Population Health Management
A Position Paper

21/11/2022

Prepared by: Catherine Hayes, MD, MPH, MRCGP, D Med Mgt., FFPHMI, FRCPI, FTCD.

Associate Professor in Public Health/Specialist in PH Medicine.

Table of Contents

Acknowledgements

The author wishes to acknowledge the following persons who gave generously of their time and whose contributions helped to shape the concepts, understanding and recommendations contained in this document.

Name	***Role and Organisation***
Prof Ronan Lyons	Professor of Public Health, Swansea University and Health Data Research UK.
Prof Iain Buchan	Executive Dean of the Institute of Population Health, Chair in Public Health at University of Liverpool and Clinical Informatics and Director of Digital Strategy and Partnerships for Liverpool Health Partners.
Prof Andrew Morris	Director, Health Data Research UK.
Mr David Seymour	Health Data Research UK, Alliance Executive Director, Health Data Research UK.
Dr Paola Quattroni	Alliance Delivery Manager, Health Data Research UK.
Dr Orlaith O'Reilly	Clinical Lead Integrated Care Programme HSE.
Ms Sarah Treleaven	Principal Officer, Sláintecare Programme Implementation Office, Department of Health.
Mr Andrew Hannigan	Assistant Principal, Sláintecare Programme Implementation Office, Department of Health.
Dr Sara Burke	Research Assistant Professor of Health Policy, Trinity College Dublin.
Prof Noel McCarthy	Professor in Population Health, Trinity College Dublin.
Members of the Health Intelligence team who provided feedback	National Health intelligence Unit.

Executive Summary

Population Health Management (PHM) is the concept of aggregating population data with data from multiple care and service settings, the analysis of that data into a single, actionable patient record, and using the insights gained to identify that population's specific health care needs and to develop a tailored response to them. This is to be brought about through use of data analytics, artificial intelligence and digital technologies, by stratifying populations according to risk of deterioration in health. This allows faster access to, and greater accuracy of, diagnostic tests and use of personalised treatment plans. Well-developed personalised interventions are key to better outcomes and cost savings, especially in populations with chronic diseases.

The PHM approach emphasises prevention. The overall aims of PHM are to improve the health and wellbeing of the population, the patient experience of care, to reduce healthcare costs, improve workforce wellbeing and engagement, and to address inequalities in health and care - the **quintuple aim.**

The PHM approach is geographically based. It uses historical and current data about people's health and use of health and social care services to design new proactive models of care which will improve health and wellbeing currently and anticipate future health needs. It involves communities and local people, the statutory health service and other public services including social services working together to join up services for people by sharing goals information and resources.

The core building blocks for successful implementation of PHM are **infrastructure** (shared vison and leadership, agreed governance structure, digital and data infrastructure and analytical capacity and capability), **intelligence** (opportunities to improve care quality efficiency and equity based on population health need) and **interventions** (care models focusing on proactive interventions to prevent illness, reduce the risk of hospitalisation and address inequalities). These capabilities should be present at different geographical levels to provide data driven insights; at **individual** level - to help personalise care according to need; at **neighbourhood** level (e.g. primary care networks) when care pathways and interventions can be considered; at **place** level (e.g. Community Health Networks (CHN) when PHM techniques should inform integrated care design and at **system** level when PHM techniques can inform strategic planning of large scale prevention or tertiary services (e.g. National/ Regions).

The key tools to target those in need are **Population Segmentation** where the population is split by any factor identified by needs assessment or known to be important for improving health outcomes (e.g. life course health status and age), and **Risk Stratification** where subpopulations are selected according level of risk (high, medium or low) of adverse events to enable tailored intervention packages to be developed and delivered by risk status. Changing workflows to optimise clinical pathways and to allow more interventions to take place in community settings is seen as crucial to effective PHM. PHM also places responsibility on the population to become more self-sufficient in managing their own care.

The linkage of data from electronic health records and claims as well as from patients and caregivers has become a key element in any PHM strategy. Ideally any PHM programme will be supported by a central database collecting information in relation to the demographics of the population interest, clinical and financial information, care management programmes, quality of care, patient satisfaction and access to care metrics. Although many countries have already adopted PHM, or are in the process of doing so the most developed examples of population management in action come from the UK. **NHS Digital** is the national body in the UK responsible for collecting, processing, and using data from across the NHS and social care including named data. The **Secure Anonymised Information Linkage** (SAIL) databank is a population linked service of anonymised data in Wales and provides access to multiple health and non-health datasets for research to drive population health improvement. Examples of how datasets were used during COVID-19 are provided. The **Health Data Research Alliance** is an independent alliance of over 50 leading healthcare and research organisations. Their goal is to establish and disseminate best practice for the ethical and responsible use of health datasets across the four UK nations thus creating a **Trusted Research Environment.**

Gaining the public's trust and the development of relationships between NGOs, statutory service providers and academic researchers have been the critically important factors. Strict access controls to the data, maintenance of the central population database by a trusted third party separate organisation and creation of an independent alliance of organisations who are dataset contributors and users have fostered acceptance among the public and professionals.

Seven centres of excellence (**Health Data Research Hubs)** have been set up with expertise, tools, knowledge and ways of working to maximise the insights and innovations developed from health data. These are mainly disease specific. They are led by academia and partner with industry, academic, NHS and charity organisations that hold data. All Hubs have used their data improvement efforts to support the NHS, academia and industry.

The success of PHM programmes depends on the accuracy of the risk assessments (for all levels of risk), the effectiveness of the selected interventions, the fidelity of implementation delivery and cost-effectiveness. Identification of people who are most likely to respond to interventions to improve health outcomes "impactability," without exacerbating health inequalities is also important to evaluate.

Challenges for the future advancement of PHM include better definition of the content of the segmentation analysis and the intervention steps, demonstration of its added value, in particular its cost-effectiveness, and aligning the rationale for action that underpins current efforts of customization. Regarding programme implementation, those programmes that are well-supported, funded and given sufficient time to develop are most likely to demonstrate impact.

Key opportunities to progress the PHM though the Irish health system are offered by:

(1) Development of a Population Based Resource Allocation model using a Population Segmentation approach 'Bridges to Health' by the Department of Health, as part of the Slaintecare Implementation Plan.

(2) The Integrated Care Programme for the Prevention and Management of Chronic Disease (ICP CD) in HSE. Within this programme, a Model of Integrated Care has been developed for individual chronic diseases. A sub part of the Care in the Community aspect of the Model is the GP Chronic Disease Management Programme (CDM). This is a specific programme where GPs are reimbursed to carry out specified chronic disease care for GMS patients only. Implementation of the Model of Care is part of the GP contract which has enabled data collection for the CDM. The CDM database is housed in the National Health Intelligence Unit (NHIU). A data governance structure is also in place. Stratification of the population in the CDM database into high medium or low risk of adverse health outcomes could be the key first step in the development of a database for PHM.

(3) Assessment of frailty prevalence is the first of 10 Steps of the Integrated Care Framework used by the Integrated Care Programme for Older Persons (ICPOP). This Clinical Frailty Index which has been validated in terms of predicting mortality and service utilisation by research using TILDA could be used to segment the CDM data into at risk groups by frailty category in persons aged 65 and older.

Many datasets other than CDM are also housed within the NHIU, including Health Atlas Ireland (a population geomapping of demographic census data including socioeconomic distribution, and service provision), HSE Primary Care Eligibility and Reimbursement Service (PCERS) data on drug utilisation and costs), Hospital In-patient Enquiry (HIPE) data on hospital discharges. Currently these datasets are stand alone. A unique Irish health Identifier (IHI) is currently available, in several national systems including the COVID 19 vaccination programme (COVAX), National Screening Services and Schools Immunisation programmes. Cross linkages may be possible through the Personal Public Service Number (PPSN) and the IHI. However this will require developing linking methods and trusted locations.

There is currently a basic infrastructure in place, in terms of data availability in a single location, to re-associate these datasets, at least the PCERS, HIPE and the CDM datasets and thus facilitate selection and testing of a risk prediction algorithm to stratify the population /population subsets into high, medium and low risk groups by health status. Re-associating data from PCERS, HIPE and CDM would enable personalised care planning by risk group and facilitate optimisation of medicines across several care providers. NHIU is familiar with these datasets and has developed a Health Support System (HSS) Concept and Design blueprint using Type II diabetes mellitus as a demonstration model to incorporate these and future datasets. Hence the potential to re-associate the PCERS, HIPE and CDM datasets for PHM could be realised. The IHI should be thought of as the primary re-linking methodology because it has several robust layers over and above PPSN, and has been specifically designed for this purpose.

A new governance infrastructure would be required and existing provider agreements would need to be renegotiated as an imperative to underpin the HSS. All relevant stakeholders (data providers, data users and potential beneficiaries) would need to be involved, a costing exercise carried out, and appropriate staff, tools, and technology made available to further develop the project.

In summary, the key success factors for any PHM programme are to agree a definition and a strategy, define goals and measurement, map the current status of PHM development, stratify the population, select a risk stratification algorithm using accessible datasets, define and design tailored interventions and measure success using appropriate indicators. The three domains, the people (suitably qualitied staff), the process (statistical tools) and technology are needed. An evaluation framework including feedback loops with key identified stakeholders or continuous improvement cycles need to be in place to capture the potential learnings from the PHM approach.

Key Recommendations

1. Opportunities to initiate a PHM programme in Ireland need exploration. As a starting point the current status of PHM development in the Irish health system in terms of its infrastructure, intelligence and intervention development, needs to be mapped to a Population Health Maturity Matrix such as that shown in Appendix 2. Documentation of the existing capabilities, (people, processes and technology), and training opportunities to develop PHM will be the initial step to determine future requirements, and to assess of the gap between current and future requirements.

2. The Department of Health is using 'Bridges to Health' to design a model for Population Based Resource Allocation (PBRA) as part of the implementation of Slaintecare. Representation from the Clinical Programmes in particular from the Integrated Care Programme for Chronic Disease (ICP CD) and the Chief Clinical Office on the DoH PBRA working group on would provide for greater synergy to progress PHM in HSE

3. Work needs to commence on review and selection of an appropriate risk stratification algorithm (see Appendix 5) which initially uses the existing Chronic Disease Management System housed in the National Health Intelligence Unit. The Clinical Frailty Index (CFI), currently used by the Integrated Care Programme for Older Persons (ICPOP to stratify patients according to their frailty level, could be used to segment the CDM data into at risk groups by frailty category in persons aged 65 and older.

4. A feasibility study of the data requirements for PHM and the processes needed to support this is needed in a selected CHN/CHNs and Chronic Disease Hub(s) Work has commenced on identifying and building alliances with academic, community and technology partners. TCD and St James's Hospital have received funding for a SMART D8 project in collaboration with the National Health Intelligence Unit, the new Community Structures and local community in D8 to define priority information needs and approaches to meeting these. This partnership could be a testing ground for all future PHM developments.

5. The Health Support System (HSS) Concept & Design developed by National Health Intelligence needs to be further explored as a blueprint for PHM and expanded to other available datasets to include, for example HIPE and PCERS in addition to CDM. CDM data will need to be geocoded if the data are to have a context geographically . The re-associated datasets will need to be aligned with stakeholder experience to

refine and validate the newly formed large dataset and tested to determine if the data can successfully stratify the population into low, medium and high risk of adverse health outcomes.

6. An overarching Steering Group to oversee the development of the HSS as a blueprint for PHM should be set up in early 2023 to examine governance, legal requirements, costs and resources required in terms of people, statistical tools and technology.

7. Alliances with academic, community and non-health care partners needs to be developed further.

8. Opportunities offered by the individuals and organisations contacted in the preparation of this document to provide guidance /collaboration should be availed of.

9. A system to provide continuous feedback /continuous quality improvement and an evaluation framework needs to be set up so that criteria to determine (cost) effectiveness are determined at the outset.

1. Purpose of the Position Paper

This document aims to provide an understanding of the essential components of population health management (PHM) from international literature, from the insights of those already using this approach and those who plan to use it. A mixed-methods approach was adopted in its production, namely a rapid review of the peer-reviewed literature, grey literature and the views of key leaders in the Irish and UK health systems.

It is directed primarily towards the Strategy and Planning function in HSE but will also be of interest to other functions e.g. Clinical Programmes and Strategy and Research. The Scope was provided by Health Intelligence to the author (Appendix 1). While the document largely follows the scope provided, it deviates when to do so would disrupt the flow of content.

2. Introduction - What is Population Health Management?

2.1 PHM definition/s.

What is meant by Population Health Management and how does it fit in to the wider system?

There are many definitions of Population Health Management (PHM). Different health systems and organisations across countries define population health and PHM in line with their own policy priorities and their health care and social care contexts. I have chosen the following example from the National Committee for Quality Assurance in the US.

"PHM is the 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 PHN is to maintain or improve the physical and psychosocial well-being of individuals and address disparities through cost-effective and tailored health solutions.

PHM is the concept of linking population data with data from multiple care and service settings, the analysis of that data into a single, actionable patient record, using the insights gained to identify their specific health care needs and to develop a tailored response to them. This is to be brought about by stratifying populations according to risk through use of data analytics, artificial intelligence and digital technologies. This allows faster access to diagnostic tests for prioritised subgroups of patients, more appropriate selection of diagnostic tests and use of personalised treatment plans. Well-developed personalised interventions are key to better outcomes and cost savings, especially in populations with chronic diseases. Using the data, service providers can track and hopefully improve clinical and psychosocial outcomes for clients at lower cost.

PHM is a patient centred data driven approach. Unlike disease management or wellness programmes, PHM is concerned with the total population of patients, ranging from those with minimal health risks to those who have complex health conditions. PHM aims to tailor a variety of interventions to patients based on their levels of risk (Hibbard, Greene, Sacks, Overton, & Parrotta, 2017). At an operational level, the goal of PHM is to slow the progression of risk in the patient population and at the same time to minimize the use of

costly health care such as emergency department (ED) use and hospitalizations (Healthcare Transformation Institute 2012).

2.1.1 Population health versus population health management

The key differences between population health versus population health management are presented in Table 1. The principal difference would seem to be delivery of pro-active tailored care to pre-defined at risk cohorts defined by data rather than a focus on addressing the wider determinants of health in the entire population.

Table 1 Population Health versus Population health Management

Population Health	Population Health *Management*
Is an approach aimed at **improving the health of an entire population.**	The approach improves population health by **data driven planning and delivery of proactive care to achieve maximum impact.**
Is concerned with improving the physical and mental health outcomes and wellbeing of people, while reducing health inequalities within and across a defined population. It includes action to reduce the occurrence of ill-health, including addressing wider determinants of health, and requires working with communities and partner agencies.	It includes segmentation, stratification and impact modelling to identify local 'at risk' cohorts – and, in turn, designing and tailoring interventions to prevent ill-health and to improve care and support for people with ongoing health conditions and reducing unwarranted variations in outcomes.

Source: Adapted from *NHS England, Public Health England, NHS Digital. Population Health Management Flatpack. A guide to starting Population Health Management*.

2.2 Overall aim/purpose/objectives of PHM.

There were three original overall aims of PHM, known as the **triple aim s**upported by the Institutes for Health Care Improvement which emphasise improving health and wellbeing, the patient experience and reducing costs. Since then two additional aims to address inequalities in health and care and improve workforce wellbeing and engagement have been added, the **quintuple aim** (figure 1).

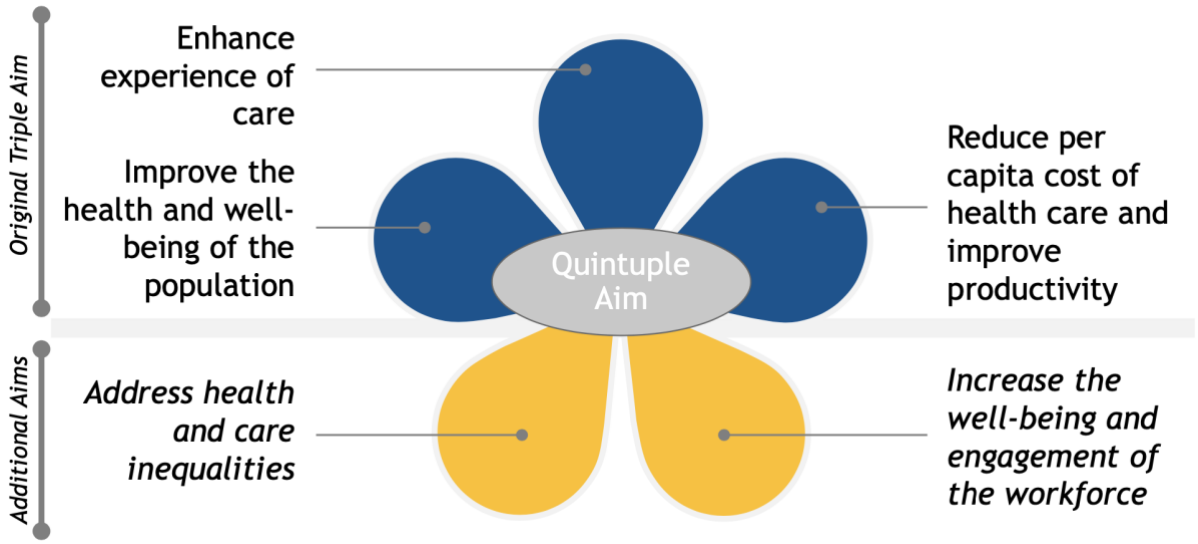


Figure 1. Aims of population health management.

Source: (NHS England, Public Health England, & NHS Digital, 2016)

3. How is PHN implemented/operationalised internationally

3.1 How is PHM delivered to the target community?

The PHM approach is geographically based. It uses historical and current data about people's health and how they are using health and social care services to design new proactive models of care which will improve health and wellbeing today as well as anticipating their health needs in the future.

PHM involves communities and local people, the statutory health service and may include other public services e.g. local authorities, schools, housing associations and social services working together to join up services for people by sharing information, resources and goals. This allows tailoring of services to the needs of people in each area, thus improving people's health, preventing illnesses, and making better use of public resources.

3.1.1 Using integrated data to improve population health in Leeds

The following is an example of how integrated care systems in the NHS use PHM (integrated health and care in action) to improve population health and well-being in Leeds (NHS, 2021).

In recognition of the significant and growing inequalities in Leeds the Clinical Commissioning Group (CCG) has an overall goal to be as good if not better than the average for England and to reduce health inequalities by 10% (Leeds Health and Care Partnership Executive Group (PEG), 2021).

Local community teams adopted a proactive PHM approach to select a sub-cohort of people living with frailty who were predicted to be most at risk of a deterioration in health and could therefore benefit most from proactive interventions. They used their knowledge of local needs to test and build on the initial insights from the data. They found that dementia, mobility and nutrition were all additional factors which compounded the risk of deterioration. The teams sought to address these through new anticipatory care models. They introduced a proactive assessment and triage service and then a range of personalised interventions including referrals to group 'live well' consultations, individual medical consultations in clinic and home visits led by an occupational therapist.

3.1.2 Measuring improvement

Figure 2 provides an overview of the three types of strategic measures proposed to date by Leeds CCG to achieve a 'Left Shift Blueprint'. The three types of measures are :

1. Health Outcomes as per the UK Healthy Outcomes Framework- these are long term over 10 years.

2. System Activity Metrics -these will provide a more immediate view of impact

3. Quality experience measures - these indicators should provide a view of a person's experience of individual services and also of their experience as they move between services in the health system also will also provide a more immediate view of progress. The integration measure will be the P3C-EQ experience measure. This is an 11 item tool designed to assess patient experiences of person centred coordinated care. This is currently being piloted as a system wide measure.

