHS England[1]	*'Population Health Management is an approach aimed at improving the health of an entire population and improves population health by data driven planning and delivery of care to achieve maximum impact for the population.'*
Government of Canada[2]	*'Population health is an approach to health that aims to improve the health of the entire population and to reduce health inequities among population groups. In order to reach these objectives, it looks at and acts upon the broad range of factors and conditions that have a strong influence on our health.'*

Reviewing a multitude of PHM definitions, it is possible to identify common themes and recognise common 'buzzwords' that frequently appear, as shown in the word cloud diagram in Figure 1.

FIGURE 1: POPULATION HEALTH MANAGEMENT DEFINITIONS: WORD CLOUD

In general, PHM is an approach that focuses on defined populations. Typically, the objective is to improve the overall 'health' levels in a population, as well as, in some systems, including an explicit objective to reduce inequities or inequalities. Definitions of outcomes (i.e., what is considered as 'health') also vary considerably, although achieving the Quadruple Aim[3] and healthcare systems integration or redesign are usually common features of a PHM strategy. Further, PHM is often described as being data-driven. Risk stratification and population segmentation techniques are recommended to identify and cater to different health profiles and needs. Increasingly, there is more and more focus on including wider social determinants of health in a population health context.

It can be helpful to think about PHM by focusing on four interconnected themes within a defined population to develop a population health system, as shown in the diagram in Figure 2.[4] PHM strategies should be coordinated across the four themes rather than focusing on each in isolation.

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1 NHS England. About the Health Systems Support Framework. Retrieved 6 August 2019 from https://www.england.nhs.uk/hssf/background/.

2 Government of Canada. What Is the Population Health Approach? Retrieved 6 August 2019 from https://www.canada.ca/en/public-health/services/health-promotion/population-health/population-health-approach.html.

3 The simultaneous pursuit of improving the patient experience of care, improving the health of populations, reducing the per capita cost of healthcare and improving the work life of healthcare professionals. For more information about the Quadruple Aim, see http://www.annfammed.org/content/12/6/573.full.

4 King's Fund. What Does Improving Population Health Really Mean? Retrieved 6 August 2019 from https://www.kingsfund.org.uk/publications/what-does-improving-population-health-mean.

FIGURE 2: POPULATION HEALTH SYSTEM [5]
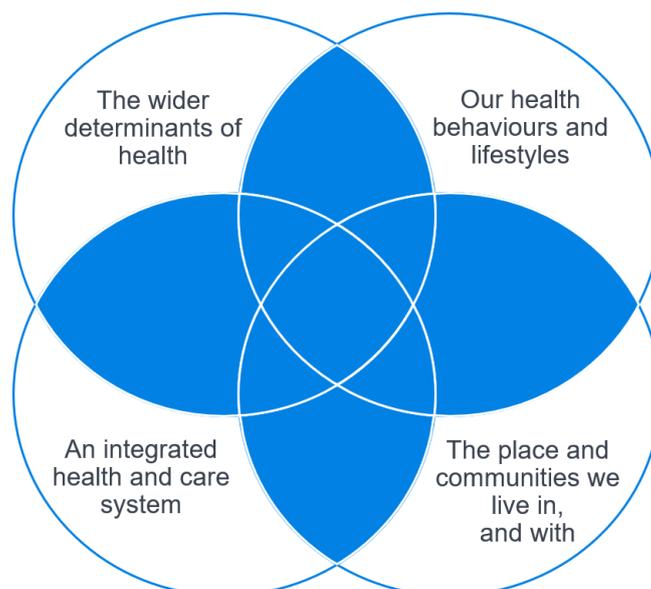
While these themes sound like sensible areas to include in your definition, it is necessary to supplement the definition with three additional points to turn a PHM strategy into action:

1. A defined population

2. A set of health outcomes that are objective, actionable and measurable.

3. A set of principles which govern how you will deal with the inevitable trade-offs you will encounter.

Guiding principles can be contradictory. For example, when setting principles, do we aim to increase overall health levels by improving the health of those we consider to be the worst off or is improving average health acceptable, even if it compromises our 'worst off' cohort and does not meet our explicit equity objectives? Once we have identified a subpopulation with a significant capacity to benefit, how do we know how responsive the patients within this group will be to a PHM strategy? The nonresponsive might have the most capacity to benefit, but the cost of reaching them may be prohibitive. Guiding principles should capture the agreed-upon system goals and defining them will force stakeholders and policy makers to weigh-up the inevitable trade-offs and grapple with the difficult decisions that need to be made at the programme outset. The Greater Manchester system in the National Health Service (NHS) England has very clear definitions and objectives, set out in Illustrative Example 1. Research conducted by the University of Manchester[6] has concluded that it is too early to tell exactly how successful this programme has been. It has opined that 'if this is successful, it represents a revolution. If not, it has been a very time-consuming and expensive exercise.' Nonetheless, this programme provides us with a robust example of a PHM strategy that extends beyond the healthcare system to encapsulate wider determinants of health.

5 Ibid..

6 University of Manchester (2018). Devolving Health and Social Care: Learning From Greater Manchester. Retrieved 6 August 2019 from
https://www.mbs.ac.uk/media/ambs/content-assets/documents/news/devolving-health-and-social-care-learning-from-greater-manchester.pdf.

ILLUSTRATIVE EXAMPLE 1: GREATER MANCHESTER'S POPULATION HEALTH AND SOCIAL CARE PARTNERSHIP[7]

HEALTHCARE SYSTEM:

Greater Manchester, England

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

The Greater Manchester Health and Social Care Partnership was established in 2016. This devolution programme involved the decentralisation of public services to be run locally (rather than nationally) for the 2.8 million people in the Greater Manchester area.

The overarching objectives of this partnership are to:

- Improve population health
- Offer integrated healthcare and social care services as well as offering more joined-up services with other non-healthcare services that affect health (e.g., education, housing)
- Standardise care and access throughout the region

The partnership has three focus areas to address the health needs of its population across the age spectrum: Early Years, Living Well and Ageing Well. Each focus area has defined objectives and activities required to meet the objectives.

For Early Years, goal outcomes include more breastfeeding, dental health, vaccinations, education and parental mental health, and decreased low birth weights, smoking during pregnancy, child obesity, accident and emergency (A&E) visits and children in care.

For Living Well, goal outcomes include getting people back to work sooner after injury or illness, improved self-care, increased health through improved lifestyle behaviours (e.g., reduce smoking and alcohol consumption while increasing physical activity), prevention and earlier detection of cancer, elimination of HIV within a generation and improved self-care.

For Ageing Well, goal outcomes include providing more housing and improving living conditions, improving nutrition and hydration and preventing falls and fractures.

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7 Greater Manchester Health and Social Care Partnership. The Bigger Picture: Why Devolution? Retrieved 6 August 2019 from http://www.gmhsc.org.uk/about-devolution/the-bigger-picture/.

3. Enablers for your PHM programme

Once you have formulated an agreed definition and a set of outcomes and guiding principles, you need the right enablers to implement a PHM programme. For example, as illustrated in Figure 3, The National Committee for Quality Assurance (NCQA)[8] defines its PHM model with the patient at the centre and supporting components that work together to create a comprehensive PHM strategy. Appropriate enablers will be required to activate each component of the PHM model.

FIGURE 3: NCQA PHM MODEL

If we break enablers down into the traditional 'People, process, technology' groups, we can work through each in turn.

3.1 PEOPLE

What kind of staff do you need for a PHM unit and what skills must they have? If you are setting up a unit within a provider organisation, there is a common assumption that PHM programmes put significant pressures on existing staff or require additional resources and personnel.[9] In fact, published surveys[10,11] reveal that a significant portion of providers expect that adopting a PHM programme will create staffing issues, due to both lack of overall resources and the need for specialist skills.

Patient advocates and navigators, care coordinators, telehealth clinicians, actuaries, analysts, nurse educators, health coaches and chief population health officers are some of the most in-demand jobs that focus on population health nowadays. Figure 4 gives an overview of the qualifications and skill set needed to build a strong, functional and collaborative PHM team.
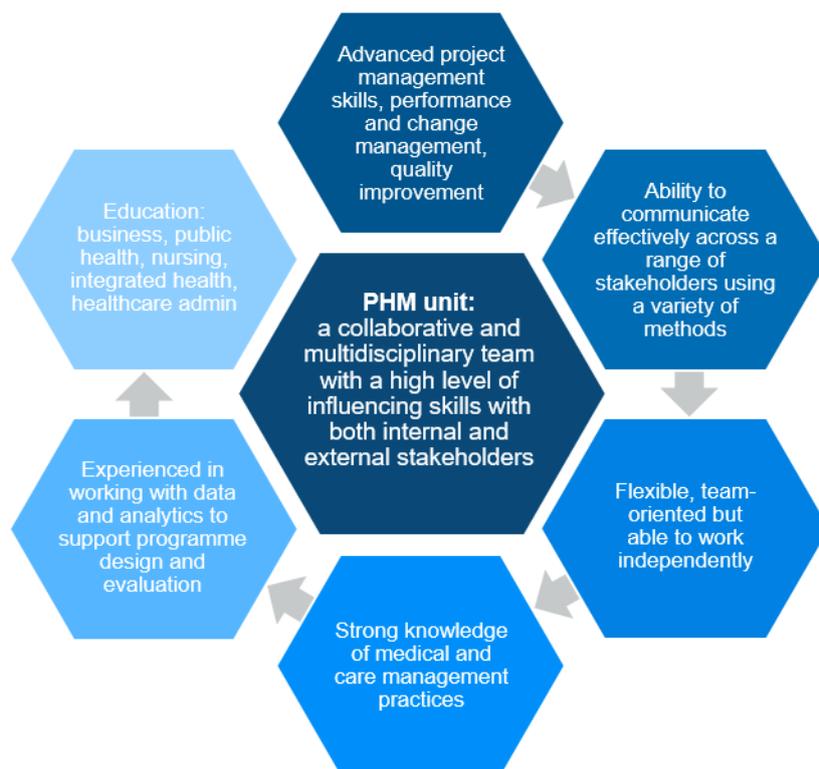
8 NCQA (2018). Population Health Management Resource Guide. Retrieved 24 September 2019 from https://www.ncqa.org/wp-content/uploads/2018/08/20180827_PHM_PHM_Resource_Guide.pdf.

9 Gamble, M. (30 April 2014). CEOs: Population health experience is hardest skill set to find. Becker's Hospital Review. Retrieved 6 August 2019 from https://www.beckershospitalreview.com/accountable-care-organizations/ceos-population-health-experience-is-hardest-skill-set-to-find.html.

10 Landi, H. (10 April 2018).Survey: Healthcare providers report slow progress on population health goals. HealthCare Innovation. Retrieved 6 August 2019 from https://www.hcinnovationgroup.com/population-health-management/news/13030067/survey-healthcare-providers-report-slow-progress-on-population-health-goals.

11 Health Research & Educational Trust (April 2014). Building a Leadership Team for the Health Care Organization of the Future. Retrieved 6 August 2019 from http://www.hpoe.org/Reports-HPOE/leadership-team-future-2014.pdf.

A well-developed PHM programme requires staff to analyse clinical data, classify and stratify patients by risk, disease and cost cohorts, develop outreach programmes for subsets of the patient population, establish clear and effective communication channels with patients and take steps to monitor and proactively help patients avoid adverse health outcomes. Such PHM processes will most likely create new responsibilities that are not part of the normal routine for the majority of existing healthcare teams. Inevitably, therefore, you will need added resources such as nurses, clinicians and technical support staff, even if many of the individual tasks can be automated.