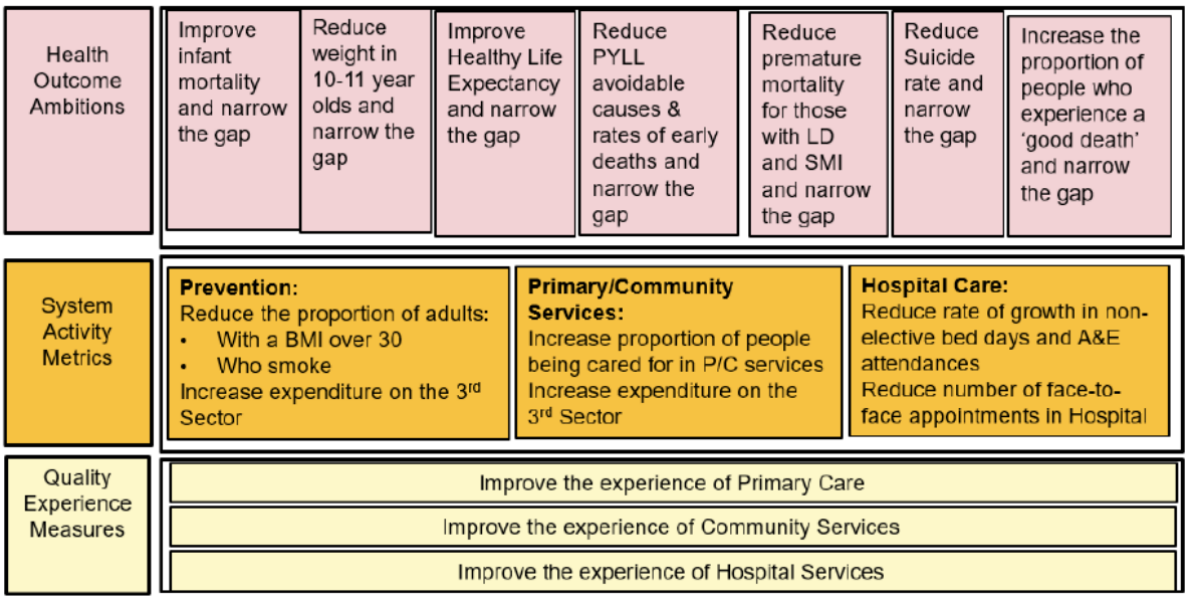


Figure 2: Health Outcomes, System Activity Metrics and Quality Experience measures proposed by the Leeds CCG

3.2 Experience of Countries adopting PHM

Many countries have adopted PHM or are in the process of doing so. Examples include UK, US, Spain, Netherlands, Lombardy (Italy) Finland, New Zealand and British Columbia. Some examples of this experience are provided here. Further examples are provided in Appendix 5.

3.2.1 Structure, funding and organisation of PHM

By far the most literature and hands-on experience of PHM comes from the UK NHS which provides healthcare to all UK citizens is primarily funded by the government and overseen by the Department of Health and Social Care. In 2016 NHS England required all health and social care organisations to join one of four geographically based sustainability and transformation partnerships (STPs). The main aim of these STPs was to encourage greater collaboration between organisations, agree systemwide priorities and plan together at how to improve health and social care. In some areas a new form of partnership emerged in 2018 in which some STPs were designated as integrated care systems (ICS). These geographically based models of care bring together primary, secondary, community and other health and care services working in close collaboration with local councils and others. By the end of 2018 NHS England had 14 ICS's of varying size and complexity.

The NHS long-term plan (LTP) published in January 2019 confirmed the policy shift towards integrated care and geographically based systems with ICSs expected to be the main mechanism to achieve this. The LTP expects the ICSs to provide a pragmatic and practical way of delivering the " **triple integration**" of primary and specialist care, physical and mental health services, and health and social care. It also expects a single Clinical Commissioning Group for each ICS to make shared decisions on population health, service redesign and long-term implementation plans. Payment system reforms will move funding from activity based payments to population-based funding.

More recently the NHS, Public Health England and the more recently established NHS Digital have produced an interactive guide (flatpack) to starting PHM which is freely available to users (NHS England et al., 2016). The flatpack aims to help organisations at the start of their PHM journey. It comprises the following:

- An introduction to PHM and how it fits into the wider health system (above)
- An overview of the core building blocks for successful implementation of PHM
- An overview of intelligence requirements for PHM including approaches and links to resources for understanding population need and identifying and targeting those who will benefit from interventions
- A guide to finding effective interventions and ensuring evaluation is embedded into PHM processes to understand impact
- Case study examples in addition to published evidence to support materials
- An overview of how PHM and personalised care work together.

The top line points of these elements are now briefly discussed. Further detail is contained in the flatpack.

3.2.2 Core building blocks for successful implementation of PHM

The Flatpack identifies three core building blocks, **infrastructure,** (the basic building blocks which must be in place) **intelligence** (opportunities to improve care quality efficiency and equity) **and intervention** (care models focusing on proactive interventions to prevent illness, reduce the risk of hospitalisation and address inequalities) for successful implementation of PHM. These capabilities should be present at different geographical levels though the purpose and process will differ according to four population groups (levels):

At **individual level P**HM can be used to help personalise care according to need

At **neighbourhood level** care pathways and interventions can be considered - suggested population 50K (approximately equivalent to a **Community Health Network** (CHN) in the Irish health system)

At **place level** PHM techniques should inform integrated care design -suggested population 250 to 500,000 (roughly equivalent to an existing Community Health Organisation (CHO) in the Irish health system)

At **system level** PHM techniques can inform strategic planning of large scale prevention or tertiary services - suggested population 1 million (roughly equivalent to a Regional Health Organisation (RHO) in the Irish health system).

PHM is the cycle that drives action by providing **data driven insight**, informed by system, place, neighbourhood, and individual needs.

Additional resources include a PHM maturity matrix, a tool which organisations may use to plot their current status in terms of PHM development and to assess their progress across core PHM components. (Appendix 2). A UK National Performance and Population Health Dashboard is under development.

3.2.2.1 PHM Infrastructure

Organisational leadership and leadership in technology with clearly defined roles and responsibilities were key requirements identified for a connected IT infrastructure. Digital technologies and technical support were identified as essential ingredients for collection, analysis and sharing of data along care providers. A robust governance framework was also a core requirement including a citizen opt out standard, data and cyber security standards. Shared health and care records were identified as a key stepping stone to PHM.

The key elements of infrastructure are:

- shared and effective leadership,
    - shared vision and collective understanding

- defining the population in question
    - population profiling
- having an agreed information governance structure
    - transparency,
    - adequacy of what data is shared,
    - data sharing agreement in place
- basic elements of digital and data infrastructure in place
- capacity and capability
    - Understand the analytical capacity and capability already within the system and the future analytical capabilities required.

Advanced actuarial analytics and informatics capabilities have been identified as key to design effective robust risk stratification and to monitor population health over time.

Machine learning and cognition analytics of structured and unstructured data together with patient profiling (Appendix 4) and risk stratification (Appendix 5) can provide additional insights .

3.2.2.2 PHM Intelligence

Once the right infrastructure is in place, the first step in the intelligence process is to understand population health need, including unmet need. This is then followed by use of tools and techniques to align need with effective interventions.

3.2.2.2.1 Understanding population need -Three Steps

The essential steps in conduct of a population health needs assessment (HNA) are as follows:

1. Collate and present data on population need - Population Health Profile
2. Critically review the data in the context of the system - System Level Workshop
3. Prioritisation of Need.

A comprehensive guide to conducting a population HNA is found in Cavanagh and Chadwick (2005).

3.2.2.2.1.1 Population Health Profile

The HSE NHIU have produced and continue to develop population health profiles via Health Atlas for the 96 CHN's and 19 priority areas defined as disadvantaged by Slaintecare (Slaintecare Healthy Communities).

An example of a draft population health profile produced in Health Atlas which may be used to determine population health need in Community Health Network Inishowen (approximate pop. 35,500) is shown in Appendix 4. The profile consists of census demographic and socio-economic data for 2016 and demographic data projected to 2022 for the CHN and comparative national data. It also includes draft estimates of risk/benefit factors from Healthy Ireland data and estimates of morbidity using TILDA data. Key findings demonstrate a higher proportion of people over 65 which is projected to increase in 2022 and greater levels of socio-economic disadvantage in comparison with national figures. The findings therefore suggest a higher level of need for GP, public health nursing and therapy services and potentially greater demand on hospital services than the average national requirement which must be accounted for in workforce and service planning.

The HSE Primary Care Unit is currently leading a major drive to engage HSE personnel in the usage of population health profiles.

A guide to completing a community profile and HNA for Irish Public Health Nurses was recently produced by UCC and HSE (Mulcahy & Downey, 2021).

3.2.2.2.1.2 System (RHO) Level Workshop

The next step is to hold a workshop to consider the quantitative and qualitative insights from across relevant partnerships on to obtain clinical and service user perspectives on priorities in terms of population need. Even if planning at CHN level it is important to obtain the systems perspective so that needs can be aligned with health system priorities and current availability of data.

3.2.2.2.1.3 Prioritisation of Need

Ideally 3-5 priority areas should be identified through the above processes.

3.2.2.2.2 Opportunity analysis

Once a needs assessment is complete, opportunity analysis can be undertaken by Public Health Departments to determine which areas of focus might best meet the current organisational and population requirements. An opportunity analysis uses the data to identify opportunities to improve the quality, efficiency or equity of the care being delivered. Outputs from a needs assessment should be combined with opportunity analysis to produce areas of focus that can deliver improvements in defined population health outcomes.

The following are examples of opportunity analysis:

- Detecting unwarranted variation within the system / between the system and its national (and international) peers
- Duplication analysis (e.g. which service users are receiving the same interventions twice?)
- Gap analysis (e.g. which evidence based practice(s) are not being followed at a population level?)
- Weighted gap analysis (e.g. weighting these gaps according to importance)
- Quadruple Fail analysis (e.g. which events are occurring in the population that are simultaneously high cost, low quality, represent a poor patient experience and may lead to increased inequalities) and the distribution of these events across the population.

3.2.2.2.3 Tools to target those in need- Population Segmentation and Integrated Care.

The current health care system essentially segments the population according to the setting in which a service is provided e.g. community care, hospital care, nursing home population, and it is funded on that basis. A practical alternative, widely used in other industries such as the insurance industry, is to stratify the population into groups that are sufficiently homogeneous to enable arranging a set of commonly needed supports and services to meet their expected needs.

Population Segmentation involves splitting the population by any factor identified by the needs assessment or known to be important for improving health outcomes e.g.

- Life course segmentation combining health status with age e.g. children/adults/older people healthy/living with long term conditions and disabilities
- Segmentation by frailty
- Segmentation by end of life care.

Integrated care aims to organize care around the patient instead of the provider. Three levels of integration have been described in the literature: macro-, meso-, and micro-level integration (Vuik, Mayer, & Darzi, 2016). For each level, a corresponding population segmentation strategy can be identified. (See Appendix 5 for further detail).

3.2.2.2.3.1 Macro-level integration

Macro-level integration applies to the entire population. The 'Bridges to Health' model is a person-focused whole population segmentation approach, with the principal goal of 'pursuing the health of each population segment' (Outcomes Based Healthcare, 2016). The 'Bridges to Health' tool segments the entire population into eight core groups, shown in Appendix 5.

A relatively recent systematic review identified 16 unique tools used in healthcare settings to inform needs-based population segmentation. These tools, nine of which were validated by peer review, helped to inform the development of population-level health service programmes (Chong, Lim, & Matchar, 2019). Some tools were proprietary and some custom built. The underlying segmentation basis of most identified tools was found to be conceptually comparable to each other. Many but not all required a comprehensive medical record (EMR). The three validated tools not requiring an EMR were post-hoc segmentation analysis of datasets. All three tools utilised self-reported disease status or unmet need.

'Bridges to Health' was the only non-validated tool not dependent on a comprehensive EMR. In this segmentation scheme, patients are placed into the segment which best characterises their overall healthcare needs. Although based on a relatively subjective assessment of medical and health-related social needs, it benefits from strong face validity among clinicians because of its ability to characterise the various typical types of patients that exist in any population and has been used widely e.g. in the Netherlands (Eissens van der Laan, van Offenbeek, Broekhuis, & Slaets, 2014) and US (Zhou, Wong, & Li, 2014).

There is emerging international evidence of use of the model, or close variants for the purposes of PHM approaches. The North West London, London Health Commission (NHS North West London Whole Systems Integrated Care), uses eight segments divided into three distinct age groups. While a number of countries have adopted population based resource allocation (PBRA) to date no documents evaluating its impact have yet been produced although there is some evolving research in this complex area.

Population Segmentation in the Irish context

The Health Foundation group at TCD have worked with the DoH and HSE NHIU under a Health Research Board Applied Partnership Award on a project involving two main components

(i) to inform the design of the new proposed regions (now complete) and

(ii) a current work package which examines PBRA.

Approaches to PBRA may be a data heavy or involve a more holistic approach which is expert based e.g. those involved in maternity and child health datasets. DOH favours the latter approach.

The Slaintecare implementation plan refers to piloting a PBRA model within 19 healthy community areas (Government of Ireland, 2021b). Health budgets are not area targeted at present.

The PBRA model being developed at DOH is based on the 'Bridges to Health' Model to address the needs of the entire population divided into the eight segments (Appendix 5). Testing of the PBRA approach will be necessary in terms of how it will affect each population segment. The segment of most concern is chronic disease. The Project Implementation Group has representations from HSE Health Intelligence and Strategy and Planning. The group would also welcome involvement from the Clinical Leads and the CCO's office.

A Workforce Planning Task Force in the DoH is underway to develop a population based approach to planning in terms of workforce resources and the planning of service provision within the workforce i.e. the WTE's needed (rather than discipline-specific) and the training required.

In terms of costs, the Economic and Social Research Institute (ESRI) are conducting work on the acute cost per segment and the per capita cost on a multi annual basis. The Irish Government Economic Service will work on the continuing costs.

Timelines.

A first pass at the metadata will soon be available for consultation and communication. It is expected the outputs of the workforce planning group will be completed within 18 months.

In terms of costings, capital funding is tied to the National Development Plan who are keen to prioritise the process. On the revenue side, applied costings are expected to be available to influence the next budget

It is expected that the pilot testing of the resource allocation will be directed initially to hospital groups and CHOs rather than the regions, until the governance structure for the regions is finalised, to avoid duplication.

3.2.2.2.4 Tools to target those in need-Risk Stratification and Integrated care

3.2.2.2.4.1 Meso level integrated care models

Risk stratification involves identifying those in the segmented groups who are at risk of future adverse events. Meso level integrated care models focus on specific sub populations and use segmentation to choose the sub population. An example would be those living in care homes who are at risk of emergency hospital admissions.

The ValCronic-CARS pilot program in Spain (Advancing Integration for a Dignified Aging (AIDA), 2013; Vuik et al., 2016), programme was initiated by the Health Agency of Valencia, Spain, and Telefónica with the aim of integrating and improving care for a subpopulation of patients with long-term conditions using telemedicine The ValCronic programme depends on a shared electronic primary care record which brings together demographic data, vaccinations information, prescribing and hospital discharges data. The pilot programme segments patients into three risk levels: High risk (level 3), patients with more complex and frequent comorbidity; Medium risk (level 2), low complexity with respect to their comorbidity; and Low risk (level 1), chronic patients in early stages, using a Community Assessment Risk Screen score, which predicts a patient's risk of hospital admission based on three simple criteria:

- having had a hospital admission in the previous six months,
- the number of long-term conditions,
- and having five or more prescriptions.

The score can be easily calculated from routine data in the EHR and the method is free to use. In addition to the patient risk score, the segments are also defined by the presence of four long-term conditions: type 2 diabetes, chronic obstructive pulmonary disease (COPD) heart failure, and hypertension which were identified as posing the highest risk. This segmenting by condition allows interventions to be developed for a specific condition, and adaptations for different combinations of conditions, which addresses multimorbidity.

In practice, the segmentation is used to deliver a highly tailored telemonitoring and education intervention (Vuik et al., 2016) (See Appendix 5 for further detail).

Meso level Risk Stratification in the Irish context

Assessment of frailty prevalence is the second of 10 Steps of the Integrated Care Framework used by the Integrated Care Programme for Older Persons (ICPOP). This categorisation has been adapted from work by O'Halloran et al. on The Irish Longitudinal Study on Ageing (TILDA) (2017) (Figure 2).

The Clinical Frailty Scale (CFS) has attracted interest because of its simplicity and because it includes consideration of multiple relevant dimensions, including multimorbidity and degree of symptom control, mobility, physical activity, help with activities of daily living, dependency, and cognition (O'Halloran et al., 2021)..

The CFS has been validated in people over 65 years in the Canadian Health Study of health and Aging in terms of predicting mortality and service utilisation across settings (O'Halloran et al., 2021; Rockwood et al., 2005). Recent research (Theou et al., 2021) has resulted in development of a classification tree to assist with routine scoring of the CFS.

Researchers at TCD have recently applied the CFS classification tree to data from TILDA and correlated it with the distribution of health and social care utilisation by the nine CFS categories which ranged from CFS1 Very fit to CFS7 Severe Frailty (O'Halloran et al., 2021).

No participants were 'very severely frail' CFS8 or 'terminally ill' CFS9 as TILDA is a sample of community dwelling adults. CFS transitions over time were also examined (O'Halloran et al., 2021).

Increasing CFS categories were associated with elevated use of hospital and community health services and formal and informal social care provision. Transitions over time suggested CFS transitions are dynamic, with a two-year probability of transitioning from 'fit' (CFS1-3) to 'vulnerable' CFS4), and 'fit' to 'frail' (CFS5+) at 34% and 6%, respectively. 'Vulnerable' and 'frail' had a 22% and 17% probability of reversal to 'fit' and 'vulnerable', respectively.

The CFS classification tree could be used to segment the CDM data into at-risk groups by frailty category in persons aged 65 and older.

Figure 2. Risk stratification based on frailty prevalence. *Source:* Integrated Care Programme https://www.icpop.org/integrated-care-framework#gref

3.2.2.2.4.2 Micro-level integrated care models

Micro-level integrated care models require high risk patients to be identified. A district health board in New Zealand (Love, Swansson, & Whelen, 2014; Vuik et al., 2016) is in the process of an ambitious system integration programme, which aims to integrate services across primary, secondary, and community care. The health board has introduced a risk-stratification procedure to identify individuals at risk of unplanned emergency admissions in the next six months. The risk algorithm stratifies patients into two groups: patients at very high risk, who receive intensive care management, and those at risk who are assigned a care coordinator from their local practice. To develop this risk algorithm, a one-off anonymised linked data set was created from a large range of sources, including patient registries, primary care consultation data, and hospital care data. An automated risk score in the e-summary health record, and personal care plans may be viewed by providers across the system. The data governance and information technology requirements related to this data provision are currently being addressed. (See Appendix 5 for further detail).

3.2.2.2.5 Other tools

3.2.2.2.5.1 Impactability modelling

The concept of "impactability" introduces the idea that risk stratification approaches should not just identify people at high risk for a health event, but also people who are most likely to respond to interventions to improve health outcomes (Lewis., 2010). Impactability modelling is used to indicate what preventive intervention would be best performed, on which cohort, by whom, and how in order to maximise impact (see Section 6.2 Evidence of impact and critical success) for further discussion.

3.2.2.2.5.2 Other tools for smaller populations

Other tools (for smaller populations e.g. PCNs or individual GP practices) include:

- Threshold Models e.g. patients aged 65 or over who have experienced two or more unplanned admissions in the previous year
- Clinical experience
- Gap analysis - e.g. high-risk patients whose care appears suboptimal such as a patient with heart failure who had not been offered beta-blocker medication despite having no contraindications.

3.2.2.2.6 Impact assessments

Once the PHM intelligence is complete the next step is to conduct a series of impact assessments to include:

Equality Impact Assessment – to ensure the proposal will not inadvertently worsen health inequalities e.g.

- Strategic Health Asset Planning and Evaluation (SHAPE) is a web enabled, evidence based application designed to inform and support the strategic planning of services to
    - Support evaluation of the impact of service configuration on local populations
    - Provide intelligence to help assess the optimum location of services.

Financial Impact Assessment – to ensure that the proposed intervention is cost-effective and affordable for the population cohorts identified. There are three key drivers for modelling the financial impact of an intervention:

- Risk threshold (e.g. centile rank)
- Effectiveness of the intervention (% of population impactable)

- Cost of the intervention (per person)

Ethical Impact Assessment – to ensure that the proposed intervention will not cause more harm than good

3.2.2.3 PHM Interventions (flatpack)

The next step is to build from the learnings of the analytics to make decisions on the services provided to the public; identifying effective, evidence-based **interventions** and **implementing** them. The following key factors are involved:

3.2.2.3.1 Implementation of Effective Interventions

The following factors need to be considered for effective interventions to be successfully implemented:

- Design care models, interventions and implementation plans based on evidence to target priority patient groups
- The process is not necessarily about making wholescale changes, rather where services can be adapted or tweaked so they are more relevant and useful for the local population e.g.,
    - Social prescribing (a short-term intermediary services that facilitate patients with psychosocial needs to engage in non-clinical support) (Kilgarriff-Foster & O'Cathain, 2015)
- Flexibility is needed to avoid exacerbating health inequalities.
- Multiple interventions may be needed or to think about interventions at system, place, neighbourhood or individual levels e.g.,
    - System level, outputs from needs assessments, predictive modelling and impactability tools can highlight population level need or gaps in care
    - Individual level analysis may lead to identification in population level gaps in care e.g. where individuals who are identified as being at high risk but not receiving effective interventions. This might be for a number of reasons which in turn may lead to a number of differing needs.

At both a system and individual level, the next step is to match up effective evidence- based interventions with the gaps in need.

3.2.3 Workforce

Changing workflows to optimise clinical pathways and allow more interventions to take place in community settings is seen as crucial to effective PHM. PHM is contingent on strengthening and delivering primary care at scale. Hence there is a need to understand the impacts that interventions will have on the workforce and plan accordingly, leveraging

resources across the system and tiers to fill gaps and identify further gaps and define any new roles.

System Dynamic Modelling (SDM) is a methodology where cause and effect variables are arranged into a causal loop diagram that are connected by arrows denoting their causal influence. Each causal link is assigned a polarity, either positive (+) or negative (-) to indicate the relationship between the dependent and independent variables. A prime example of its use in workforce planning (Sterman, 2001).

With SDM organisations are able to use their population health data (specifically their needs analysis over the next five, 10 and 15 years) and model different scenarios in terms of the composition of the workforce to meet the forecasted flux in population needs. Using SDM, the workforce is modelled around the population's health needs rather than the number of people within the population. The other advantage of SDM is that it is competency-based and not profession-based.

As part of the Irish Slaintecare project on PBRA modelling, (see Section 3.2.3.2.3.1.Population Segmentation In an Irish context), the Department of Health (DoH) Human Resources section is currently examining the workforce requirement for implementation of its workforce SDM. An SDM report for the nursing profession was recently completed to address the the central role of the nursing workforce in improving health and wellbeing and expanding the primary, community and social care sectors as part of the implementation of Slaintecare (Caulfield, Hynes, & O'Connor, 2022).

3.2.4 Patient Empowerment and Activation

PHM also places responsibility on the population to become more self-sufficient in managing their own care through prevention, education and improved adherence to medication.

Patient activation operates at three broad levels:

- The whole population where the aim is to support them to stay well or to make informed decisions if health needs change
- those with long-term physical conditions (30%), where the aim is to provide the support needed to help them manage their condition
- those with complex needs (5%), where the aim is to ensure individuals receive co-ordinated support through a joined up, integrated approach.

Patient activation interventions include :

- adoption of digital and remote monitoring technologies
- improving health literacy of patients
- self-care programmes including social prescribing

- personal health budgets
- health champions and local area care coordinators.

Greater patient responsibility will require enhanced evidence based case management and robust analytics to measure the impact of interventions and outcomes for patients.

3.2.5 Personalised care interventions

PHM data lead through active targeting of rising risk individuals. Personalised care interventions are based on proactive personalised conversations with people which focus on delivering the outcomes that matter most to them, paying attention to their clinical needs as well as their wider health and well-being. Shared decision making enabling choice and supported self-management are key elements of personalised care interventions.

3.2.6 Care Integration

Much of the change effort needed is by making the system data-led and heading towards data driven leadership. As well as the insights from the data, it is critical to engage with other key stakeholders e.g. clinicians, analysts and managers when making decisions to transform local care. Getting front-line staff to drive initiatives forward, getting buy-in from the start of the analysis period is critical to successful implementation.

Staff and patients therefore need to be involved in co-designing:

- Clinician and patient decision-support tools at the point of care
- Prevention services for cohorts of patients at risk of adverse outcomes
- Shared care records across the continuum of care.

3.2.7 Evaluation

Ongoing monitoring and evaluation is required to ensure the programme being implemented remains fit-for-purpose as the population evolves and changes. The type of evaluation needs to be decided upon, process (implementation), outcome and impact.

Key steps are:

- Define key indicators and outcomes to be measured and evaluated for success
- Evaluate impact against agreed indicators and outcomes, and whether any changes are needed.

The NHS LTP expects that by 2021-22 there will be systems to support PHM in every ICS. However they recognise that moving the mindset from a reactive approach to a proactive model of care for population health is a big challenge. It will require significant culture change, new financial incentives and performance metrics. It will also require investment in smart technology and new skills and talent.

3.2.8 Modelling the impact of interventions

The modelling approach allows the impacts of the interventions to be quantified in relation to population segments. Resource allocation and operational plans can be formulated in terms of the population segments (See Bridges to Health Model and other examples **(Appendix 5).** Specialised statistical and data analytical capacity will be required to do this.

3.3 Implementation of Slaintecare and Healthy Ireland

See Sections 3.2.3.2.3.1.Population Segmentation In an Irish context and 3.2.4 Workforce.

4. Health intelligence requirements for PHM

The need to align technology with effective processes and stakeholder engagement is essential for success.

4.1 What health analytics are used – advanced modelling?

See sections: 3.2.2.2.3 Tools to target those in need - Population Segmentation and Integrated Care and 3.2.2.2.4 Tools to target those in need - Risk Stratification and Integrated Care and Appendix 5.

Tools to target those in need, Modelling the impact of interventions and Appendix 3.

4.2 Information systems underpinning PHM

The information systems which underpin the use of PHM for service planning in the NHS and the anonymised datasets used by researchers to inform policy and planning by government and NHS are covered in this section.

4.2.1 Role of the electronic health record, longitudinal record community and/hospital

The integration of data from electronic health records and claims as well as from patients and caregivers has become a key element in any PHM strategy. Visualization of the most appropriate data at the right time and place, in the most appropriate format can make the difference between effective use and poor use of data (Fields & Gandhi, 2019). Ideally any PHM program will be supported by a central database collecting information in relation to the demographics of the population interest, clinical and financial information, care management programmes, quality of care, patient satisfaction and access to care metrics. Most PHM tools require a complete standardised and consistent dataset for the population of interest for a reasonable period of time; Millman Actuarial suggest at least one year (Buckle et al., 2019).

4.2.2 NHS Digital

NHS Digital is the national body responsible for collecting, processing and using data from across the NHS and social care including named data . It is the data and technology partner

of the NHS in England and was set up by the Health and Social Care Act 2012. NHS Digital ensures patient information is protected, and can be shared legally and used safely to improve health and care. There are very strict rules about who can access confidential patient information, how it must be protected and what it can be used for.

Before information is shared with other organisations, they must satisfy a Data Access Request Service that they will store it safely and legally, and they have a good reason for using it that will benefit health and care. All data releases are notified through a data release register.

4.2.2.1 Functions of NHS Digital

NHS Digital functions are as follows:

- To run and manage computer systems that link different parts of health and care together and give health and care professionals the information they need
- To provide apps, websites and services to give public and patients control over your own health and care
- To collect specific health and care data to check how the health and care service is performing and to improve care.

Data are collected from the following settings:

- GP surgeries
- Hospitals
- OPD clinical
- Labs that provide results of tests
- Clinical commissioning groups who organise care
- Organisations that NHS works closely with e.g.
    - care homes
    - social care agencies providing home care
    - local authorities who organise and fund these types of care.

NHS Digital also links with the Department of Health and Social Care and Public Health England.

4.2.2.2 NHS Digital Services

Services provided by NHS Digital consist of the following:

Information for improved care:

- A central IT service (he NHS Spine) links the client record to the NHS number and makes sure this important information is never lost, regardless of where the patient is treated
- Vital medical information including medicines and allergies is recorded in a Summary Care Record
- Call -recall system e.g. for routine screening.

Information for self-management and improving access to care. This is provided via the:

- NHS website
- NHS App – for people to access services e.g. appointments
- Electronic Prescription Service
- E-Referrals service.

4.2.3 Data Visualisation

4.2.3.1 Fingertips

Fingertips is a web-based national UK platform under the auspices of Public Health England that provides easy access to a rich source of indicators across a range of health and wellbeing topics. Data are organised into thematic Public Health Profiles, all of which can be accessed via: https://fingertips.phe.org.uk. These Profiles were designed to support Joint Strategic Needs Assessment and commissioning, as well as to improve the nation's health and wellbeing and reduce inequalities. The Profiles enable one to:

- Select indicators at different geographical levels
- Benchmark against the regional or national average
- Export data, tables and images to use locally.

Examples of Profiles are:

- National General Practice Profiles
- Public Health Outcomes Framework
- Productive Healthy Aging Profile

- Wider Impacts of Covid-19 on Health (WICH). This tool uses near real time data to monitor indicators of potential impacts on health during the COVID-19 pandemic.

4.2.3.2 NHS England National Performance and Population Health Dashboard

The NHS England National Performance and Population Health Dashboard is currently under development by a new NHS organisation, The North East London Commissioning Support Unit (NEL-CSU) which provides expert support and advice in building databanks in the UK. They are the working in partnership with Cerner US, alongside Imperial College Health Partners and Optimedis Cobic UK, (an organisation that provides support for local health and care partners in delivering integrated care systems), to deliver a cloud based platform that can collate data from various entry points including electronic patient records which will be used by the ICSs in England. Its stakeholders include all of the NHS organisations, who support ICSs, Public Health England and Local Authorities. The dashboard will encompass all of the existing datasets in use including fingertips and be responsive to user need. The end-product is intended to be "an interactive, easy-to-use dashboard" that will help ICS sites to benchmark their performance and understand the impact they are making and to track, predict, intervene and manage conditions more cost-effectively.

4.3 Health intelligence requirements for implementation of PHM

The following health intelligence data requirements for implementation of PHM are based primarily on the experience of Prof Ronan Lyons, Chair of the COVID-19 set up by the Welsh Government to provide rapid assimilation of available evidence from multiple data sources and guide analysis of data to inform policy development and appraisal (The Lancet Digital Health, 2021) Technical Advisory Group (TAG).

The Secure Anonymised Information Linkage (SAIL) databank (www.saildatabank.com) has existed in Wales since 2008, based at Swansea University. It is a population linked service of anonymized data. SAIL holds and provides access to linked de-identified data from multiple sources at individual, household and multiple ecological levels, for the population of Wales. It is funded by Medical Research Council, Economic and Social Research Council and the Welsh Government. It is designed to safely provide a means of linking together all person-based data within Wales for use in research and public-benefit enquiry. It collates population-scaled life stories from datasets across time and across organisations. While the initial focus was on health, this now broadened into wellbeing and local and central government data – to include social justice, housing, education, policing, employment, etc. Its purpose is to support evaluation of natural experiments (i.e. policy and service changes); epidemiology; "e" and hybrid cohort studies; intervention studies (clinical trials); system modelling and many more.

An example is where demographic data (Wales Demographic Dataset) is linked is to census data on ethnicity (which is properly coded), and education data. This linkage has allowed Public-Health Wales (PHW) to measure infection rates and uptake of COVID-19 vaccine in ethnic groups in education settings which is a major advantage for PHW.

All applications to use SAIL must be approved by an independent Governance Review Panel.

4.3.1 Role of unique patient identification

The original demographic data for SAIL comes from the NHS. In the UK every person has a unique NHS number. The NHS register consists of a Personal Demographic Spine of names, addresses and dates of birth. The population register is maintained by the recently established Digital Health and Care Wales, (formerly National Wales Information System), a Trusted Third Party separate organisation. They match on names and addresses and create an anonymous population database for others to use. Where names and addresses do not match they use deterministic or probability matching. The NHS numbers are then encrypted and the dataset can then be linked to other data sets. A similar highly effective integrated national Electronic Health Record, AORTA exists in the Netherlands.

4.3.1.1 Individual Health Identifier (IHI) In Ireland

The Health Identifiers Act 2014 was the first step in the creation of an Individual Health Identifier (IHI) in Ireland and describes what the IHI record for every person who uses the health services is allowed to contain. The HSE (e-health Ireland) has been assigned to build and operate the IHI Register of unique health identifiers that will be used across health and social care systems which will allow unique identification of an individual on the basis of their personal data. It will not contain medical data. The proposed Electronic Health Record (EHR), will rely upon the IHI as the cornerstone for unique and safe identification of patients. However, implementation of the IHI and EHR at a national scale has yet to be realised.

The COVID-19 pandemic highlighted several deficiencies in the availability of Irish health data for decision-making to provide rapid responses at the onset of the pandemic. However the experience of COVID-19 also provided the opportunity for the rapid introduction of many new health technology features to aid the response to the pandemic (Walsh, Mac Domhnaill, & Mohan, 2021). Moreover, pre-existing eHealth tools, such as e-Prescribing and eReferrals, and telemedicine were increasingly adopted during the pandemic. New technologies emerged such as cloud based data lake platforms to collect and collate COVID-19 data, the COVID Care Tracker, and the artificial intelligence-based Health Chatbot to triage suspected COVID-19 cases. The IHI has has now been incorporated into COVAX , national COVID vaccination programme register which is now the single biggest national population dataset (Walsh et al., 2021).

4.3.2 Role of data linkage (re-association).

SAIL is constructed on a split file principle where demographic data and clinical/other data are linked using a link key and then deidentified and further encrypted. Data linkages on health data could include, ED attendance, Hospital Admission, Outpatient attendance , General Practice contacts, correspondence, prescriptions, diagnostics. The types of data include structured and unstructured data e.g. medication instructions, paper clinical notes, out-of-pocket expenses. Digital Health and Care Wales uniquely matches identities to an Anonymised Linkage Field (ALF) and residences to a Residential Anonymised Linkage Field (RALF) before uploading data to SAIL (Lyons et al., 2020).

Example 1

(Thompson et al., 2021) set up a national e-cohort (n=464531) study using anonymised linked data for pupils, staff and associated households linked via educational settings in Wales to estimate the odds of testing positive for SARS-CoV-2 infection for staff and pupils over the period August– December 2020. The e-cohort was created using anonymised linked data held within the (SAIL) Databank. The primary health cohort was the Welsh COVID-19 e-cohort, which consists of all people alive and known to the NHS in Wales on or after the 1 January 2020. To this core, they linked the School Workforce Annual Census, the Pupil Level Annual School Census and finally COVID-19 antigen testing data to the cohort. The results improved understanding of likely transmission pathways into and through educational settings.

Example 2

Lyons et al (2020) describe the development of two population-based cohorts in Wales, derived from multiple data sources to provide near real-time, in-pandemic, intelligence and analytics to TAG (Lyons et al., 2020). The primary objectives were:

1. to determine the risk factors for infection, morbidity and mortality related to COVID-19

2. to determine the risk of COVID-19 infection and outcomes in occupational groups and

3. to measure the population impact of COVID-19 on healthcare utilisation.

The secondary objectives were

1. to create a platform to enable the evaluation of policies and interventions aimed at controlling the epidemic, whether clinical or non-pharmaceutical in nature and

2. provide access to these derived population-based cohorts and linked data sources to organisation and people with relevant skills and expertise within the NHS, academia and government.

In the paper Lyons et al. (2020) provide explicit detail on the multiple demographic and healthcare data sources used in the creation of the two population cohorts and the architecture of the linkage.

4.3.3 Health Data Research UK

The Health Data Research UK (HDR UK) organisation convenes the UK Health Data Research Alliance. This is an independent alliance (https://ukhealthdata.org/) of over 50 leading healthcare and research organisations. Their goal is to establish and disseminate best practice for the ethical and responsible use of health datasets across the four UK nations. Interaction with patients and disease advocacy communities are key aspects of their role, to understand their interests and values regarding health data use, and to share the work of the Alliance (The Lancet Digital Health, 2021).

The vision of the Alliance as stated in their Green Paper, (UK Health Data Research Alliance, 2020) is that every health and care interaction and research endeavour will be enhanced by access to large scale anonymised data and advanced analytics. The 'Alliance') is committed to an approach to data access based primarily around Trusted (Trustworthy) Research Environments (TREs); with appropriate robust and independent TRE accreditation, monitoring and auditing. The aim is to meet researchers' technical and functionality requirements both now and in the future, while providing confidence to data custodians and the public through implementing a rigorous system of data access. This is required to meet research needs for Machine Learning capability, High Performance Computing or High Throughput Computing e.g., for analysis of genetic and imaging data, and also to support the convergence of research and care to enable a future of personalised medicine.

The approach to using TREs has been a central element of the COVID-19 Data and Connectivity National Core Studies developed by HDRUK in partnership with the Office for National Statistics. This project connects UK health data to support and accelerate research on COVID-19, enabling streamlined data access and analysis for COVID-19 with TREs providing data access across the four UK nations. Some examples are:

- Office for National Statistics Secure Research Service
- Secure eResearch Platform (SeRP) which includes the:
    - Adolescent Mental Health Data Platform (ADP),
    - Dementia Platform UK (DPUK) and
    - SAIL Databank

This platform has enabled researchers to access data derived from millions of depersonalised health records since 2011. Data for this TRES has been used to monitor any links between COVID -19 vaccination and rare blood clots.

- Health & Social Care Northern Ireland is establishing a new TRE in partnership with SeRP.

4.3.3.1 Health Data Research Hubs

Health Data Research Hubs have been set in October 2019. They are funded by the UK Research Innovation Council. These are seven centres of excellence with expertise, tools, knowledge and ways of working to maximise the insights and innovations developed from health data. They are mainly disease specific and are led by academia in partnership with industry, academic, NHS and charity organisations that hold data. All Hubs have used their data improvement efforts to support the NHS, academia, and industry in utilising the power of data to understand and overcome COVID-19.

4.3.3.1.1 Impact

The Hubs have made 157 datasets available via the Hub Collections Health Data Research Innovation Gateway, a portal that allows researchers and innovators to find and request access to datasets. Involvement of patients and the public, particularly minority voices such as people with disabilities, minority ethnic communities, LGBTQI+, has positively impacted on many of the Hubs' processes and outputs. Examples key projects with industry, academia, NHS and charity are:

- DATAMIND– this will improve the use of big data for mental health research by providing expert data services, tools and expertise to a wide range of users. DATAMIND will operate across the four nations of the UK, bringing together expertise from the NHS, universities, charities, research institutes and industry.