Illustrative Example 2 shows how one English system went about implementing the organisational design of its PHM programme.

ILLUSTRATIVE EXAMPLE 2: UPDATING ORGANISATIONAL PLANS TO SUPPORT FUTURE DEVELOPMENT[12]

HEALTHCARE SYSTEM:

Southampton Clinical Commissioning Group (CCG), England

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Update existing organisational development (OD) plan to support Southampton CCG's future development.

Strategies and activities included:

Develop new conceptual OD plan with a strong focus on CCG's values, strategic objectives and operational delivery.

Skill profiling tools and a gap analysis of current and desired capabilities.

Team members received coaching and mentoring from professional expert to help with strategy development and implementation.

12 NHS South, Central and West. Reinvigorating an organization. Retrieved 6 August 2019 from http://www.scwcsu.nhs.uk/case-studies/Reinvigorating-an-organisation/.

Illustrative Example 3 shows how one US system went about implementing its PHM programme, based on strong organisational collaboration, clear programme objectives and investment in its workforce.

ILLUSTRATIVE EXAMPLE 3: ACCOUNTABLE CARE ORGANISATION WITH SOLID WORKFORCE ENGINEERING

HEALTHCARE SYSTEM:

Hennepin Health-Prepaid Medical Assistance Program (PMAP), Minneapolis, Minnesota

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Hennepin Health-PMAP, a county-based managed care programme in the Midwestern United States, was created in 2011 through a partnership involving four organisations: the Hennepin County Human Services and Public Health Department; Hennepin County Medical Center, a trauma centre and medium-size public hospital; NorthPoint Health and Wellness Center, a federally qualified health centre; and Metropolitan Health Plan, a nonprofit, county-run, state-certified health maintenance organisation (HMO) that serves Medicare and Medicaid enrolees. Hennepin Health-PMAP offers medical, behavioural and social services to those aged under 65 who are eligible for Medicaid.[13]

The main objective of this partnership was to engineer a workforce to deliver high-quality care to support the integrated delivery of medical, behavioural and social services for a specific population of healthcare beneficiaries.

The four partners formed an accountable care organisation (ACO) and were able to share financial risks among sectors in a way that allowed for some innovative approaches to addressing population health.[14] The lessons learned from this collaboration supply insights that are relevant to others operating towards similar PHM goals.

This important partnership created a powerful programme that tailored coordinated care to particular healthcare populations and defined specific goals, e.g., reduction of hospital admissions. The targeted population was clearly understood up-front, in terms of actual demographics and clinical needs. This population is mostly a high-need community, thus Hennepin Health-PMAP uses an interdisciplinary model that is designed to meet clinical, behavioural, social and economic needs. This approach recognises that each set of needs plays a vital part in a patient's overall health. The population is stratified into risk tiers, permitting Hennepin Health-PMAP to direct finite care coordination resources and interventions to the members with greatest risk for high costs. The stratification process depends on the risk-tiering outcomes, based on patients' past utilisation. The development of a prospective risk-scoring model is under way and its adoption will further enhance the analytical capabilities of the programme.[15]

The foundation of this successful care model is the formation of interdisciplinary care coordination teams that are located in primary care clinics. The teams consist of registered nurse care coordinators, clinical social workers, and community health workers. Experts in nonclinical services support these traditional clinical teams. Nonclinical services include housing and vocational support and such aspects as are considered important determinants of health. The Hennepin Health-PMAP population, in general, tends to have greater risk of high costs as it represents the Medicaid population. As stated above, the ACO stratifies its membership into risk classes. That allows the ACO to tailor the model of care to meet individual patients' needs and to prioritise the need for care coordination resources. For example, one risk category identified is high-risk members.

The case of Hennepin Health-PMAP is an example of a comprehensive PHM programme. The key to success for this ACO was the solid partnership of those paying for healthcare and providers serving this particular population and their common goals of improved care coordination in various spaces such as medical, behavioural and social settings.

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13 Medicaid is a US health coverage programme that is jointly funded by states and the federal government to provide healthcare services to low-income adults, children, pregnant women, elderly adults and people with disabilities.
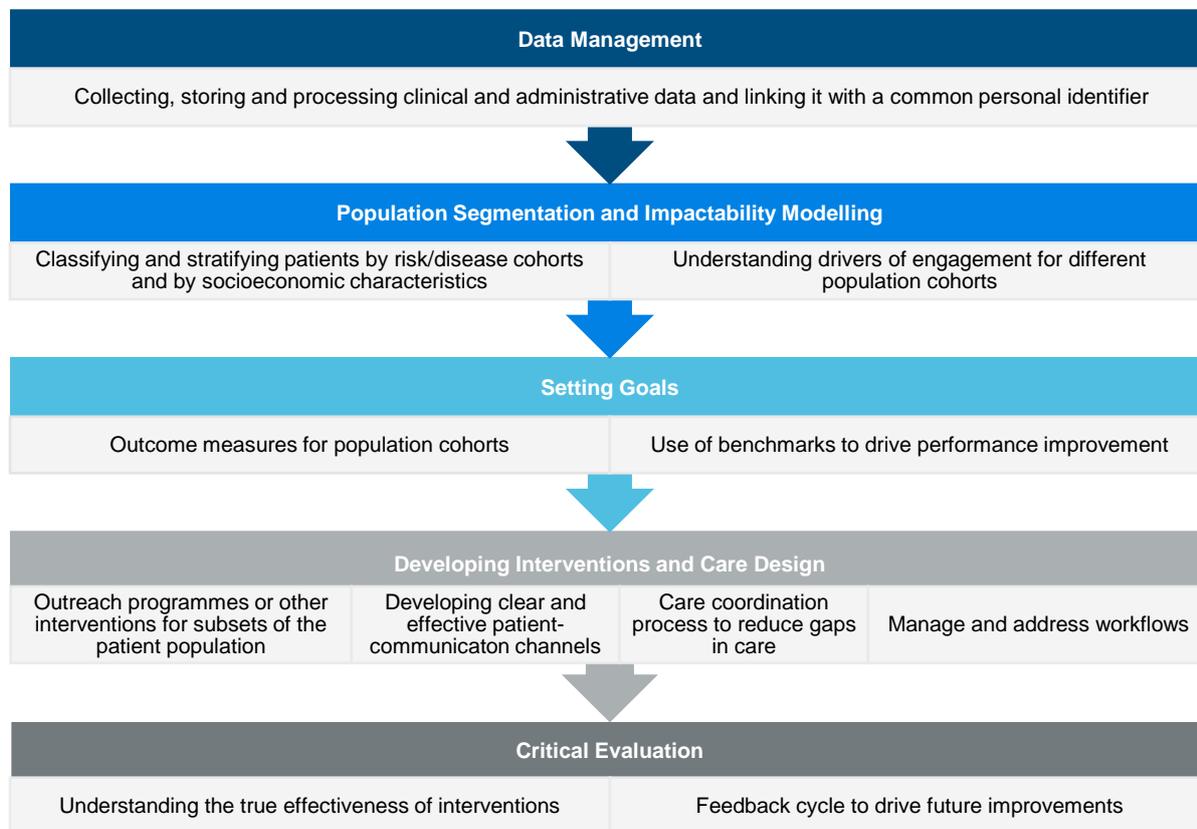
14 Gamble, M. (2014). Population Health Experience Is Hardest Skill Set to Find. Becker's Hospital Review.