- NHS DigiTrials focusses on the development of a foundation service to improve the assessment of clinical trial feasibility – supporting improved planning and delivery of clinical trials in the UK.

4.4 Academic and other partnerships involved

PHM is collaborative between numerous agencies within and outside the healthcare system. HDR UK and SAIL are led by academic partners. The primary objective of academic partners is to use the aggregated data to answer key questions relating to health services research. Increasingly Cloud-based shared services are being used for organisations within the NHS to improve the way knowledge is securely shared, to facilitate consultation with stakeholders and to engage partners.

4.5 How data will work in the regions?

The Health eResearch Centre (HeRC) in Liverpool brings together a multi-disciplinary team of researchers, developers and clinicians to understand more about how under-used health data can be re-purposed to improve health. In their work on more than 40 research projects the centre combines the latest technology with innovative, mathematical models to deliver better services across the UK. The Combined Intelligence for Population Health action (CIPHA) is a population health management platform which collects and uses data in near real time, set up in Liverpool over a three month period to manage the Covid 19 crisis for a population of 16m and to drive its recovery. It is a collaboration involving the NHS, local government and Liverpool University. It coordinated the roll out of the Liverpool Covid 19 community testing pilot programme, through acting as an enabler, supporting access to datasets through a TRE and providing the technical capabilities needed for the mature data analytics required for actionable information.

4.5.1 Another example - Singapore

(Gunapal et al., 2015) describe the setup of a regional health system database which was a collaborative effort towards developing a national architecture for healthcare utilisation data across diverse clinical systems with a disparate data models. The database linked records from polyclinic visits, specialist outpatient clinics, hospital discharges, chronic disease management system records and mortality data from local registries. The database

facilitated a risk stratification of patients based on their previous utilisation and chronic disease information. It was set up with the intention to support proactive PHM in Singapore and to support the secondary use of administrate of health data in health services research.

4.6 Teaching/training commitments

Population health management training requires a shift from a more traditional vertical, disciplinary approach to a multidisciplinary, problem based approach. In the NHS the Population Health Academy provides training, webinars, and an online network for staff working across health and social care. In Ireland the workforce planning project on implementation of Slaintecare in DoH will address training as part of workforce capability.

5. Developments in PHM in Ireland

5.1 DASSL

In Ireland the Health Research Board has funded DASSL (Data Access, Storage, Sharing and Linkage) awards in 2019 The aim of DASSL is to develop a proof of concept model for technical infrastructure that will inform an enabling data environment nationally for the safe and controlled access, storage, sharing and linkage of research data and routinely collected health and social care datasets in Ireland. The key elements of the DASSL model are:

1. A health research Data Hub
2. A data linkage service
3. A trusted third party
4. A safe haven (Moran, 2016),

all of which are relevant to set up and implementation of PHM. DASSL needs to take into account the potential for implementation and sustainability of such a model on a national scale. Other aspects for consideration are data sensitivity, data heterogeneity, legal and ethical issues, data quality, use of standards for importing and exporting data, and semantic interoperability, all of which need to be considered for successful implementation of PHM.

HRB also fund secondary data analysis projects (SDAP) with emphasis on data linkage which is highly relevent to PHM..

5.2 Healthy Ireland Strategic Action Plan

The recently published Healthy Ireland Strategic Action Plan 2021 -2025 (Government of Ireland, 2021a) embeds the principles of Slaintecare, universal access and reduced health inequalities, paving the way for integrated preventive and treatment services.

5.3 Smart D8 Pilot Project

TCD and St James's Hospital have sought funding for a SMART D8 project in collaboration with the NHIU and health and social services in D8 to define priority information needs in the new CHNs, Chronic Disease Hubs and the Integrated Care Areas for Older Diseases Programme (ICPOP) and approaches to meeting these through primary care data including the CDM Programme and hospital data. This partnership could be a testing ground for all future PHM developments.

5.4 The Chronic Disease Management Programme in the HSE

This section is informed by discussions with Dr Orlaith O'Reilly, National Clinical Advisor and Group Lead for Chronic Disease.

Clinical Design and Innovation within HSE is currently leading a large-scale programme of change and improvement to develop a system of integrated care within our health and social care services. Four Integrated Care Programmes (ICPs) are being introduced on a phased basis: ICPs for Prevention and Management of Chronic Disease, Older Persons, Children, and Patient Flow. The objective of the ICPs is to design an integrated model of care that treats patients at the lowest level of complexity that is safe, timely, efficient and as close to home as possible. It is based on the principles of illness prevention, patient empowerment, multi-disciplinary cross-service care planning and delivery, where all health and social care services work together to provide a flexible network of care responsive to the changing needs of patients and their families.

The Integrated Care Programme for the Prevention and Management of Chronic Disease (ICP CD) aims to improve the prevention, diagnosis, and appropriate management of management of chronic diseases in primary care, supported by the Make Every Contact Count (MECC) brief intervention programme. Within this programme a Model of Integrated Care has been developed for individual chronic diseases. This is built on an approach which helps people understand and care for their own condition in collaboration with their General Practitioner and the general practice team thereby reducing reliance on the hospital system. This includes easy access to diagnostics and specialist supports in the community and close co-ordination with hospital services so that people can receive the care they need, when they need it and in the most appropriate way for their circumstances, be it at home, in the community or in hospital.

A major component of the community care aspects of the Model of Care is the GP Chronic Disease Management Programme (CDM) (Level 1). This is a specific programme where GPs are reimbursed to carry out specified chronic disease care for GMS patients only, as part of the CDM programme with primary care. The data underpinning the CDM programme are based on a live register of patients diagnosed with at least one of eight chronic conditions: Asthma, COPD, Diabetes Mellitus, cardiovascular diseases including heart failure, Ischaemic health disease, stroke and TIA. Implementation of the model of care is part of the GP contract which has enabled data collection for the CDM. The CDM database is housed in Health Intelligence. A data governance structure is also in place. Dr O'Reilly as Chair of the Data group of the ICP CD has set up a data governance structure under Clinical Strategy and Programmes. Thus the CDM programme could form the basis of a PHM database. Stratification of the population in the CDM database into high medium or low risk of adverse health outcomes could be the key first step in the development of database for

PHM. Assessment of frailty prevalence is the second of 10 Steps of the Integrated Care Framework used by the Integrated Care Programme for Older Persons (ICPOP). This Clinical Frailty Index (CFI) which has been validated in terms of predicting mortality and service utilisation by research using TILDA could be used to segment the CDM data into at risk groups by frailty category in persons aged 65 and older.

5.5 From Disease Registries to the Health Support System

There are over 100 health related data collections (systems) in Ireland, many of which are single disease registries managed in silos. Patients with multimorbidity may have data in many different systems. The lack of processes to re-associate and share clinical data from across these existing systems and a governance infrastructure means that the data are underused and inflexible and are unable to be used in a timely manner to plan, monitor, evaluate and enhance service delivery for patient groups.

Figure 3, courtesy of Prof Iain Buchan in Liverpool demonstrates what is needed to transform 'old' silo based thinking around registries into a learning system culture which came to prominence in the Covid-19 pandemic.

The figure shows the benefit of surveillance of the adverse COVID -19 vaccination outcome of thrombotic thrombocytopaenia provided from multiple data sources. A broader application of the benefit of combined intelligence across care providers is the optimisation of medicines making medicines journeys safer for the patient. For example, combined intelligence on cumulative anticholinergic effects from a build-up of damage over years of anticholinergic drugs can predict common harms to quality of life and functional abilities of older people e.g. incontinence, cognitive impairment, falls, move to a care home (Iain Buchan, personal communication).

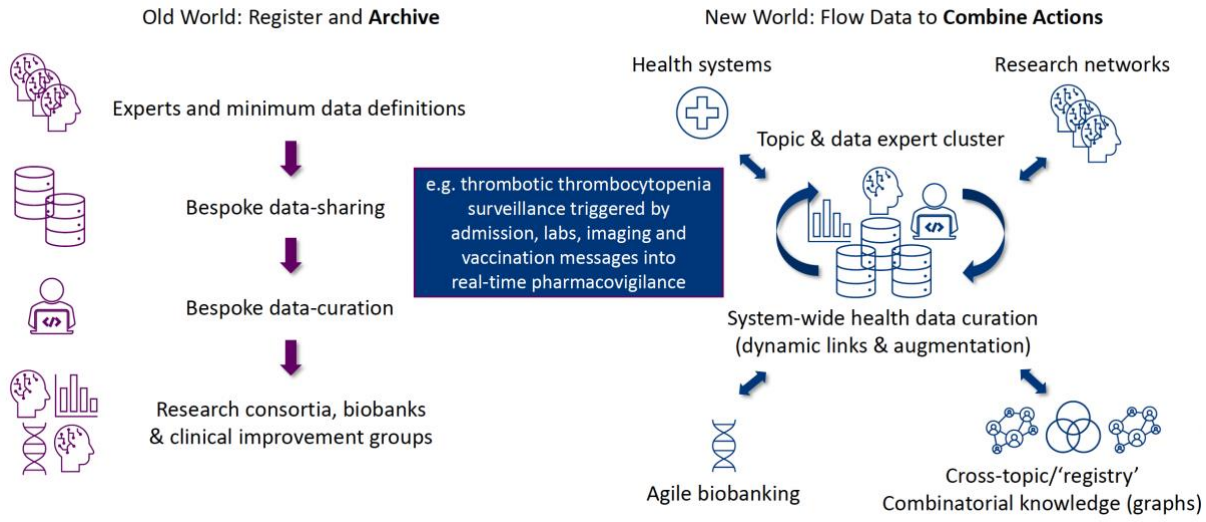


Figure 3. **Covid reset: registries to actionable analytics** (Source: Prof Iain Buchan, Liverpool)

Many datasets other than CDM are also housed within Health Intelligence including Health Atlas (e.g. population geomapping of demographic, socioeconomic population distribution, service provision), HSE Primary Care Eligibility and Reimbursement Service (PCERS) data on drug utilisation and cost data), Hospital In-patient Enquiry (HIPE) data on hospital discharges. Currently these datasets are stand alone in that there are no identifiers to enable cross linkages.

Currently a basic infrastructure is in place in terms of data availability in a single location, to re-associate these datasets, at least the PCERS, HIPE and the CDM datasets and thus facilitate selection and testing of a risk prediction algorithm to stratify the population /population subsets into high, medium and low risk groups according to health status. Re-associating data from PCERS, HIPE and CDM would enable personalised care planning by risk group and facilitate optimisation of medicines across several care providers.

NIHU is familiar with these datasets and has developed a Health Support System (HSS) Concept and Design blueprint using Type II diabetes mellitus as a demonstration model to incorporate these and future datasets. The HSS design blueprint could include laboratory diagnostic tests, screening programmes e.g. Diabetic Retina Screen and data from brief Interventions under Make Every Contact Count (Appendix 3). The potential to reassociate the PCERS, HIPE and CDM and many other datasets for PHM could be realised under the auspices of the HSS model.

A new governance infrastructure would be required and existing provider agreements would need to be renegotiated as an imperative to underpin the HSS. All relevant stakeholders (data providers, data users and potential beneficiaries would need to be involved, a costing exercise carried out, and the appropriate staff, tools, and technology made available to further develop the project.

6. PHM outcomes

6.1 Overall impact/outcome of PHM against targets (if known) and the evolution of PHM delivery over time in response to impact, funding or policy changes.

PHM is still new and evolving. The extent to which health care delivery systems can deliver effective PHM programs is still unclear. Lewis et al (Lewis, Kirkham, Duncan, & Vaithianathan, 2013) refer to 'Triple Fail' events i.e. a simultaneous failure to meet all three 'Triple Aim' goals of improving outcomes, enhancing patient experience and lowering costs. They argue that the stratified approach of PHM should reduce the incidence of 'Triple Fail' but direct evidence for this is lacking. Analysis by the Nuffield Trust 'think tank' (Imison et al., 2017) suggests that some STPs are targeting up to 30% reductions in some areas of hospital activity, including outpatient care, ED attendances and emergency inpatient care over a four year period. However this is being planned in the face of steady growth in all areas of hospital activity. In New Zealand, weak indirect evidence from a before-after study of two tailored intervention programmes for very high and at risk patients in all care settings shows substantial reduction in the number of emergency care presentations and in acute care bed days (Appendix 5). However controlled trials are needed to address effectiveness.

6.2 Evidence of impact and critical success.

The success of PHM programs depends on the accuracy of the risk assessments (for all levels of risk), the effectiveness of the selected interventions, and the fidelity of implementation delivery (Hibbard et al., 2017) Furthermore the efficient use of resources to achieve the goals of improved health and decreased use of costly care must be considered. One way to increase efficiency is to not only take into account risk levels but also to consider the likelihood of responsiveness to the intervention or "impactability." According to a study by the Nuffield Trust,(Lewis., 2010), the concept of "impactability" introduces the idea that risk stratification approaches should not just identify people at high risk for a health event, but they should identify people who are most likely to respond to interventions to improve health outcomes. This concept, while discussed in the context of managing the high-risk patients, has applicability for all risk levels. The study findings identified equity and access as important aspects to bear in mind when considering impactability as impactability modelling could have the potential to exacerbate existing health inequalities e.g. marginalised groups may be excluded from certain programmes due to predicated poor compliance.

One potential measure of impactability is a patient's activation level,. The Patient Activation Measure (PAM), is a valid and reliable measure of patients' self-management skills and confidence (Hibbard et al. 2005). Several studies indicate that targeted interventions undertaken in the clinical setting can successfully increase PAM scores (Hibbard et al., 2017; Shane-McWhorter et al., 2015; Shively et al., 2013). (Hibbard et al., 2017) showed that less activated patients had significantly higher odds of Emergency Department utilisation or hospitalisation compared to those with high PAM scores. They were more likely to have a new chronic disease diagnosis on each year of the observation period. Hence understanding the patient's capability for self-management is a key part of understanding the risk of health deterioration and of avoidable utilization. interventions which aim to improve the PAM score are likely to be effective.

The authors recommend (Hibbard et al., 2017) that PHM should focus on "impactability" or segmenting populations based on not just clinical risk, but the likelihood that interventions can modify patient behaviour. As there is a growing body of evidence that it is possible to increase activation levels (Hibbard, Greene, and Tusler 2009; Wolever et al. 2010; Shively et al. 2013) the patient's PAM score can be used to target patients with appropriate interventions to help them achieve an adequate level of self-management skill. This may be a more efficient use of resources, as it refines the targeting of support to those who are most likely to benefit from it. The authors recommend that future research, using controlled trials is needed to test whether targeting interventions to activation level in addition to risk level reduces risks and costs.

7. Key learnings

From my discussion with leaders, gaining the public's trust and the development of relationships between NGOs, statutory service providers and academic researchers have been the critically important factors. Involvement of commercial organisations is also key to innovation. The NHS electronic patient record is maintained by an independent third party. Funding an independent organisation, the HDRUK, who have built an Alliance of

stakeholders (The Lancet Digital Health, 2021), who for the most part have datasets and a vested interest in using data for legitimate purposes has allowed building trust, credibility and momentum for PHM acceptance. Very strict controls around dataset access has helped gain public trust. In the UK demonstrating the value of using linked data to allow rapid response to COVID 19 in Wales and Liverpool in particular has been an important accelerator. In New Zealand access to patient data across multiple care settings has facilitated uptake amongst general practitioners (Appendix 3).

In terms of what may be improved, the tension between simplicity and precision in use of population segmentation tools has already been alluded to. Use of risk stratification to identify 'at risk' patients before they deteriorate is also a major consideration (Imison et al., 2017).

A recent scoping review on customised care (Minvielle, Fourcade, Ricketts, & Waelli, 2021) highlighted three areas for researchers and managers to advance the customisation in health care delivery systems: better definition of the content of the segmentation analysis and the intervention steps, demonstrate its added value, in particular its economic viability, and align the logics of action that underpin current efforts of customization.

Regarding programme implementation, those programmes that are well-supported, funded and given sufficient time to develop are most likely to demonstrate benefit.

8. Conclusion

The key success the factors of any PHM programme are to agree a definition and a strategy, define goals and measurement, stratify the population according to risk, define and design tailored interventions and measure success (Buckle et al., 2019). The three domains, the people (suitably qualitied staff), the process (statistical tools) and technology are needed. Genuine feedback loops or continuous improvement cycles need to be in place to capture the potential learnings from the PHM approach.

9. Recommendations

1. Population Health Management needs to be developed in Ireland to support delivery of integrated care as part of the Slaintecare reforms. As a starting point this document should be presented jointly to HSE Strategy and Planning from Health Intelligence and the Integrated Care Programme for Chronic Diseases (ICP CD).

2. The current status of PHM development in the Irish health system needs to be ascertained. Mapping of the current infrastructure, intelligence and intervention development to a Population Health Maturity Matrix such as that shown in Appendix 2 should be commenced without delay. Documentation of the existing capabilities, (people, processes and technology), and training opportunities to develop PHM will be the initial step to determine future requirements, and to assess of the gap between current and future requirements.

3. The Department of Health is using 'Bridges to Health' to design a model for Population Based Resource Allocation (PBRA) as part of the implementation of

Slaintecare. Representation from the Clinical Programmes in particular from ICP CD and the Chief Clinical Office on the DoH PBRA working group on would provide for greater synergy to progress PHM in HSE .

4. Work needs to commence on review and selection of an appropriate risk stratification algorithm (see Appendix 5) which initially uses the existing Chronic Disease Management System housed in the National Health Intelligence Unit. The Clinical Frailty Index (CFI), currently used by the Integrated Care Programme for Older Persons (ICPOP to stratify patients according to their frailty level, could be used to segment the CDM data into at risk groups by frailty category in persons aged 65 and older.

5. A feasibility study of the data requirements for PHM and of the processes to support this is needed in a selected CHN/CHNs and Chronic Disease Hub(s) Work has commenced on identifying and building alliances with academic, community and technology partners. TCD and St James's Hospital have successfully obtained funding for a SMART D8 project in collaboration with the National Health Intelligence Unit the new Community Structures in D8 and local community to define priority information needs and develop approaches to meeting these. This partnership could be a testing ground for all future PHM developments.

6. Alliances with academic, community and non-health care partners needs to be developed further.

10. The Health Support System (HSS) Concept & Design developed by National Health Intelligence needs to be further explored as a blueprint for PHM and expanded to other available datasets to include, for example HIPE and PCERS in addition to CDM. CDM data will need to be geocoded if the data are to have a context geographically . The re-associated datasets will need to be aligned with stakeholder experience to refine and validate the newly formed large dataset and tested to determine if the data can successfully stratify the population into low, medium and high risk of adverse health outcomes.

7. An overarching Steering Group to oversee the development of the HSS as a blueprint for PHM should be set up by the end of 2022 to examine governance, legal requirements, costs and resources required in terms of people, statistical tools and technology.

8. Opportunities offered by the individuals and organisations contacted in the preparation of this documents to provide guidance /collaboration should be availed of.

9. A system to provide continuous feedback /continuous quality improvement and an evaluation framework needs to be set up so that criteria to determine (cost) effectiveness are determined at the outset.

10. References

Advancing Integration for a Dignified Aging (AIDA). (2013). Best practice: the programme VALCRONIC-CARS, improving the process of chronic care *2021*(Oct 13). Retrieved from http://www.project aida.eu/wp-content/themes/ thunderbolt/docs/Valcronic.pdf

Buckle, J., Counihan, A., Hayward, T., Kallis N., MacDonnell, B., Manning, K., & Taneja, N. (2019). Milliman Research Report. How to implement a population health management programme. *Milliman International Health Research 2019 series*.