15 Health Research & Educational Trust (April 2014). Building a Leadership Team for the Health Care Organization of the Future. Retrieved 24 September 2019 from http://www.hpoe.org/Reports-HPOE/leadership-team-future-2014.pdf.

3.2 PROCESS

While the exact processes will depend on agreed-upon goals and objectives, a PHM programme will likely require some broad but well-developed processes, including those shown in Figure 5.

FIGURE 5: PHM PROCESS OVERVIEW

Data Management

Collecting, storing and processing clinical and administrative data and linking it with a common personal identifier

Population Segmentation and Impactability Modelling

Classifying and stratifying patients by risk/disease cohorts and by socioeconomic characteristics	Understanding drivers of engagement for different population cohorts

Setting Goals

Outcome measures for population cohorts	Use of benchmarks to drive performance improvement

Developing Interventions and Care Design

Outreach programmes or other interventions for subsets of the patient population	Developing clear and effective patient-communicaton channels	Care coordination process to reduce gaps in care	Manage and address workflows

Critical Evaluation

Understanding the true effectiveness of interventions	Feedback cycle to drive future improvements

Illustrative Example 4 shows how state and territory health departments in Australia are at different stages of setting up a number of processes to support PHM, including a framework to ensure evidence-based decision-making and timely analysis. Some of the processes appear mundane, such as proper coding and tracking of medical devices and interventions, and yet are essential as an underpin to data confidence and, hence, robust decisions based on high-quality data and analysis.

ILLUSTRATIVE EXAMPLE 4: SETTING UP PROCESSES TO SUPPORT PHM IN AUSTRALIA[16]

HEALTHCARE SYSTEM:

Australia (Queensland Health, NSW Health, Research Australia, Australian Government)

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Produce high-quality data to improve the delivery of health services and increase understanding of diseases, their treatments and side effects.

Activities include:

- Queensland Health established a statewide clinically led Data and Analytics Committee to drive a culture of data sharing and innovation and applying supply chain international standard product descriptors.
- NSW Health continues to progress NSW Health Analytics Framework software to support evidence-based decision-making and analysis.
- Primary Health Care Networks have the ability to build a shared platform to assist all parts of the healthcare sector.
- Research Australia is partnering with HealthConsult and iDataMap Pty Ltd to create a consumer-driven lake of health data.
- Ten Australian Government agencies will spend about AUD 20.5 million from their existing allocations to implement new governance data arrangements over the forward estimates.

OUTCOMES:

- The Data & Analytics Committee established by Queensland Health is expected to provide localised population health data to inform preventive action and planning.
- Application of supply chain international standard product descriptors and GS1 standards will enable patient identification and future tracking of medical consumable products and services via standard product descriptors.
- NSW Health Analytics Framework is expected to achieve better health outcomes and improve health system planning and performance.
- Shared platform will increase data linkage and analytic capacity, giving more holistic population outcomes, patient experience, service utilisation and system performance.
- Consumer-driven lake project will involve data collection through devices such as wearables and apps to deliver real-time health information to consumers and promote consumer understanding of the value of sharing health data.

Appropriate systems will need to be developed to support these processes to ensure the successful implementation and maintenance of the PHM programme as well as the integration of the technology, data and analytics that are developed to support the programme.

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16 Government of Australia. Actions Across Australia Case Study – Interoperability and Data Quality: 3. High-Quality Data With a Commonly Understood Meaning That Can Be Used With Confidence. Retrieved 6 August 2019 from https://conversation.digitalhealth.gov.au/actions-across-australia-case-study-interoperability-and-data-quality.

3.3 TECHNOLOGY, DATA AND ANALYTICS

Data collection and management

Ideally, any PHM programme would be supported by a central database, continuously collecting information related to the demographics of the population of interest, clinical and financial information, care management programmes, quality of care, patient satisfaction and access to care metrics, amongst others. Most PHM tools require complete, standardised and consistent data for the population of interest for a reasonable period of time, at least a complete year.

In reality, the available information is not usually this complete, or collected at a centralised point. Even if the required data can be consolidated, there are likely to be other challenges that emerge. For example, it can be challenging to track a single patient through all of their encounters with the healthcare system if there is not a unique, system-wide patient identifier in use.

In addition, combining the traditional health data with broader socioeconomic data, such as educational information, thereby capturing social determinants of health, can significantly improve the accuracy of predictive risk modelling.

Illustrative Examples 5 and 6 show how Singapore and New Zealand set up shared data systems for PHM.

ILLUSTRATIVE EXAMPLE 5: SETTING UP A REGIONAL HEALTH SYSTEM DATABASE FOR SEAMLESS POPULATION HEALTH MANAGEMENT IN SINGAPORE[17]

HEALTHCARE SYSTEM:

Regional Health System (RHS), Singapore

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Set up a regional health system database which would facilitate big data analytics for proactive PHM and health services research.

Activities included:

- Conglomeration of four isolated data sets—operational data source for primary care, operational data source for acute care, chronic disease management system and death registry
- Data linkage from different sources via unique identification number
- Creating multiple interconnected tables for data analysis.
- The database development required a cross-functional team and the database provided new insights in understanding chronic disease distribution, healthcare utilisation and cross-utilisation of healthcare services across the system

OUTCOMES:

- The RHS database linked the data using the unique identification number as the linking variable. The final anonymised database has multiple interconnected tables that include patient demographics, chronic disease and healthcare utilisation information.
- It facilitated risk stratification of patients based on their past healthcare utilisation and chronic disease information.
- It provided an opportunity to analyse healthcare utilisation of the population across diverse clinical systems, which enabled proactive PHM.

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17 Gunapal, P.P.G., Kannapiram, P., Teow, K.L. et al. (16 October 2015). Setting up a regional health system database for seamless population health management in Singapore. SAGE Journals. Retrieved 6 August 2019 from https://journals.sagepub.com/doi/full/10.1177/2010105815611440.

HEALTHCARE SYSTEM:

Health One for Canterbury District Health Board, New Zealand

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Build an integrated health system to keep people healthy, provide the right care and support to the right person at the right time and in the right place.

Activities include:

- Collect patient data from primary and secondary care providers and make the data visible in a single shared patient record.
- Provide access to patient data at the point of care for multiple providers, aimed at providing better and more integrated care.

OUTCOMES:

- Health One provided access to up-to-date and relevant information, allowing timely, safe and more informed decision-making along with a unified view of the complete patient medical record.
- It helped achieve the aim of an integrated health system, putting the patient at the centre of care, making better use of resources and improving the quality of care.
- It improved patient safety and clinical efficiency, provided more comprehensive patient insights and supported seamless workflow through the health systems.
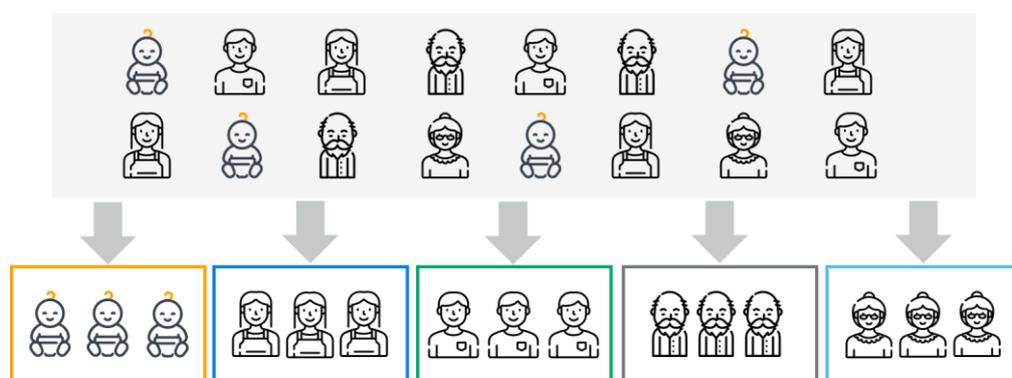
Population stratification

A PHM programme requires a number of supporting analytical tools to:

- Stratify the population into the groups we would like to consider (risk stratification)
- Track the progression of the health status of high-risk individuals or groups
- Identify which individuals are the most susceptible to interventions (impactability modelling)
- Monitor the success of any interventions on patient outcomes
- Predict the likelihood of adverse health events and as a result assist with preventing them

A robust risk stratification tool is essential for a successful PHM programme to divide a population into homogenous groups that are defined by characteristics that members within a group have in common, e.g., age, sex and/or clinical conditions. Members within a particular group are estimated to have risk profiles that are similar to other members within the group.

FIGURE 6: RISK STRATIFICATION ILLUSTRATION

18 More information about Orion Health is available at http://web.orionhealth.com/rs/981-HEV-035/images/OrionHealth_Canterbury_ DHB_CaseStudy_ROW.pdf.

Risk stratification allows you to identify the most at-risk members of the population so that appropriate interventions can be targeted where they are most needed. Populations may be stratified according to different features such as:

- **Cost cohort stratification:** Patients are identified for interventions based on costs incurred during their treatments.
- **Condition cohort stratification:** Population segments are determined based on conditions in common, and hence homogenous healthcare needs.
- **Utilisation cohort stratification:** This approach stratifies patients based on their utilisation patterns.
- **Social cohort stratification:** Populations are grouped based on some social features, such as geographic location, socioeconomic status etc.

ILLUSTRATIVE EXAMPLE 7: RISK STRATIFICATION TO DEVELOP CAPITATION[19] ARRANGEMENT FOR A MAJOR INSURER IN THE GCC[20] REGION

HEALTHCARE SYSTEM:

Major insurer in a Gulf Cooperation Council (GCC) country

PHM OBJECTIVE AND DESCRIPTION OF PROGRAMME:

Milliman assisted an insurer that wanted to address rapidly rising claims costs by implementing a capitation arrangement with major hospital groups in the region.

We used our proprietary risk stratification tool, the Milliman Advanced Risk Adjusters™ (MARA™), to understand the risk profile of members included in the population and the risk profile of members who would be allocated to each hospital group.