Caulfield, P., Hynes, T., & O'Connor, P. (2022). *Spending Review 2022. A System Dynamics Model of Nursing Workforce Supply*. Dublin: Government of Ireland

Cavanagh, S., & Chadwick, K. (2005). *Health needs assessment: A practical guide.* London: Health Development Agency UK (Now National Institute for Clinical Excellence).

Chong, J. L., Lim, K. K., & Matchar, D. B. (2019). Population segmentation based on healthcare needs: a systematic review. *Syst Rev, 8*(1), 202. doi:10.1186/s13643-019-1105-6

Delaware Center for Health Innovation. (2013). Choose Health Delaware: Delaware's State Health Care Innovation Plan. Retrieved from http://dhss.delaware .gov/dhcc/cmmi/files/choosehealth plan.pdf

Eissens van der Laan, M. R., van Offenbeek, M. A., Broekhuis, H., & Slaets, J. P. (2014). A person-centred segmentation study in elderly care: towards efficient demand-driven care. *Soc Sci Med, 113*, 68-76. doi:10.1016/j.socscimed.2014.05.012

Fields, R. W., & Gandhi, N. (2019). Tools for Population Health Management. *Prim Care, 46*(4), 529-538. doi:10.1016/j.pop.2019.07.012

Government of Ireland. (2021a). *Healthy Ireland. Strategic Action Plan 2021–2025. Building on the first seven years of implementation*. Retrieved from Dublin:

Government of Ireland. (2021b). *Sláintecare. Right Care. Right Place. Right Time. Sláintecare Implementation Strategy & Action Plan 2021 — 2023*. Retrieved from Dublin:

Gunapal, P. P. G., Kannapiran, P., Teow, K. L., Zhu, Z., Xiaobin You, A., Saxena, N., . . . Heng, B. H. (2015). Setting up a regional health system database for seamless population health management in Singapore. *Proceedings of Singapore Healthcare, 25*(1), 27-34. doi:10.1177/2010105815611440

Hibbard, J. H., Greene, J., Sacks, R. M., Overton, V., & Parrotta, C. (2017). Improving Population Health Management Strategies: Identifying Patients Who Are More Likely to Be Users of Avoidable Costly Care and Those More Likely to Develop a New

Chronic Disease. *Health services research, 52*(4), 1297-1309. doi:10.1111/1475-6773.12545

Imison, C., Curry, N., Holder, H., Castle-Clarke, S., Nimmons, D., Appleby, J., . . . Lombardo, S. (2017). *Shifting the balance of care: great expectations. Research report*. Retrieved from www.nuffieldtrust.org.uk/research/shifting-the-balance-of-care

Kilgarriff-Foster, A., & O'Cathain, A. (2015). Exploring the components and impact of social prescribing. *Journal of Public Mental Health, 14 (3)*, 127-134.

Leeds Health and Care Partnership Executive Group (PEG). (2021). *Developing an Integrated Care Partnership in Leeds – Progress, proposals and next steps*. Retrieved from Leeds: 13.3-Leeds-ICP-Development.pdf

Lewis, G. (2010). "Impactibility Models": Identifying the Subgroup of High-Risk Patients Most Amenable to Hospital-Avoidance Programs. *The Milbank quarterly, 88*, 240-255. doi:10.1111/j.1468-0009.2010.00597.

Lewis, G., Kirkham, H., Duncan, I., & Vaithianathan, R. (2013). How Health Systems Could Avert 'Triple Fail' Events That Are Harmful, Are Costly, And Result In Poor Patient Satisfaction. *Health Affairs, 32*(4), 669-676. doi:10.1377/hlthaff.2012.1350

Love, T., Swansson, J., & Whelen, C. (2014). Development of an algorithm to stratify patients by risk of acute hospitalisation. . Retrieved from http://www.healthpointpathways.co.nz/assets/AtRisk

Lynn, J., Straube, B. M., Bell, K. M., Jencks, S. F., & Kambic, R. T. (2007). Using population segmentation to provide better health care for all: the "Bridges to Health" model. *The Milbank quarterly, 85*(2), 185-212. doi:10.1111/j.1468-0009.2007.00483.x

Lyons, J., Akbari, A., Torabi, F., Davies, G. I., North, L., Griffiths, R., . . . Lyons, R. (2020). Understanding and responding to COVID-19 in Wales: protocol for a privacy-protecting data platform for enhanced epidemiology and evaluation of interventions. *BMJ Open, 10*(10), e043010. doi:10.1136/bmjopen-2020-043010

Minvielle, E., Fourcade, A., Ricketts, T., & Waelli, M. (2021). Current developments in delivering customized care: a scoping review. *BMC Health Services Research, 21*(1), 575. doi:10.1186/s12913-021-06576-0

Moran, R. (2016). *Proposals for an Enabling Data Environment for Health and Related Research in Ireland* Retrieved from Health Reserch Board: www.hrb.ie/publications

Mulcahy, H., & Downey, J. (2021). *Community Profiling and Health Needs Assessment: A Practical Guide for Public Health Nurses* Cork: UCC and HSE NMPDU Retrieved from https://www.lenus.ie/handle/10147/630648

NHS. Integrated health and care in action. *Population Health Management. Understanding how integrated care systems are using population health management to improve health and wellbeing.* Retrieved from www.england.nhs.uk/integratedcare

NHS England, Public Health England, & NHS Digital. (2016). *Population Health Management Flatpack. A guide to starting Population Health Management. Version 1.0*. NHS

NHS North West London Whole Systems Integrated Care. What population groups do we want to include? . Retrieved from http://integration.healthiernorth westlondon.nhs.uk/chapter/what- population-groups-do-we-want-to- include-

O'Halloran, A., Hartley, P., Moloney, D., McGarrigle, C., Kenny, R., & Romero-Ortuno, R. (2021). Informing patterns of health and social care utilisation in Irish older people according to the Clinical Frailty Scale [version 1; peer review: 2 approved]. *HRB Open Research, 4*(54). doi:10.12688/hrbopenres.13301.1

Outcomes Based Healthcare. (2016). Segmentation for Outcomes. Segmentation approaches for outcomes based commissioning. Part 2 – Evaluation of the Bridges to Health Segmentation Model for Outcomes Measurement. Retrieved from www.outcomesbasedhealthcare.com

Rockwood, K., Song, X., MacKnight, C., Bergman, H., Hogan, D. B., McDowell, I., & Mitnitski, A. (2005). A global clinical measure of fitness and frailty in elderly people. *Cmaj, 173*(5), 489-495. doi:10.1503/cmaj.050051

Shane-McWhorter, L., McAdam-Marx, C., Lenert, L., Petersen, M., Woolsey, S., Coursey, J. M., . . . Chuy, L. (2015). Pharmacist-provided diabetes management and education via a telemonitoring program. *J Am Pharm Assoc (2003), 55*(5), 516-526. doi:10.1331/JAPhA.2015.14285

Shively, M. J., Gardetto, N. J., Kodiath, M. F., Kelly, A., Smith, T. L., Stepnowsky, C., . . . Larson, C. B. (2013). Effect of Patient Activation on Self-Management in Patients With Heart Failure. *Journal of Cardiovascular Nursing, 28*(1), 20-34. doi:10.1097/JCN.0b013e318239f9f9

Sterman, J. D. (2001). System Dynamics Modeling: Tools for Learning in a Complex World. *California Management Review, 43*(4), 8-25. doi:10.2307/41166098

The Lancet Digital Health. (2021). Power to the people. *The Lancet Digital Health, 3*(8), e462. doi:10.1016/S2589-7500(21)00147-3

Thompson, D. A., Abbasizanjani, H., Fry, R., Marchant, E., Griffiths, L., Akbari, A., . . . Lyons, R. A. (2021). Staff–pupil SARS-CoV-2 infection pathways in schools in Wales: a population-level linked data approach. *BMJ Paediatrics Open, 5*(1), e001049. doi:10.1136/bmjpo-2021-001049

UK Health Data Research Alliance. (2020). *Trusted Research Environments (TRE). A strategy to build public trust and meet changing health data science needs. 200713 TRE Green Paper V2.0.pdf*. Retrieved from

Vuik, S. I., Mayer, E. K., & Darzi, A. (2016). Patient Segmentation Analysis Offers Significant Benefits For Integrated Care And Support. *Health Aff (Millwood), 35*(5), 769-775. doi:10.1377/hlthaff.2015.1311

Walsh, B., Mac Domhnaill, C., & Mohan, G. (2021). Developments in Healthcare Information Systems in ireland and Internationally *ESRI Survey and Statistical Report Series Number 105*

Zhou, Y. Y., Wong, W., & Li, H. (2014). Improving care for older adults: a model to segment the senior population. *Perm J, 18*(3), 18-21. doi:10.7812/tpp/14-005

Appendix 1-Document Scope

Population Health Management (PHM) – an international review

Position paper

What is PHM?

1. PHM definition/s.
2. Overall goal/purpose/objectives.

How is PHN implemented/operationalised internationally

3. How is PHM delivered to the target community?
4. Countries adopting/adapting.
5. When started.
6. Structure, funding and organisation.
7. PHM sponsor, owner - what entity is responsible for PHM – DOH, health org (public or private), insurance company, data organisation etc?
8. Non-health agency involvement/input (data enablers) - organisation/administration e.g. state statistics org involvement, social partners, housing, education, environment etc.
9. Academic and other partnerships involved.
10. Research commitments.
11. Teaching/training commitments.

Scope of PHM

12. Are patient groups prioritised? Age, morbidities etc? Inclusion/exclusion criteria.
13. Degree of focus on prevention by patient group – obesity, diabetes, heart failure, COPD, cancer etc.
14. Degree of focus on treatments, procedures, settings – GP, ED, OPD, day care, inpatient, rehab etc.
15. What range of services are included – health education, rehabilitation, primary care (GP), community care, hospital acute, mental health, social care etc.
16. What determines the scope – political/jurisdiction, health geography, personal status (e.g. veterans) etc.
17. Population coverage estimates.

PHM outcomes

18. Summarise the overall impact/outcome of PHM against targets (if known).
19. Evidence of impact and critical success.
20. Has PHM delivery evolved over time in response to impact, funding or policy changes.

Health intelligence

21. What information system/s underpin PHM – what data sources are used (hospital. Community, other health, non-health) are used.

22. What health analytics are used – advanced modelling?

23. Role of the electronic health record, longitudinal record community/hospital or both.

24. Role of unique patient identification.

25. Role of data linkage (re-association).

26. Role of disease/health registries (if any).

Key learnings/discussion

27. What are the key learnings to date – what worked well, what did not, what would they do differently.

28. Any parallels or implications for the implementation of *Slaintecare*, *Healthy Ireland* etc?

29. Any parallels or implications for the Chronic Disease Management Programme (CDM)?

Conclusions

Recommendations

Appendix 2- PHM maturity matrix

Journey of development for building PHM capability

Source: Future NHS collaboration platform

	Emerging	Developing	Maturing ICS	Thriving ICS
Infrastructure	• Limited use of local data. Reliance on national data to undertake analysis for planning and commissioning activities. • Poor digital maturity across health and care providers.	• Some linking of traditional data flows between primary and secondary care. • Information governance arrangements in place between commissioners and primary and secondary care providers to support analysis of population health. • No clear PHM vision shared across the system. • Individual and sporadic population health leadership.	• Linked primary, secondary, community, mental health care data available for direct care and care redesign, with plans to link wider data sources, including social care and other wider determinants • ICS wide Information Governance arrangements which support analysis of linked data for care design including wider determinants • Clear plans for convergence of linked data set with population health data feed from Local Health and Care Record platform. • Clear vision for PHM at system and place level, with some PCNs engaged and involved. • Multi-professional leadership throughout the different tiers of the ICS.	• Full flows of data from all health and social care sources available for direct care and care planning, including demonstrable efforts to link patient level information on wider determinants (housing, unemployment, income etc). • System wide information governance arrangements which allow for analysis of de-identified patient level data for care design purposes and smooth re-identification within ICPs and PCNs for proactive case finding and management. • Responsive data feed from Local Health and Care Record platform to support above data model. • Cross system leadership and vision clearly articulated and embedded across the system.

Intelligence	• Disparate analytical teams spread across the system mainly undertaking traditional commissioning and reporting activities • Limited intelligence tools to help with understanding population health demands.	• Traditional reporting, intelligence systems and analytical outputs acting at organisation level with limited clinical engagement. • Use of analytical teams and support units to provide population health analytical insight, but not in a systematic and consistent way across the STP. • Costing and performance analysis is organisationally focused rather than patient focused.	• Starting to use local linked data to segment and stratify population to understand needs of different patient groups and risk factors. The costs of different cohorts are understood now and in the future. • Some social determinants information being used alongside health data. • Starting to map and understand system analytical workforce and intelligence tools with plans being developed for more networked analytical teams'. • Analytical support made available for PCNs to help understand high and rising risk patients and to support care design activities. • Population health costing data starting to be used for forecasting demand and risk to inform future payment and contracting models.	• Well developed cross ICS analytical function with skills in predictive techniques that enables actionable insights to be regularly delivered to PCNs and Place networked or federated analytical teams. • Analysis which shows current and future costs of different cohorts, key risk factors (across health and wider social needs) and those patients who are at greatest risk of a deterioration in health and care • Operating model in place between analytical team, place and PCN teams to provide responsive actionable insight to inform proactive and anticipatory care. • Early blended payment models across integrated providers predicated on population health risk and financial modelling.

Intervention	• Largely reactive health and care system delivered by providers where there is minimal collaboration. • Limited progress to tailor care models for different patient groups.	• Basic population segmentation in place to understand needs of key groups with early insight into resource use. • Limited engagement across primary and secondary care teams to integrate care around high need groups • Limited use of voluntary and third sector to respond to key patient groups. • Social prescribing and anticipatory care activity not linked to needs analysis.	• Forums and working arrangements being established between primary and secondary care, social care, and public heath teams - and with third sector involvement - to design proactive care models for different patient groups based on patient level analysis. • Integrated MDTs (primary and secondary care) being supported to adopt rapid improvement cycles to implement anticipatory care interventions (including social prescribing), measure impact and refine approach. • Personalised care plans in place for at risk groups. • Population health analysis being used to inform shared workforce models between primary and secondary care.	• Clearly defined care models in place for key population groups across vertically and horizontally integrated teams. • A range of anticipatory care interventions have been designed and financial incentives put in place to support implementation through PCN MDTs. • Clear working arrangements between PCNs and voluntary and community sector partners with clear offers of support for specific patient groups. • Whole population health analysis and demand forecasts informing provider contracting and payments models, including shared workforce agreements.

Appendix 3 - Health Support System

Health Support System (HSS) Concept & design blueprint

October 2021

Background
There are over 100 health related data collections (systems) in Ireland, many of which are "health registries"[1].

The challenge

- Data on patient interactions with health services is fragmented data and held in silos.
- Patient with a number of clinical conditions can have data held in many systems.
- The service provider on the front line is unlikely to have visibility of the full data spectrum on their patients.
- Systems established for specific purposes can be inflexible and unable to evolve with moving healthcare priorities.
- Resources can be quickly exhausted if significant manual processes are involved in data collection and processing.
- The potential to use available data for operational and strategic purposes is constrained.

With the exception of certain clinical conditions such as cancer and cystic fibrosis for which registries exist, it is challengingto estimate the number of patients with a particular condition of interest nationally or locally, such as diabetes. Processes to easily contact specific patient groups to offer new service such as COVID-19 vaccination is therefore fraught.

The absence of processes and a governance infrastructure to re-associate and share clinical data from across existing platforms is the root cause of being unable to exploit advanced clinical and epidemiological analytics required to better plan,monitor, evaluate and enhance service delivery for patient groups.

To resolve this problem, a new framework is required, especially in the context of Sláintecare and the eHealth agenda including the national electronic health record (EHR) or its proxies, the Integrated Information Service (IIS), and the Individual Health Identifier (IHI).

Proposed solution – the Health Support System (HSS)
The proposed solution is to re-associate "real world" data in a novel way within a framework referred to as the Health Support System (HSS) that is explicitly designed to enable, as far as is practical and appropriate, the four functions as outlined below for the patient groups included:

1. **Support direct/indirect patient care** – to inform individual patient care in the context of the patient group.
2. **Support service activity metrics and quality assurance/improvement of services to patient groups** – at national,health service and practitioner levels.
3. **Enable planning, monitoring and evaluation of services –** as relevant to the patient groups.
4. **Support the generation of new knowledge through scientific methodologies** – address pressing health service,epidemiological and clinical questions of the day.

The HSS recognises the basic tenet and patient expectations that a quality health service should continuously and purposefully "learn" from all patient interactions, interventions and outcomes, and be responsive to current and future healthneeds and priorities of patients groups.

The degree to which each of the four functions are achievable depends on the data available, its potential for re-association and moderation, the quality of the analysis and feedback, and the engagement of stakeholders. It is envisaged, therefore, that the HSS will evolve on a phased basis.

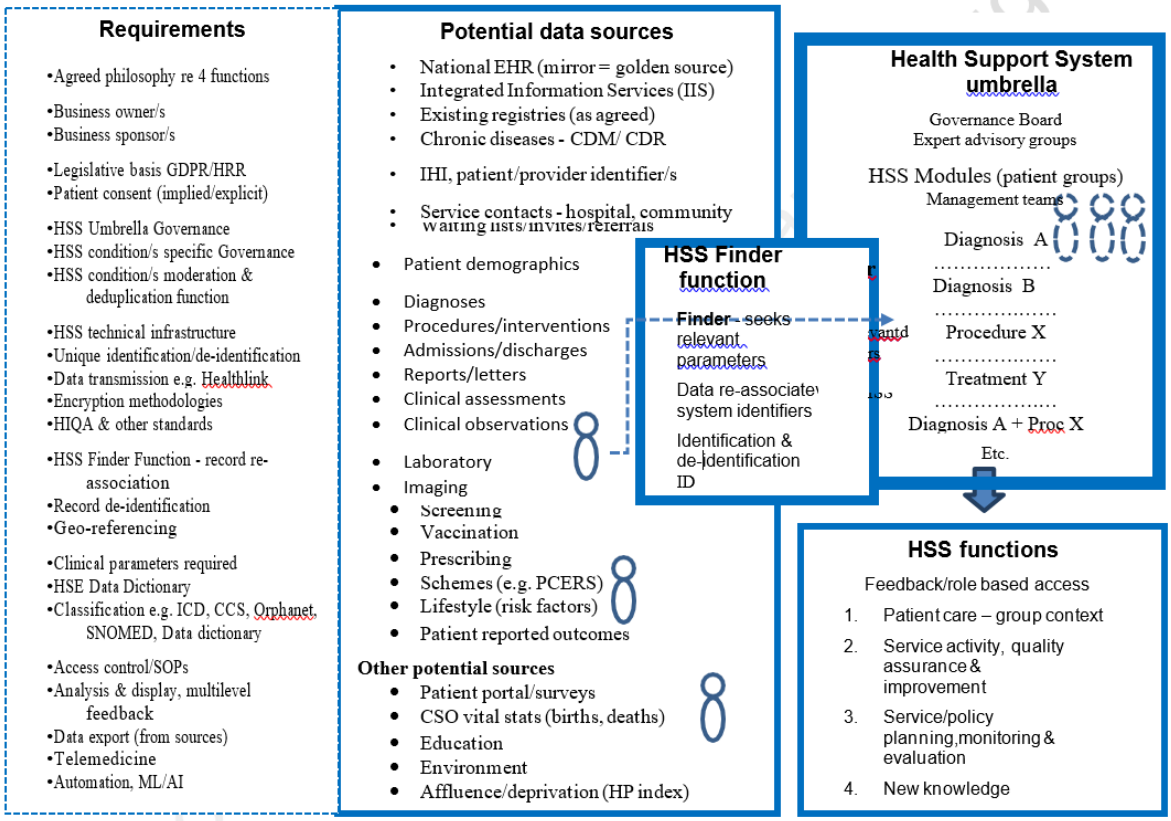
HSS modules
Each HSS module is condition specific i.e. for a defined patient group. While broadly akin to the traditional "health registry", each HSS module exploits the potential of re-associating available data using automated processes and analytics where practical and appropriate. Manual processes would be primarily reserved for data moderation.