MARA uses longitudinal data sets[21] and advanced statistical methods to calculate a total risk score per member in the population considered, where the total risk score represents the expected overall healthcare resource utilisation for each member compared to the average member in the population. This risk score can be further decomposed into major service categories, e.g., inpatient, outpatient, physician, emergency and pharmacy categories. In addition, MARA produces outputs summarising each member's clinical conditions and how they contribute to the member's overall risk score, if at all. Using MARA, it is also possible to calculate the likelihood of hospitalisation within a 12-month period.

OUTCOMES:

Using the results of the risk stratification, the insurer was able to take an informed approach to designing a capitation arrangement with hospitals in the region as well as developing future programmes for efficiency improvements with the risk and clinical profile of its member base in mind.

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19 Capitation refers to the payment of a fee to a medical provider, such that the amount paid is determined by the number of enrolled patients.

20 The Gulf Cooperation Council (GCC), or Cooperation Council for the Arab States of the Gulf, refers to the political and economic alliance of six Middle Eastern countries—Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Bahrain, and Oman.

21 Longitudinal data sets track the same individuals over time.

Impactability modelling

Alongside risk stratification models, you should consider the use of impactability modelling. According to a study by the UK-based health think tank the Nuffield Trust,[22] impactability models 'aim to identify the subset of at-risk patients for whom preventive care is expected to be successful.' Impactability modelling involves identifying which individuals in each population group would be most amenable to the interventions proposed, and which interventions would be most effective for those individuals. The aim is to work out how effective the interventions under consideration will be. If individuals are identified as high-risk and appropriate interventions are identified, but the individuals resist the interventions proposed—by, for example, not attending regular scheduled appointments—then the interventions will have no impact. Predictive modelling tools can identify instances where interventions are unlikely to be effective, so that these interventions can be managed differently to increase their effectiveness.

Equity and access are important aspects to bear in mind when considering impactability. As discussed in the Nuffield Trust study,[23] the use of predictive models means that patients are 'identified according to objective criteria rather than the attentiveness of the physician or the wishes of patients and their relatives' and patients can be prioritised according to 'gaps' in care. Conversely, impactability modelling could also have the potential to exacerbate existing healthcare disparities and inequalities. For example, those with a low socioeconomic status, addiction, mental illness, language barriers or other social problems may be excluded from enrolling in certain programmes if these factors were found to predict poor compliance or effectiveness.

A PHM programme can also use technological tools to make interventions more effective, efficient and targeted to the patient. For example, an outreach effort to patients with high blood pressure can be automated through targeted text messages, reminders, voice messages and/or emails to assist them to manage the condition.

22 Lewis, G.H. (June 2010). 'Impactibility models': Identifying the subgroup of high-risk patients most amenable to hospital-avoidance programs. The Nuffield Trust. Retrieved 6 August 2019 from https://www.ncbi.nlm.nih.gov/pubmed/20579284.

23 Ibid.

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4. Evaluation framework

How will you know whether your PHM programme is successful? An effective evaluation framework is a key component and you should incorporate it in two distinct phases:

1. Before launch, when an effective evaluation framework can help determine which interventions should be prioritised, and can help frame expected outcomes and potential unintended consequences.

2. After launch, when your framework can assess the programme outcomes against expectations, and, critically, allow further ongoing refinements to help maximise the programme's ability to deliver on targets.

A key element of building an effective evaluation framework is identifying the goals of the programme and planning in detail how you will measure success. This should be an important part of the design phase of the project as it also allows ongoing refinement to the project to improve results.

Measures of success can cover a range of potential factors including:

- **Quality of care:** Although there is no standardised set of quality metrics, the Donabedian model that considers 'structure,' 'process' and 'outcomes' is a widely used framework.[24]
  - **Structure:** Resources and organisational arrangements in place to deliver care.
  - **Process:** Appropriate physician and other provider activities carried out to deliver care.
  - **Outcomes:** The results of physician and other provider activities.
- **Patient experience and/or satisfaction:** For example, measured through surveys and patient engagement.
- **Cost of care:** The costs of the programme (direct and indirect) may need to be balanced against cost savings of successful outcomes. Per-patient costs may need to be considered as well as overall costs. Measuring cost savings of successful outcomes can extend quite widely and include societal costs and benefits (e.g., improved productivity and lower absenteeism).
- **Reduction of inequalities or distribution of outcomes:** Measuring the movement of the mean or average outcome may not be enough. In some contexts, your mean outcome may get worse, but the distribution of outcomes may become narrower and that could be considered a success.
- **Access to care:** This means having 'timely use of personal health services to achieve the best health outcomes'[25] and includes four main components: *coverage* to facilitate entry into the healthcare system, *services* with a usual source of care in order to receive recommended screening and prevention services, *timeliness* such that healthcare is provided when the need is recognised and a *workforce* that is capable, qualified and culturally competent.

There are a number of significant challenges in evaluating the impact of a PHM programme. Typically the more powerful and sophisticated an evaluation methodology is, the more complex and challenging it is to implement, and the more onerous the data requirements will be. At one extreme, evaluation methodologies can be largely qualitative and observational, focusing on case studies or series of related case studies. At the other extreme, evaluation approaches can focus on randomised controlled trials (RCTs) or even meta-analyses[26] of RCTs.

Most commonly, evaluation approaches for PHM interventions focus on a before and after (observational) analysis. This will typically measure an outcome for a population after allowing for the impact of a PHM initiative, comparing it to the experience for the same population pre-intervention. Before and after comparisons of this nature can have the benefit of being quantitative and data-driven, but can also be fraught with pitfalls. The key challenges to look out for are selection bias, the impact of reversion to the mean and confounders. We address each of these in more detail in Figure 7. By comparison, RCTs can avoid these pitfalls but may be onerous or impractical to implement in some circumstances.

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24 Agency for Healthcare Research and Quality. Understanding Quality Measurement. Retrieved 24 September 2019 from https://www.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/chtoolbx/understand/index.html.