The HSS can be applied to common or unusual conditions. Candidate conditions include **COVID-19, diabetes, dementia,heart failure, COPD, congenital defects, inherited cardiac conditions, hip dysplasia, and rare diseases.**

By design, the scope of each module can expand iteratively, depending on the availability of relevant data.

HSS governance
It is proposed that the HSS will operate under an umbrella framework covering governance, design, development and deployment, and be guided by subject-matter expert groups/international experts and Clinical Programmes, ensuring strictcompliance with GDPR, HRR and other relevant legislation.

Overview of the critical Health Support System (HSS) components and framework



Note: The availability and relevance of data and the degree to which a longitudinal view can be created will vary by condition.

HSS Finder function

Embedded in the appropriate technical environment, the "case-finder" functionality is the HSS engine that identifies records from different datasets that contain the codes, key words etc. relevant to a HSS module.

The actual inclusion of a record (patient) in the HSS module follows a finding/filtering process as defined by the expert group to ensure that clinical subtleties and local nuances in data recording and classification are reflected. Potential candidate records for inclusion in a HSS module will be moderated in line with agreed processes.

Appropriate technical and security infrastructures within a "safe harbour" environment will support robust methodologies for: re- associating (see DASL HRB) and de-duplicating data (IHI, demographics, health sector number/s etc.); encryption/hashing; de- identification and re-identification as appropriate (such as to enable patient call/recall by the service provider).

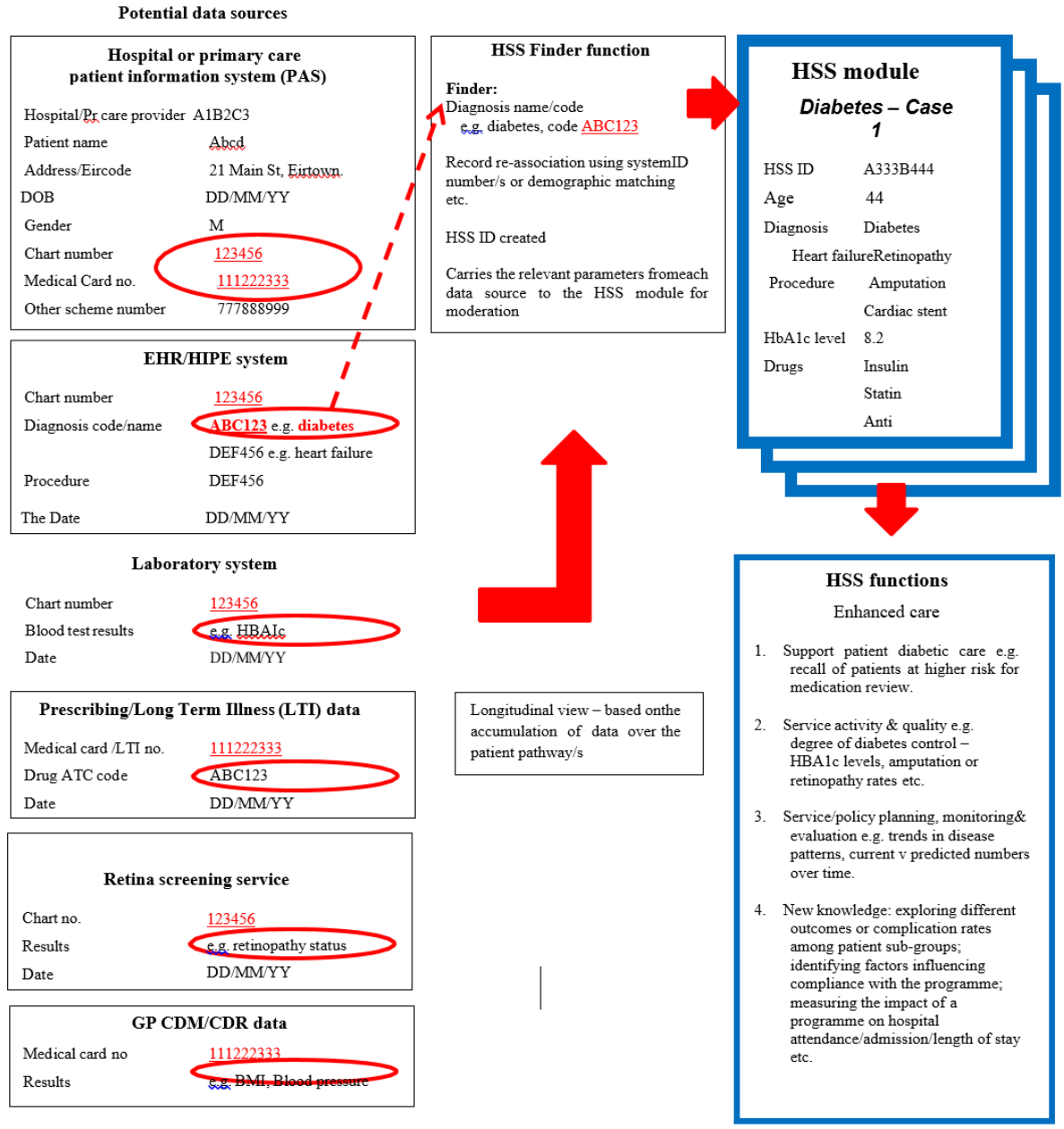
Role based access to HSS functions

Provision of safe and secure role based access relevant module elements in line with relevant policies and procedures.

Note: the required precision, accuracy, and completeness of data may vary with the condition of interest and the particular function.

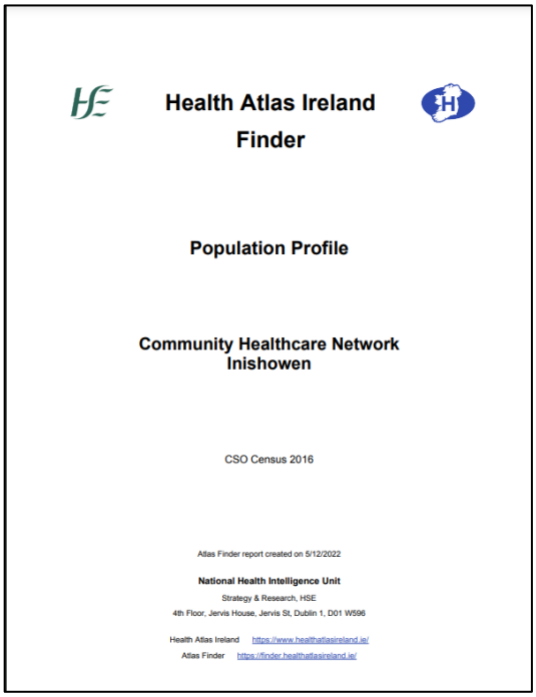
Health Support System (HSS) for Diabetes - example of potential data re-association

High level example of identifying patients with diabetes, using parameters derived from existing information systems.



Appendix 4 – Health Atlas Finder profiling reports

Health Atlas Finder produces ready-made PDF reports for any of its given geographical areas. Reports can be based on the most recent Census, or can use population projections to estimate the number of people in any given area for any given year, currently up to 2051 (based on 2016 Census data). Each PDF report provides a cover page and table of contents before progressing to the selected profiling tables (e.g. Inishowen CHN, 2016 data, see below).



Health Atlas Ireland

Finder

Population Profile

Community Healthcare Network
Inishowen

CSO Census 2016

Atlas Finder report created on 5/12/2022

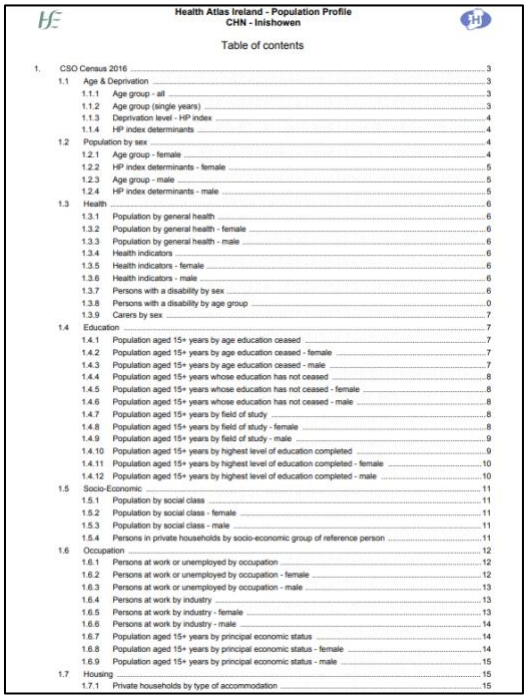
National Health Intelligence Unit

Strategy & Research, HSE

4th Floor, Jervis House, Jervis St, Dublin 1, D01 W596

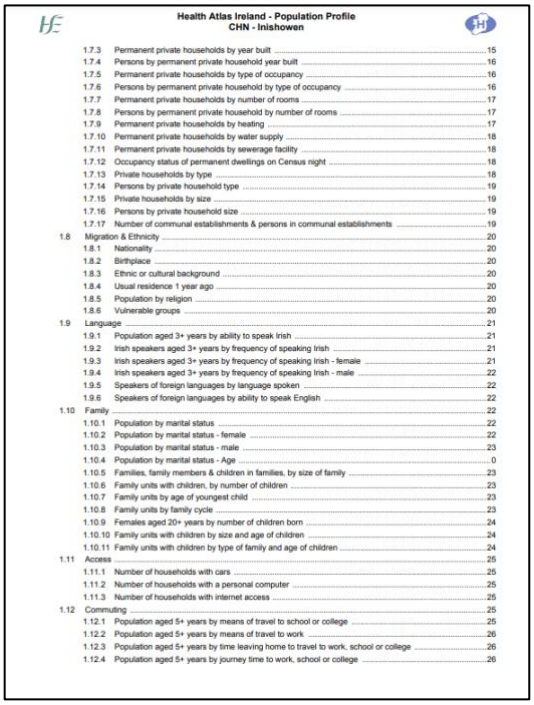
Health Atlas Ireland https://www.healthatlasireland.ie/

Atlas Finder https://finder.healthatlasireland.ie/

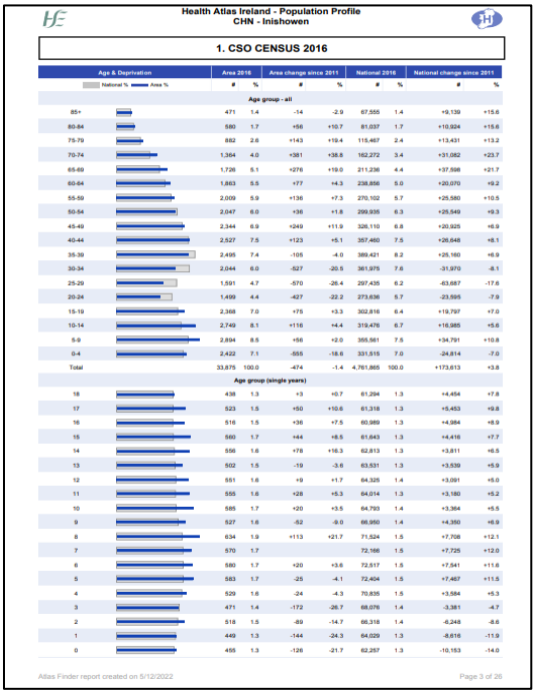


Health Atlas Ireland - Population Profile
CHN - Inishowen

Table of contents



Health Atlas Ireland - Population Profile
CHN - Inishowen



Health Atlas Ireland - Population Profile
CHN - Inishowen

1. CSO CENSUS 2016

Age & Deprivation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Age group - all								
85+	471	1.4	-14	-2.9	67,555	1.4	+9,139	+15.6
80-84	580	1.7	+56	+10.7	81,037	1.7	+10,924	+15.6
75-79	882	2.6	+143	+19.4	115,467	2.4	+13,431	+13.2
70-74	1,364	4.0	+381	+38.8	162,272	3.4	+31,082	+23.7
65-69	1,726	5.1	+276	+19.0	211,236	4.4	+37,598	+21.7
60-64	1,863	5.5	+77	+4.3	238,856	5.0	+20,070	+9.2
55-59	2,009	5.9	+136	+7.3	270,102	5.7	+25,580	+10.5
50-54	2,047	6.0	+36	+1.8	299,935	6.3	+25,549	+9.3
45-49	2,344	6.9	+249	+11.9	326,110	6.8	+20,925	+6.9
40-44	2,527	7.5	+123	+5.1	357,460	7.5	+26,648	+8.1
35-39	2,495	7.4	-105	-4.0	389,421	8.2	+25,160	+6.9
30-34	2,044	6.0	-527	-20.5	361,975	7.6	-31,970	-8.1
25-29	1,591	4.7	-570	-26.4	297,435	6.2	-63,687	-17.6
20-24	1,499	4.4	-427	-22.2	273,636	5.7	-23,595	-7.9
15-19	2,368	7.0	+75	+3.3	302,816	6.4	+19,797	+7.0
10-14	2,749	8.1	+116	+4.4	319,476	6.7	+16,985	+5.6
5-9	2,894	8.5	+56	+2.0	355,561	7.5	+34,791	+10.8
0-4	2,422	7.1	-555	-18.6	331,515	7.0	-24,814	-7.0
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Age group (single years)								
18	438	1.3	+3	+0.7	61,294	1.3	+4,454	+7.8
17	523	1.5	+50	+10.6	61,318	1.3	+5,453	+9.8
16	516	1.5	+36	+7.5	60,989	1.3	+4,984	+8.9
15	560	1.7	+44	+8.5	61,643	1.3	+4,416	+7.7
14	556	1.6	+78	+16.3	62,813	1.3	+3,811	+6.5
13	502	1.5	-19	-3.6	63,531	1.3	+3,539	+5.9
12	551	1.6	+9	+1.7	64,325	1.4	+3,091	+5.0
11	555	1.6	+28	+5.3	64,014	1.3	+3,180	+5.2
10	585	1.7	+20	+3.5	64,793	1.4	+3,364	+5.5
9	527	1.6	-52	-9.0	66,950	1.4	+4,350	+6.9
8	634	1.9	+113	+21.7	71,524	1.5	+7,708	+12.1
7	570	1.7			72,166	1.5	+7,725	+12.0
6	580	1.7	+20	+3.6	72,517	1.5	+7,541	+11.6
5	583	1.7	-25	-4.1	72,404	1.5	+7,467	+11.5
4	529	1.6	-24	-4.3	70,835	1.5	+3,584	+5.3
3	471	1.4	-172	-26.7	68,076	1.4	-3,381	-4.7
2	518	1.5	-89	-14.7	66,318	1.4	-6,248	-8.6
1	449	1.3	-144	-24.3	64,029	1.3	-8,616	-11.9
0	455	1.3	-126	-21.7	62,257	1.3	-10,153	-14.0

Atlas Finder report created on 5/12/2022 Page 3 of 26

1. CSO CENSUS 2016

Age & Deprivation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Age group - all								
85+	471	1.4	-14	-2.9	67,555	1.4	+9,139	+15.6
80-84	580	1.7	+56	+10.7	81,037	1.7	+10,924	+15.6
75-79	882	2.6	+143	+19.4	115,467	2.4	+13,431	+13.2
70-74	1,364	4.0	+381	+38.8	162,272	3.4	+31,082	+23.7
65-69	1,726	5.1	+276	+19.0	211,236	4.4	+37,598	+21.7
60-64	1,863	5.5	+77	+4.3	238,856	5.0	+20,070	+9.2
55-59	2,009	5.9	+136	+7.3	270,102	5.7	+25,580	+10.5
50-54	2,047	6.0	+36	+1.8	299,935	6.3	+25,549	+9.3
45-49	2,344	6.9	+249	+11.9	326,110	6.8	+20,925	+6.9
40-44	2,527	7.5	+123	+5.1	357,460	7.5	+26,648	+8.1
35-39	2,495	7.4	-105	-4.0	389,421	8.2	+25,160	+6.9
30-34	2,044	6.0	-527	-20.5	361,975	7.6	-31,970	-8.1
25-29	1,591	4.7	-570	-26.4	297,435	6.2	-63,687	-17.6
20-24	1,499	4.4	-427	-22.2	273,636	5.7	-23,595	-7.9
15-19	2,368	7.0	+75	+3.3	302,816	6.4	+19,797	+7.0
10-14	2,749	8.1	+116	+4.4	319,476	6.7	+16,985	+5.6
5-9	2,894	8.5	+56	+2.0	355,561	7.5	+34,791	+10.8
0-4	2,422	7.1	-555	-18.6	331,515	7.0	-24,814	-7.0
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Age group (single years)								
18	438	1.3	+3	+0.7	61,294	1.3	+4,454	+7.8
17	523	1.5	+50	+10.6	61,318	1.3	+5,453	+9.8
16	516	1.5	+36	+7.5	60,989	1.3	+4,984	+8.9
15	560	1.7	+44	+8.5	61,643	1.3	+4,416	+7.7
14	556	1.6	+78	+16.3	62,813	1.3	+3,811	+6.5
13	502	1.5	-19	-3.6	63,531	1.3	+3,539	+5.9
12	551	1.6	+9	+1.7	64,325	1.4	+3,091	+5.0
11	555	1.6	+28	+5.3	64,014	1.3	+3,180	+5.2
10	585	1.7	+20	+3.5	64,793	1.4	+3,364	+5.5
9	527	1.6	-52	-9.0	66,950	1.4	+4,350	+6.9
8	634	1.9	+113	+21.7	71,524	1.5	+7,708	+12.1
7	570	1.7			72,166	1.5	+7,725	+12.0
6	580	1.7	+20	+3.6	72,517	1.5	+7,541	+11.6
5	583	1.7	-25	-4.1	72,404	1.5	+7,467	+11.5
4	529	1.6	-24	-4.3	70,835	1.5	+3,584	+5.3
3	471	1.4	-172	-26.7	68,076	1.4	-3,381	-4.7
2	518	1.5	-89	-14.7	66,318	1.4	-6,248	-8.6
1	449	1.3	-144	-24.3	64,029	1.3	-8,616	-11.9
0	455	1.3	-126	-21.7	62,257	1.3	-10,153	-14.0