25 Agency for Healthcare Research and Quality. Chartbook on Access to Health Care. Retrieved 24 September 2019 from https://www.ahrq.gov/research/findings/nhqrdr/chartbooks/access/elements.html.

26 Meta-analysis involves aggregating results from multiple RCTs.

FIGURE 7: PHM EVALUATION PITFALLS

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Selection and sample size	Any situation where an individual is making a choice will introduce the potential for selection bias. For example, is a PHM programme successful at improving health outcomes in its own right, or has the programme attracted those who would have had better health outcomes anyway? Bias can typically arise when an individual chooses to participate in a programme, when participants for a project are chosen based on particular criteria or when an individual remains in a programme based on choice or eligibility. Further, having small sample sizes may produce spurious results and limit confidence in the results and the effects of the PHM interventions.
Confounders	The age-old maxim of statistical analysis that correlation does not equal causation applies equally here too. Often data in results may point to interesting outcomes but may mask the true underlying picture. For many years, for example, there was a widely held belief that birth order had a significant impact on the incidence of Down syndrome. In fact, later research has shown that maternal age at birth is a key factor, and of course birth order is heavily correlated with maternal age at birth. The only way to fully address confounders of this nature is to gather sufficient data to analyse across a range of variables. For example, an analysis by both birth order and maternal age will quickly show that birth order is not significant to incidences of Down syndrome. However, this raises a challenge of having enough data to make such granular analysis meaningful and statistically significant. There will be situations where your evaluation of a PHM programme is assessing the impact of the programme by comparing the outcomes for the population covered by the programme to the experience pre-intervention. In this situation there is an added complexity where the outcomes for the population if the intervention had not taken place (the 'counterfactual') will be unknown. It will be important to make appropriate allowances for trends and other factors such as changes in risk profile which could influence the experience for the population, rather than simply attributing any changes to the PHM programme. This can require complex modelling of potential outcomes and will add further uncertainty to your analysis. Failure to identify and adjust for the effects of confounding variables will also compromise the ability to generalise or transfer the learnings and design elements of PHM programmes from one setting to another.
Reversion to the mean	This can be another key challenge in evaluating any PHM intervention, in particular because the impact can be significant on results, both in terms of quantum and even directionally. For example, a PHM intervention may focus on a subgroup of an overall population with the highest costs in the previous year. Following the introduction of the programme, the costs for this group are much closer to the average than they had been in the previous year. The programme is therefore deemed a success. However, an examination of a similar population without the PHM initiative might show very similar results. The highest claimants in one year may not be the highest the next year, and reversion to the mean will pull outliers towards the centre over time.

Measuring outcomes successfully will therefore typically require:

- Gathering sufficient data to provide a baseline assessment
- Identifying a suitable control group against which to compare outcomes, whether that is a different population at the same point in time, or the same population pre-intervention
- Selecting evaluation methodology appropriate for the intervention and outcomes under study.
- Assessing the impact of selection bias and adjusting appropriately for it
- Allowing for other challenges such as confounders and reversion to the mean

A critical element of any evaluation mechanism will be a feedback loop that allows ongoing results to influence the design of the system, facilitating iterative improvements over time.

While PHM programmes can have a range of potential outcomes, and their success will not always be measured in purely financial terms, it is likely that some element of cost-effectiveness analysis will be required. A common approach is to identify a measure of success and plot the achievement of that goal against the incremental costs required to get there. Perhaps the most commonly used measure in health economic terms is the quality-adjusted life year (QALY).[27] Plotting the incremental QALY gains against the incremental costs can allow a PHM initiative to be compared to other interventions (or no intervention). This can also facilitate deciding whether pilot programmes justify proceeding to full programmes. For example, we can define an efficient frontier according to a predetermined threshold (e.g., 'we will only accept programmes that generate an incremental QALY less than X amount of money'). Comparing programmes B through F to programme A in Figure 8, we see that only programmes C and D have cost per QALY values below the threshold. Further, we see that even if the threshold were increased above X amount of money, then programme B would not be considered acceptable, as it is dominated by programmes C and D (i.e., programme B is less effective and more expensive than programmes C and D).

FIGURE 8: INCREMENTAL QALY VERSUS INCREMENTAL COSTS
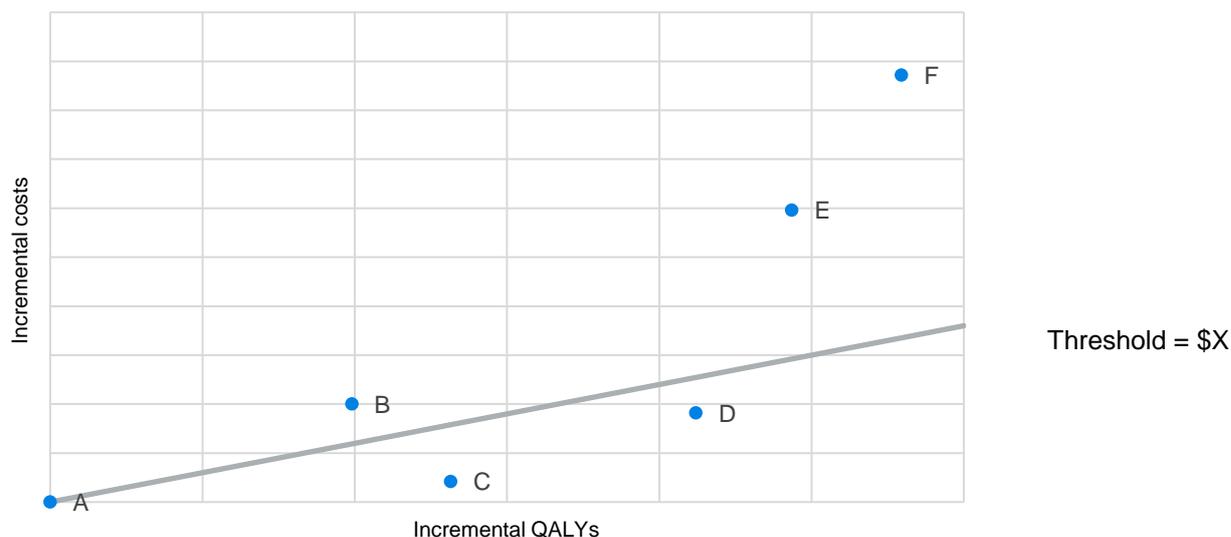
Challenges associated with using QALYs