Health Atlas Ireland - Population Profile
CHN - Inishowen

Age & Deprivation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Deprivation level - HP index								
Extremely affluent	22	0.1	-1	-4.5	77,802	1.6	-1,923	-2.4
Very affluent	310	0.9	+14	+4.9	310,816	6.5	+21,784	+7.5
Affluent	2,093	6.2	+134	+6.9	819,257	17.2	+66,834	+8.9
Marginally above average	6,806	20.1	+233	+3.6	1,277,631	26.8	+68,618	+5.7
Marginally below average	10,909	32.2	-131	-1.2	1,203,652	25.3	+17,594	+1.5
Disadvantaged	8,898	26.3	-460	-4.9	712,558	15.0	-7,382	-1.0
Very disadvantaged	3,821	11.3	-259	-6.3	278,059	5.8	+727	+0.3
Extremely disadvantaged	1,016	3.0	-5	-0.5	82,091	1.7	+7,360	+9.8
HP index determinants								
Age dependency	13,088	38.6	+459	+3.6	1,644,119	34.5	+129,136	+8.5
Classes - professional	1,900	5.6	+111	+6.2	386,648	8.1	+50,028	+14.9
Classes - semi & unskilled	5,692	16.8	-463	-7.5	671,494	14.1	+14,031	+2.1
Education - primary or lower	4,865	14.4	-1,062	-17.9	386,498	8.1	-70,398	-15.4
Education - 3rd level	4,576	13.5	+559	+13.9	881,276	18.5	+141,284	+19.1
Unemployed - aged 15+	2,432	7.2	-1,680	-40.9	265,962	5.6	-124,715	-31.9

Population by sex	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Age group - female								
85+	317	0.9	-4	-1.2	44,493	0.9	+4,563	+11.4
80-84	337	1.0	+31	+10.1	45,841	1.0	+4,151	+10.0
75-79	450	1.3	+48	+11.9	61,350	1.3	+5,945	+10.7
70-74	650	1.9	+155	+31.3	82,771	1.7	+15,057	+22.2
65-69	854	2.5	+169	+24.7	106,275	2.2	+18,935	+21.7
60-64	932	2.8	+56	+6.4	120,158	2.5	+11,241	+10.3
55-59	1,047	3.1	+124	+13.4	136,244	2.9	+13,843	+11.3
50-54	1,048	3.1	+7	+0.7	151,723	3.2	+14,074	+10.2
45-49	1,164	3.4	+85	+7.9	163,286	3.4	+9,617	+6.3
40-44	1,289	3.8	+110	+9.3	179,978	3.8	+15,496	+9.4
35-39	1,261	3.7	-35	-2.7	198,376	4.2	+16,352	+9.0
30-34	1,113	3.3	-144	-11.5	188,796	4.0	-10,375	-5.2
25-29	838	2.5	-298	-26.2	152,213	3.2	-35,195	-18.8
20-24	771	2.3	-183	-19.2	136,052	2.9	-14,543	-9.7
15-19	1,166	3.4	+49	+4.4	147,908	3.1	+9,151	+6.6
10-14	1,294	3.8	-6	-0.5	156,098	3.3	+8,683	+5.9
5-9	1,441	4.3	+95	+7.1	174,091	3.7	+17,358	+11.1
0-4	1,191	3.5	-270	-18.5	161,784	3.4	-12,469	-7.2
Total	17,163	50.7	-11	-0.1	2,407,437	50.6	+91,884	+4.0

Health Atlas Ireland - Population Profile
CHN - Inishowen

Population by sex	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
HP index determinants - female								
Age dependency	6,534	19.3	+218	+3.5	832,703	17.5	+62,223	+8.1
Classes - professional	878	2.6	+94	+12.0	174,806	3.7	+23,510	+15.5
Classes - semi & unskilled	2,693	7.9	-186	-6.5	309,433	6.5	+6,950	+2.3
Education - primary or lower	2,183	6.4	-500	-18.6	182,599	3.8	-34,681	-16.0
Education - 3rd level	2,854	8.4	+368	+14.8	491,432	10.3	+78,175	+18.9
Unemployed - aged 15+	957	2.8	-191	-16.6	112,509	2.4	-23,353	-17.2
Age group - male								
85+	154	0.5	-10	-6.1	23,062	0.5	+4,576	+24.8
80-84	243	0.7	+25	+11.5	35,196	0.7	+6,773	+23.8
75-79	432	1.3	+95	+28.2	54,117	1.1	+7,486	+16.1
70-74	714	2.1	+226	+46.3	79,501	1.7	+16,025	+25.2
65-69	872	2.6	+107	+14.0	104,961	2.2	+18,663	+21.6
60-64	931	2.7	+21	+2.3	118,698	2.5	+8,829	+8.0
55-59	962	2.8	+12	+1.3	133,858	2.8	+11,737	+9.6
50-54	999	2.9	+29	+3.0	148,212	3.1	+11,475	+8.4
45-49	1,180	3.5	+164	+16.1	162,824	3.4	+11,308	+7.5
40-44	1,238	3.7	+13	+1.1	177,482	3.7	+11,152	+6.7
35-39	1,234	3.6	-70	-5.4	191,045	4.0	+8,808	+4.8
30-34	931	2.7	-383	-29.1	173,179	3.6	-21,595	-11.1
25-29	753	2.2	-272	-26.5	145,222	3.0	-28,492	-16.4
20-24	728	2.1	-244	-25.1	137,584	2.9	-9,052	-6.2
15-19	1,202	3.5	+26	+2.2	154,908	3.3	+10,646	+7.4
10-14	1,455	4.3	+122	+9.2	163,378	3.4	+8,302	+5.4
5-9	1,453	4.3	-39	-2.6	181,470	3.8	+17,433	+10.6
0-4	1,231	3.6	-285	-18.8	169,731	3.6	-12,345	-6.8
Total	16,712	49.3	-463	-2.7	2,354,428	49.4	+81,729	+3.6
HP index determinants - male								
Age dependency	6,554	19.3	+241	+3.8	811,416	17.0	+66,913	+9.0
Classes - professional	1,022	3.0	+17	+1.7	211,842	4.4	+26,518	+14.3
Classes - semi & unskilled	2,999	8.9	-277	-8.5	362,061	7.6	+7,081	+2.0
Education - primary or lower	2,682	7.9	-562	-17.3	203,899	4.3	-35,717	-14.9
Education - 3rd level	1,722	5.1	+191	+12.5	389,844	8.2	+63,109	+19.3
Unemployed - aged 15+	1,475	4.4	-1,489	-50.2	153,453	3.2	-101,362	-39.8

Health Atlas Ireland - Population Profile
CHN - Inishowen

Health	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population by general health								
Very good	19,408	57.3	-955	-4.7	2,827,544	59.4	+59,863	+2.2
Good	9,777	28.9	-161	-1.6	1,316,467	27.6	+33,511	+2.6
Fair	3,142	9.3	+24	+0.8	382,905	8.0	+14,774	+4.0
Bad	486	1.4	+44	+10.0	62,697	1.3	+5,454	+9.5
Very bad	94	0.3			13,738	0.3	+1,320	+10.6
Not stated	968	2.9	+574	+145.7	158,514	3.3	+58,691	+58.8
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Population by general health - female								
Very good	9,843	29.1	-319	-3.1	1,426,423	30.0	+35,045	+2.5
Good	4,963	14.7	-38	-0.8	666,152	14.0	+18,233	+2.8
Fair	1,578	4.7	+13	+0.8	198,591	4.2	+6,699	+3.5
Bad	246	0.7	+28	+12.8	32,753	0.7	+3,237	+11.0
Very bad	46	0.1	-8	-14.8	7,187	0.2	+681	+10.5
Not stated	487	1.4	+313	+179.9	76,331	1.6	+27,989	+57.9
Total	17,163	50.7	-11	-0.1	2,407,437	50.6	+91,884	+4.0
Population by general health - male								
Very good	9,565	28.2	-636	-6.2	1,401,121	29.4	+24,818	+1.8
Good	4,814	14.2	-123	-2.5	650,315	13.7	+15,278	+2.4
Fair	1,564	4.6	+11	+0.7	184,314	3.9	+8,075	+4.6
Bad	240	0.7	+16	+7.1	29,944	0.6	+2,217	+8.0
Very bad	48	0.1	+8	+20.0	6,551	0.1	+639	+10.8
Not stated	481	1.4	+261	+118.6	82,183	1.7	+30,702	+59.6
Total	16,712	49.3	-463	-2.7	2,354,428	49.4	+81,729	+3.6
Health indicators								
Health bad/very bad	580	1.7	+44	+8.2	76,435	1.6	+6,774	+9.7
Carers	1,462	4.3	+17	+1.2	195,263	4.1	+8,151	+4.4
Disabled	4,433	13.1	+80	+1.8	643,131	13.5	+47,796	+8.0
Health indicators - female								
Health bad/very bad	292	0.9	+20	+7.4	39,940	0.8	+3,918	+10.9
Carers	919	2.7	+24	+2.7	118,151	2.5	+4,038	+3.5
Disabled	2,253	6.7	-	-	331,551	7.0	-	-
Health indicators - male								
Health bad/very bad	288	0.9	+24	+9.1	36,495	0.8	+2,856	+8.5
Carers	543	1.6	-7	-1.3	77,112	1.6	+4,113	+5.6
Disabled	2,180	6.4	-	-	311,580	6.5	-	-
Persons with a disability by sex								
Female	2,253	6.7	-	-	331,551	7.0	-	-
Male	2,180	6.4	-	-	311,580	6.5	-	-
Total	4,433	13.1	-	-	643,131	13.5	-	-

Health Atlas Ireland - Population Profile
CHN - Inishowen

Health	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Carers by sex								
Female	919	2.7	+24	+2.7	118,151	2.5	+4,038	+3.5
Male	543	1.6	-7	-1.3	77,112	1.6	+4,113	+5.6
Total	1,462	4.3	+17	+1.2	195,263	4.1	+8,151	+4.4

Education	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 15+ years by age education ceased								
Under 15 years	2,518	7.4	-1,087	-30.2	184,266	3.9	-55,642	-23.2
15	1,818	5.4	-463	-20.3	124,642	2.6	-24,938	-16.7
16	2,033	6.0	-654	-24.3	226,150	4.7	-34,892	-13.4
17	1,350	4.0	-379	-21.9	217,663	4.6	-28,177	-11.5
18	1,774	5.2	-96	-5.1	358,642	7.5	-14,047	-3.8
19	652	1.9	-26	-3.8	122,278	2.6	-5,803	-4.5
20	678	2.0	-65	-8.7	117,591	2.5	+2,664	+2.3
21 and over	3,744	11.1	+321	+9.4	757,567	15.9	+115,713	+18.0
Not stated	7,346	21.7	+2,244	+44.0	988,253	20.8	+138,684	+16.3
Total	21,913	64.7	-205	-0.9	3,097,052	65.0	+93,562	+3.1
Population aged 15+ years by age education ceased - female								
Under 15 years	1,044	3.1	-543	-34.2	83,736	1.8	-25,691	-23.5
15	832	2.5	-143	-14.7	52,844	1.1	-11,977	-18.5
16	881	2.6	-256	-22.5	99,761	2.1	-15,863	-13.7
17	650	1.9	-207	-24.2	113,297	2.4	-15,352	-11.9
18	933	2.8	-81	-8.0	187,442	3.9	-8,882	-4.5
19	381	1.1	-28	-6.8	70,002	1.5	-3,503	-4.8
20	422	1.2	-32	-7.0	63,919	1.3	+1,440	+2.3
21 and over	2,262	6.7	+222	+10.9	405,083	8.5	+65,238	+19.2
Not stated	3,804	11.2	+1,180	+45.0	507,184	10.7	+67,851	+15.4
Total	11,209	33.1	+112	+1.0	1,583,268	33.2	+53,261	+3.5
Population aged 15+ years by age education ceased - male								
Under 15 years	1,474	4.4	-544	-27.0	100,530	2.1	-29,951	-23.0
15	986	2.9	-320	-24.5	71,798	1.5	-12,961	-15.3
16	1,152	3.4	-398	-25.7	126,389	2.7	-19,029	-13.1
17	700	2.1	-172	-19.7	104,366	2.2	-12,825	-10.9
18	841	2.5	-15	-1.8	171,200	3.6	-5,165	-2.9
19	271	0.8	+2	+0.7	52,276	1.1	-2,300	-4.2
20	256	0.8	-33	-11.4	53,672	1.1	+1,224	+2.3
21 and over	1,482	4.4	+99	+7.2	352,484	7.4	+50,475	+16.7
Not stated	3,542	10.5	+1,064	+42.9	481,069	10.1	+70,833	+17.3
Total	10,704	31.6	-317	-2.9	1,513,784	31.8	+40,301	+2.7

Health Atlas Ireland - Population Profile
CHN - Inishowen

Education	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 15+ years whose education has not ceased								
Still at school or college	2,772	8.2	+8	+0.3	427,128	9.0	-	-
Other	1,125	3.3	+106	+10.4	231,133	4.9	-	-
Population aged 15+ years whose education has not ceased - female								
Still at school or college	1,438	4.2	-18	-1.2	216,074	4.5	-	-
Other	590	1.7	+76	+14.8	116,122	2.4	-	-
Population aged 15+ years whose education has not ceased - male								
Still at school or college	1,334	3.9	+26	+2.0	211,054	4.4	-	-
Other	535	1.6	+30	+5.9	115,011	2.4	-	-
Population aged 15+ years by field of study								
Education & teacher training	955	2.8	+16	+1.7	123,940	2.6	+11,502	+10.2
Arts	321	0.9	+23	+7.7	61,930	1.3	+5,755	+10.2
Humanities	329	1.0	+14	+4.4	60,801	1.3	+5,376	+9.7
Social sciences, business & law	2,022	6.0	+86	+4.4	453,971	9.5	+40,012	+9.7
Science, mathematics & computing	818	2.4	+77	+10.4	144,500	3.0	+13,937	+10.7
Engineering, manufacturing & construction	1,568	4.6	-184	-10.5	272,231	5.7	-12,694	-4.5
Agriculture & veterinary	520	1.5	-48	-8.5	79,330	1.7	-3,612	-4.4
Health & welfare	1,675	4.9	+196	+13.3	229,845	4.8	+26,886	+13.2
Services	908	2.7	-39	-4.1	134,115	2.8	+715	+0.5
Other subjects	23	0.1	+5	+27.8	3,306	0.1	+158	+5.0
Not stated	12,774	37.7	-351	-2.7	1,533,083	32.2	+5,527	+0.4
Total	21,913	64.7	-205	-0.9	3,097,052	65.0	+93,562	+3.1
Population aged 15+ years by field of study - female								
Education & teacher training	767	2.3	+10	+1.3	98,557	2.1	+10,328	+11.7
Arts	181	0.5	+17	+10.4	33,555	0.7	+2,349	+7.5
Humanities	181	0.5	+11	+6.5	36,809	0.8	+3,710	+11.2
Social sciences, business & law	1,438	4.2	+72	+5.3	280,834	5.9	+19,604	+7.5
Science, mathematics & computing	395	1.2	+13	+3.4	59,572	1.3	-166	-0.3
Engineering, manufacturing & construction	107	0.3	+3	+2.9	25,436	0.5	+1,403	+5.8
Agriculture & veterinary	44	0.1			13,206	0.3	+279	+2.2
Health & welfare	1,451	4.3	+133	+10.1	194,033	4.1	+21,035	+12.2
Services	607	1.8	-37	-5.7	82,314	1.7	-857	-1.0
Other subjects	14	0.0	+3	+27.3	2,042	0.0	+158	+8.4
Not stated	6,024	17.8	-113	-1.8	756,910	15.9	-4,582	-0.6
Total	11,209	33.1	+112	+1.0	1,583,268	33.2	+53,261	+3.5

Health Atlas Ireland - Population Profile
CHN - Inishowen

Education	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 15+ years by field of study - male								
Education & teacher training	188	0.6	+6	+3.3	25,383	0.5	+1,174	+4.8
Arts	140	0.4	+6	+4.5	28,375	0.6	+3,406	+13.6
Humanities	148	0.4	+3	+2.1	23,992	0.5	+1,666	+7.5
Social sciences, Business & Law	584	1.7	+14	+2.5	173,137	3.6	+20,408	+13.4
Science, mathematics & computing	423	1.2	+64	+17.8	84,928	1.8	+14,103	+19.9
Engineering, manufacturing & construction	1,461	4.3	-187	-11.3	246,795	5.2	-14,097	-5.4
Agriculture & veterinary	476	1.4	-48	-9.2	66,124	1.4	-3,891	-5.6
Health & welfare	224	0.7	+63	+39.1	35,812	0.8	+5,851	+19.5
Services	301	0.9	-2	-0.7	51,801	1.1	+1,572	+3.1
Other subjects	9	0.0	+2	+28.6	1,264	0.0		
Not stated	6,750	19.9	-238	-3.4	776,173	16.3	+10,109	+1.3
Total	10,704	31.6	-317	-2.9	1,513,784	31.8	+40,301	+2.7
Population aged 15+ years by highest level of education completed								
No formal education	856	2.5	+305	+55.4	52,214	1.1	+9,827	+23.2
Primary education	4,009	11.8	-1,367	-25.4	334,284	7.0	-80,225	-19.4
Lower secondary	3,921	11.6	-561	-12.5	449,766	9.4	-49,723	-10.0
Upper secondary	3,216	9.5	-166	-4.9	573,643	12.0	-27,855	-4.6
Technical or vocational qualification	1,730	5.1	+126	+7.9	271,532	5.7	+12,835	+5.0
Advanced certificate/ completed apprenticeship	931	2.7	+51	+5.8	182,318	3.8	+10,393	+6.0
Higher certificate	1,012	3.0	+81	+8.7	153,351	3.2	+18,229	+13.5
Ordinary bachelor degree or national diploma	1,268	3.7	+140	+12.4	237,117	5.0	+15,140	+6.8
Honours bachelor degree, professional qualification or both	1,811	5.3	+214	+13.4	331,293	7.0	+59,992	+22.1
Postgraduate diploma or degree	1,382	4.1	+172	+14.2	284,107	6.0	+59,363	+26.4
Doctorate(Ph.D) or higher	115	0.3	+33	+40.2	28,759	0.6	+6,789	+30.9
Not stated	1,662	4.9	+767	+85.7	198,668	4.2	+58,797	+42.0
Total	21,913	64.7	-205	-0.9	3,097,052	65.0	+93,562	+3.1

Health Atlas Ireland - Population Profile
CHN - Inishowen

Education	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 15+ years by highest level of education completed - female								
No formal education	377	1.1	+127	+50.8	23,918	0.5	+4,617	+23.9
Primary education	1,806	5.3	-627	-25.8	158,681	3.3	-39,298	-19.8
Lower secondary	1,714	5.1	-207	-10.8	206,638	4.3	-24,659	-10.7
Upper secondary	1,641	4.8	-119	-6.8	304,968	6.4	-21,688	-6.6
Technical or vocational qualification	1,018	3.0	+95	+10.3	148,594	3.1	+10,263	+7.4
Advanced certificate/ completed apprenticeship	365	1.1	+26	+7.7	62,730	1.3	+7,705	+14.0
Higher certificate	580	1.7	+49	+9.2	87,061	1.8	+11,298	+14.9
Ordinary bachelor degree or national diploma	787	2.3	+89	+12.8	130,425	2.7	+6,908	+5.6
Honours bachelor degree, professional qualification or both	1,148	3.4	+163	+16.5	183,833	3.9	+33,494	+22.3
Postgraduate diploma or degree	864	2.6	+102	+13.4	164,431	3.5	+33,982	+26.1
Doctorate(Ph.D) or higher	55	0.2	+14	+34.1	12,743	0.3	+3,791	+42.3
Not stated	854	2.5	+400	+88.1	99,246	2.1	+26,848	+37.1
Total	11,209	33.1	+112	+1.0	1,583,268	33.2	+53,261	+3.5
Population aged 15+ years by highest level of education completed - male								
No formal education	479	1.4	+178	+59.1	28,296	0.6	+5,210	+22.6
Primary education	2,203	6.5	-740	-25.1	175,603	3.7	-40,927	-18.9
Lower secondary	2,207	6.5	-354	-13.8	243,128	5.1	-25,064	-9.3
Upper secondary	1,575	4.6	-47	-2.9	268,675	5.6	-6,167	-2.2
Technical or vocational qualification	712	2.1	+31	+4.6	122,938	2.6	+2,572	+2.1
Advanced certificate/ completed apprenticeship	566	1.7	+25	+4.6	119,588	2.5	+2,688	+2.3
Higher certificate	432	1.3	+32	+8.0	66,290	1.4	+6,931	+11.7
Ordinary bachelor degree or national diploma	481	1.4	+51	+11.9	106,692	2.2	+8,232	+8.4
Honours bachelor degree, professional qualification or both	663	2.0	+51	+8.3	147,460	3.1	+26,498	+21.9
Postgraduate diploma or degree	518	1.5	+70	+15.6	119,676	2.5	+25,381	+26.9
Doctorate(Ph.D) or higher	60	0.2	+19	+46.3	16,016	0.3	+2,998	+23.0
Not stated	808	2.4	+367	+83.2	99,422	2.1	+31,949	+47.4
Total	10,704	31.6	-317	-2.9	1,513,784	31.8	+40,301	+2.7