Although cost-effectiveness analysis using QALYs is a common and widely accepted approach, it is not without its challenges. Concerns with using QALYs include ethical, methodological and contextual challenges.[28]

Another approach to cost-effectiveness analysis for PHM interventions is a return on investment (ROI) type model. A challenge of this method is capturing the full cost of any investment, and capturing the full financial

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27 According to the National Institute for Health and Care Excellence (NICE), QALY is 'a measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life.' See https://www.nice.org.uk/glossary?letter=q.

28 Pettit, D.A., Raza, S., Naughton, B. et al. (2016). The limitations of QALY: A literature review. J Stem Cell Res Ther. Retrieved 24 September 2019 from https://www.longdom.org/open-access/the-limitations-of-qaly-a-literature-review-2157-7633-1000334.pdf.

value of returns in terms of outcomes. This is a particular challenge in the context of PHM programmes where the determinants of health can be wide-ranging, and in particular the benefits of improved health outcomes.

Both cost/QALY and ROI approaches give widely varying results depending on the investment perspective taken and the range of costs and benefits accruing to different stakeholders that are included.

One interesting framework is the Social Return on Investment (SROI) model developed by Social Value UK.[29] This approach looks to identify the key stakeholders in any intervention and assign financial value to all outcomes, even those which do not have directly measurable financial outcomes. The approach has been adopted and adapted by many organisations including the World Health Organisation. Depending on the scope of a PHM intervention and the perspective of the body introducing the initiative, the SROI can be a very useful framework for assessing a cost-benefit analysis or for comprehensively evaluating the success of a PHM programme.

5. Conclusion

PHM is not easy. Key success factors of any PHM programme are to agree a definition and strategy, define goals and measurement, stratify the population, define and design interventions and measure success. Key statistical tools and technology can enable the process, but you must have suitably qualified staff and the right enablers. It is critical to understand how to operate a genuine feedback loop or continuous improvement cycle to capture the potential gains from a PHM approach.

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29 SROI Network (January 2012). A Guide to Social Return on Investment. Retrieved 6 August 2019 from http://www.socialvalueuk.org/app/uploads/2016/03/The%20Guide%20to%20Social%20Return%20on%20Investment%202015.pdf.

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Appendix 1: PHM Definitions

NHS England[30]	*'Population Health Management is an approach aimed at improving the health of an entire population and improves population health by data driven planning and delivery of care to achieve maximum impact for the population.'*
RAND Health Care[31]	*'The PHM model is characterized by three key principles: a focus on the health outcomes of the entire population; coordination of health and medical services through the continuum of care needs, from prevention and health promotion to curative care, disease management, and palliative care; and proactive management of care needs. PHM addresses health care needs from health and wellness to coping with the end of life, and encompasses all dimensions of health, including physical, mental, and social well-being.'*
David Kindig and Greg Stoddart in the American Journal of Public Health[32]	*Population health relates to 'the health outcomes of a group of individuals, including the distribution of such outcomes within the group. The field of population health includes health outcomes, patterns of health determinants, and policies and interventions that link these two.'*
Government of Canada[33]	*'Population health is an approach to health that aims to improve the health of the entire population and to reduce health inequities among population groups. In order to reach these objectives, it looks at and acts upon the broad range of factors and conditions that have a strong influence on our health.'*
US Centers for Disease Control and Prevention (CDC)[34]	*'CDC views population health as an interdisciplinary, customizable approach that allows health departments to connect practice to policy for change to happen locally. This approach utilizes non-traditional partnerships among different sectors of the community – public health, industry, academia, health care, local government entities, etc. – to achieve positive health outcomes. Population health brings significant health concerns into focus and addresses ways that resources can be allocated to overcome the problems that drive poor health conditions in the population.'*
The King's Fund[35]	*Population health relates to 'health outcomes of a defined group of people, as well as the distribution of health outcomes within the group. This means that health equity – the avoidable differences in health between different parts of the population – is a core part of understanding population health. Other terms, like population health management or population health care, are sometimes used interchangeably with population health. While the meanings of these terms aren't fixed, they are typically used to refer to a narrower definition of population health than the one we have described above – focusing more heavily on medical services and particular groups of patients.'*
NCQA[36]	*PHM is a 'model of care that addresses individuals' health needs at all points along the continuum of care, including the community setting, through participation, engagement and targeted interventions for a defined population. The goal of PHM is to maintain or improve the physical and psychosocial well-being of individuals and address health disparities through cost-effective and tailored health solutions.'*

30 NHS England, About the Health Systems Support Framework, op cit.

31 RAND (2015). Population Health Management and the Second Golden Age of Arab Medicine. Retrieved 6 August 2019 from https://www.rand.org/pubs/periodicals/health-quarterly/issues/v5/n1/01.html.

32 Kindig, D. & Stoddart, G. (March 2003). What is population health? American Journal of Public Health. Retrieved 6 August 2019 from https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.93.3.380.

33 Government of Canada, What Is the Population Health Approach? op cit.

34 CDC. What Is Population Health? Retrieved 6 August 2019 from https://www.cdc.gov/pophealthtraining/whatis.html.

35 King's Fund, What Does Improving Population Health Really Mean? op cit.

36 NCQA, Population Health Management Resource Guide, op cit.

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