Health Atlas Ireland - Population Profile
CHN - Inishowen

Socio-Economic	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population by social class								
Professional workers	1,900	5.6	+111	+6.2	386,648	8.1	+50,028	+14.9
Managerial & technical	7,773	22.9	-145	-1.8	1,336,896	28.1	+85,225	+6.8
Non-manual	5,659	16.7	+62	+1.1	837,145	17.6	+35,841	+4.5
Skilled manual	6,277	18.5	-1,106	-15.0	671,890	14.1	-35,479	-5.0
Semi-skilled	4,266	12.6	-220	-4.9	501,103	10.5	+13,654	+2.8
Unskilled	1,426	4.2	-243	-14.6	170,391	3.6	+377	+0.2
All others gainfully occupied & unknown	6,574	19.4	+1,067	+19.4	857,792	18.0	+23,967	+2.9
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Population by social class - female								
Professional workers	878	2.6	+94	+12.0	174,806	3.7	+23,510	+15.5
Managerial & technical	4,205	12.4	-58	-1.4	709,195	14.9	+45,455	+6.8
Non-manual	3,487	10.3	+16	+0.5	513,101	10.8	+18,568	+3.8
Skilled manual	2,390	7.1	-369	-13.4	241,289	5.1	-8,943	-3.6
Semi-skilled	2,079	6.1	-107	-4.9	233,149	4.9	+5,243	+2.3
Unskilled	614	1.8	-79	-11.4	76,284	1.6	+1,707	+2.3
All others gainfully occupied & unknown	3,510	10.4	+492	+16.3	459,613	9.7	+6,344	+1.4
Total	17,163	50.7	-11	-0.1	2,407,437	50.6	+91,884	+4.0
Population by social class - male								
Professional workers	1,022	3.0	+17	+1.7	211,842	4.4	+26,518	+14.3
Managerial & technical	3,568	10.5	-87	-2.4	627,701	13.2	+39,770	+6.8
Non-manual	2,172	6.4	+46	+2.2	324,044	6.8	+17,273	+5.6
Skilled manual	3,887	11.5	-737	-15.9	430,601	9.0	-26,536	-5.8
Semi-skilled	2,187	6.5	-113	-4.9	267,954	5.6	+8,411	+3.2
Unskilled	812	2.4	-164	-16.8	94,107	2.0	-1,330	-1.4
All others gainfully occupied & unknown	3,064	9.0	+575	+23.1	398,179	8.4	+17,623	+4.6
Total	16,712	49.3	-463	-2.7	2,354,428	49.4	+81,729	+3.6
Persons in private households by socio-economic group of reference person								
A Employers & managers	4,335	12.8	-720	-14.2	722,585	15.2	+18,859	+2.7
B Higher professional	1,499	4.4	+15	+1.0	330,313	6.9	+37,290	+12.7
C Lower professional	3,475	10.3	+260	+8.1	548,805	11.5	+65,381	+13.5
D Non-manual	4,870	14.4	+547	+12.7	841,337	17.7	+73,683	+9.6
E Manual skilled	3,852	11.4	-325	-7.8	436,768	9.2	-23,425	-5.1
F Semi-skilled	2,833	8.4	-364	-11.4	403,657	8.5	+10,938	+2.8
G Unskilled	1,468	4.3	-254	-14.8	167,976	3.5	+2,242	+1.4
H Own account workers	2,422	7.1	-602	-19.9	243,997	5.1	-24,683	-9.2
I Farmers	2,784	8.2	-304	-9.8	227,052	4.8	-16,328	-6.7
J Agricultural workers	149	0.4	-35	-19.0	25,141	0.5	-978	-3.7
Z All others gainfully occupied & unknown	5,789	17.1	+1,125	+24.1	729,017	15.3	+23,260	+3.3
Total	33,476	98.8	-657	-1.9	4,676,648	98.2	+166,239	+3.7

Health Atlas Ireland - Population Profile
CHN - Inishowen

Occupation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Persons at work or unemployed by occupation								
Managers, directors & senior officials	850	2.5	-75	-8.1	169,032	3.5	-2,377	-1.4
Professional occupations	2,021	6.0	+73	+3.7	393,608	8.3	+39,827	+11.3
Associate professional & technical occupations	1,053	3.1	+32	+3.1	248,413	5.2	+17,253	+7.5
Administrative & secretarial occupations	1,250	3.7	+4	+0.3	228,032	4.8	+1,380	+0.6
Skilled trades occupations	3,014	8.9	-607	-16.8	316,313	6.6	-31,791	-9.1
Caring, leisure & other service occupations	1,300	3.8	+107	+9.0	166,163	3.5	+21,574	+14.9
Sales & customer service occupations	912	2.7	-57	-5.9	155,030	3.3	-250	-0.2
Process, plant & machine operatives	1,026	3.0	-152	-12.9	162,641	3.4	-5,095	-3.0
Elementary occupations	1,310	3.9	-136	-9.4	200,287	4.2	-1,443	-0.7
Not stated	1,682	5.0	+596	+54.9	233,084	4.9	+35,488	+18.0
Total	14,418	42.6	-215	-1.5	2,272,603	47.7	+74,566	+3.4
Persons at work or unemployed by occupation - female								
Managers, directors & senior officials	306	0.9	-21	-6.4	63,328	1.3	+1,768	+2.9
Professional occupations	1,222	3.6	+26	+2.2	220,809	4.6	+18,187	+9.0
Associate professional & technical occupations	440	1.3	+37	+9.2	102,982	2.2	+10,066	+10.8
Administrative & secretarial occupations	1,039	3.1	+2	+0.2	177,738	3.7	-4,940	-2.7
Skilled trades occupations	202	0.6	-17	-7.8	29,136	0.6	-1,939	-6.2
Caring, leisure & other service occupations	1,077	3.2	+34	+3.3	136,646	2.9	+14,429	+11.8
Sales & customer service occupations	624	1.8	-67	-9.7	100,438	2.1	-2,566	-2.5
Process, plant & machine operatives	160	0.5	-41	-20.4	27,692	0.6	+96	+0.3
Elementary occupations	585	1.7	+45	+8.3	79,892	1.7	+492	+0.6
Not stated	732	2.2	+299	+69.1	103,815	2.2	+18,202	+21.3
Total	6,387	18.9	+297	+4.9	1,042,476	21.9	+53,795	+5.4

Health Atlas Ireland - Population Profile
CHN - Inishowen

Occupation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Persons at work or unemployed by occupation - male								
Managers, directors & senior officials	544	1.6	-54	-9.0	105,704	2.2	-4,145	-3.8
Professional occupations	799	2.4	+47	+6.3	172,799	3.6	+21,640	+14.3
Associate professional & technical occupations	613	1.8	-5	-0.8	145,431	3.1	+7,187	+5.2
Administrative & secretarial occupations	211	0.6	+2	+1.0	50,294	1.1	+6,320	+14.4
Skilled trades occupations	2,812	8.3	-590	-17.3	287,177	6.0	-29,852	-9.4
Caring, leisure & other service occupations	223	0.7	+73	+48.7	29,517	0.6	+7,145	+31.9
Sales & customer service occupations	288	0.9	+10	+3.6	54,592	1.1	+2,316	+4.4
Process, plant & machine operatives	866	2.6	-111	-11.4	134,949	2.8	-5,191	-3.7
Elementary occupations	725	2.1	-181	-20.0	120,395	2.5	-1,935	-1.6
Not stated	950	2.8	+297	+45.5	129,269	2.7	+17,286	+15.4
Total	8,031	23.7	-512	-6.0	1,230,127	25.8	+20,771	+1.7
Persons at work by industry								
Agriculture, forestry & fishing	949	2.8	+7	+0.7	89,116	1.9	-2,410	-2.6
Building & construction	1,011	3.0	+169	+20.1	101,849	2.1	+14,478	+16.6
Manufacturing industries	1,013	3.0	+145	+16.7	229,548	4.8	+19,745	+9.4
Commerce & trade	2,229	6.6	+65	+3.0	480,117	10.1	+23,828	+5.2
Transport & communications	665	2.0	+63	+10.5	171,194	3.6	+24,664	+16.8
Public administration	602	1.8	-66	-9.9	106,797	2.2	-7,063	-6.2
Professional services	3,031	8.9	+313	+11.5	471,656	9.9	+46,307	+10.9
Other	2,486	7.3	+769	+44.8	356,364	7.5	+79,732	+28.8
Total	11,986	35.4	+1,465	+13.9	2,006,641	42.1	+199,281	+11.0
Persons at work by industry - female								
Agriculture, forestry & fishing	70	0.2	+3	+4.5	10,485	0.2	-610	-5.5
Building & construction	61	0.2	+9	+17.3	7,211	0.2	+14	+0.2
Manufacturing industries	179	0.5	-7	-3.8	66,569	1.4	+4,679	+7.6
Commerce & trade	1,105	3.3	-18	-1.6	231,794	4.9	+4,040	+1.8
Transport & communications	137	0.4	+6	+4.6	46,328	1.0	+8,067	+21.1
Public administration	311	0.9	-60	-16.2	50,846	1.1	-3,072	-5.7
Professional services	2,281	6.7	+208	+10.0	341,979	7.2	+30,618	+9.8
Other	1,286	3.8	+347	+37.0	174,755	3.7	+33,412	+23.6
Total	5,430	16.0	+488	+9.9	929,967	19.5	+77,148	+9.0

Health Atlas Ireland - Population Profile
CHN - Inishowen

Occupation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Persons at work by industry - male								
Agriculture, forestry & fishing	879	2.6	+4	+0.5	78,631	1.7	-1,800	-2.2
Building & construction	950	2.8	+160	+20.3	94,638	2.0	+14,464	+18.0
Manufacturing industries	834	2.5	+152	+22.3	162,979	3.4	+15,066	+10.2
Commerce & trade	1,124	3.3	+83	+8.0	248,323	5.2	+19,788	+8.7
Transport & communications	528	1.6	+57	+12.1	124,866	2.6	+16,597	+15.3
Public administration	291	0.9	-6	-2.0	55,951	1.2	-3,991	-6.7
Professional services	750	2.2	+105	+16.3	129,677	2.7	+15,689	+13.8
Other	1,200	3.5	+422	+54.2	181,609	3.8	+46,320	+34.2
Total	6,556	19.4	+977	+17.5	1,076,674	22.6	+122,133	+12.8
Population aged 15+ years by principal economic status								
At work	11,986	35.4	+1,465	+13.9	2,006,641	42.1	+199,281	+11.0
Looking for first regular job	231	0.7	-95	-29.1	31,434	0.7	-2,732	-8.0
Unemployed having lost or given up previous job	2,432	7.2	-1,680	-40.9	265,962	5.6	-124,715	-31.9
Student	2,772	8.2	+8	+0.3	427,128	9.0	+18,290	+4.5
Looking after home/ family	2,690	7.9	-475	-15.0	305,556	6.4	-34,362	-10.1
Retired	4,463	13.2	+736	+19.7	545,407	11.5	+88,013	+19.2
Unable to work due to permanent sickness or disability	1,140	3.4	-95	-7.7	158,348	3.3	+1,355	+0.9
Other	96	0.3	+45	+88.2	14,837	0.3	+1,521	+11.4
Total	25,810	76.2	-91	-0.4	3,755,313	78.9	+146,651	+4.1
Population aged 15+ years by principal economic status - female								
At work	5,430	16.0	+488	+9.9	929,967	19.5	+77,148	+9.0
Looking for first regular job	113	0.3	-17	-13.1	13,957	0.3	-697	-4.8
Unemployed having lost or given up previous job	957	2.8	-191	-16.6	112,509	2.4	-23,353	-17.2
Student	1,438	4.2	-18	-1.2	216,074	4.5	+8,439	+4.1
Looking after home/ family	2,474	7.3	-523	-17.5	284,809	6.0	-37,069	-11.5
Retired	2,223	6.6	+416	+23.0	270,171	5.7	+50,186	+22.8
Unable to work due to permanent sickness or disability	533	1.6	-23	-4.1	79,952	1.7	+2,461	+3.2
Other	69	0.2	+38	+122.6	8,025	0.2	+1,197	+17.5
Total	13,237	39.1	+170	+1.3	1,915,464	40.2	+78,312	+4.3

Health Atlas Ireland - Population Profile
CHN - Inishowen

Occupation	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 15+ years by principal economic status - male								
At work	6,556	19.4	+977	+17.5	1,076,674	22.6	+122,133	+12.8
Looking for first regular job	118	0.3	-78	-39.8	17,477	0.4	-2,035	-10.4
Unemployed having lost or given up previous job	1,475	4.4	-1,489	-50.2	153,453	3.2	-101,362	-39.8
Student	1,334	3.9	+26	+2.0	211,054	4.4	+9,851	+4.9
Looking after home/ family	216	0.6	+48	+28.6	20,747	0.4	+2,707	+15.0
Retired	2,240	6.6	+320	+16.7	275,236	5.8	+37,827	+15.9
Unable to work due to permanent sickness or disability	607	1.8	-72	-10.6	78,396	1.6	-1,106	-1.4
Other	27	0.1	+7	+35.0	6,812	0.1	+324	+5.0
Total	12,573	37.1	-261	-2.0	1,839,849	38.6	+68,339	+3.9

Housing	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Private households by type of accommodation								
House/bungalow	11,464	33.8	-13	-0.1	1,471,650	30.9	+33,305	+2.3
Flat/apartment	385	1.1	-1	-0.3	200,879	4.2	+23,292	+13.1
Bed-sit			-3	-100.0	3,266	0.1	-2,429	-42.7
Caravan/mobile home	31	0.1	-7	-18.4	4,624	0.1	-176	-3.7
Not stated	150	0.4	+27	+22.0	21,870	0.5	-5,911	-21.3
Total	12,030	35.5	+3	+0.0	1,702,289	35.7	+48,081	+2.9
Persons by household type of accommodation								
House/bungalow	32,409	95.7	-749	-2.3	4,185,099	87.9	+105,471	+2.6
Flat/apartment	590	1.7	+26	+4.6	415,012	8.7	+72,662	+21.2
Bed-sit			-3	-100.0	4,588	0.1	-3,417	-42.7
Caravan/mobile home	68	0.2	+9	+15.3	10,272	0.2	+432	+4.4
Not stated	409	1.2	+60	+17.2	61,677	1.3	-8,909	-12.6
Total	33,476	98.8	-657	-1.9	4,676,648	98.2	+166,239	+3.7
Permanent private households by year built								
Pre 1919	896	2.6	-105	-10.5	141,200	3.0	-8,739	-5.8
1919-1945	463	1.4	-55	-10.6	109,668	2.3	-5,149	-4.5
1946-1960	543	1.6	-45	-7.7	126,107	2.6	-1,584	-1.2
1961-1970	510	1.5	-14	-2.7	116,041	2.4	+1,531	+1.3
1971-1980	1,363	4.0	-88	-6.1	213,473	4.5	-724	-0.3
1981-1990	1,449	4.3	-57	-3.8	171,044	3.6	-1,369	-0.8
1991-2000	1,895	5.6	+109	+6.1	240,811	5.1	+2,087	+0.9
2001-2010	4,148	12.2	-	-	431,763	9.1	-	-
2011 or later	230	0.7	-	-	33,436	0.7	-	-
Not stated	502	1.5	+234	+87.3	114,122	2.4	+34,512	+43.4
Total	11,999	35.4	+4,357	+57.0	1,697,665	35.7	+485,764	+40.1

Health Atlas Ireland - Population Profile
CHN - Inishowen

Housing	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Persons by permanent private household year built								
Pre 1919	1,800	5.3	-288	-13.8	320,897	6.7	-19,618	-5.8
1919-1945	936	2.8	-192	-17.0	253,302	5.3	-12,397	-4.7
1946-1960	1,105	3.3	-97	-8.1	306,286	6.4	-5,012	-1.6
1961-1970	1,089	3.2	-111	-9.3	286,256	6.0	+350	+0.1
1971-1980	3,079	9.1	-631	-17.0	550,989	11.6	-27,122	-4.7
1981-1990	3,846	11.4	-776	-16.8	474,738	10.0	-35,079	-6.9
1991-2000	6,249	18.4	-13	-0.2	747,536	15.7	-2,377	-0.3
2001-2010	13,287	39.2	-	-	1,325,437	27.8	-	-
2011 or later	730	2.2	-	-	97,848	2.1	-	-
Not stated	1,287	3.8	+559	+76.8	303,087	6.4	+94,346	+45.2
Total	33,408	98.6	+12,468	+59.5	4,666,376	98.0	+1,416,376	+43.6
Permanent private households by type of occupancy								
Owner occupied with mortgage	3,449	10.2	-519	-13.1	535,675	11.2	-47,473	-8.1
Owner occupied no mortgage	5,596	16.5	+297	+5.6	611,877	12.8	+45,101	+8.0
Rented from private landlord	1,328	3.9	-62	-4.5	309,728	6.5	+4,351	+1.4
Rented from voluntary body	76	0.2	+1	+1.3	16,765	0.4	+1,823	+12.2
Rented from local authority	898	2.7	+64	+7.7	143,178	3.0	+14,145	+11.0
Occupied free of rent	301	0.9	-9	-2.9	27,440	0.6	+2,004	+7.9
Not stated	351	1.0	+238	+210.6	53,002	1.1	+28,306	+114.6
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Persons by permanent private household by type of occupancy								
Owner occupied with mortgage	12,383	36.6	-1,462	-10.6	1,800,187	37.8	-88,639	-4.7
Owner occupied no mortgage	13,688	40.4	+5	+0.0	1,419,235	29.8	+72,645	+5.4
Rented from private landlord	3,341	9.9	+111	+3.4	831,636	17.5	+61,261	+8.0
Rented from voluntary body	131	0.4	-19	-12.7	39,111	0.8	+4,771	+13.9
Rented from local authority	2,332	6.9	+76	+3.4	393,198	8.3	+38,206	+10.8
Occupied free of rent	653	1.9	+24	+3.8	54,116	1.1	+6,233	+13.0
Not stated	880	2.6	+599	+213.2	128,893	2.7	+71,330	+123.9
Total	33,408	98.6	-666	-2.0	4,666,376	98.0	+165,807	+3.7

Health Atlas Ireland - Population Profile
CHN - Inishowen

Housing	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Permanent private households by number of rooms								
1 room	72	0.2	+21	+41.2	23,752	0.5	+694	+3.0
2 rooms	360	1.1	+21	+6.2	88,719	1.9	+10,346	+13.2
3 rooms	928	2.7	+91	+10.9	172,739	3.6	+16,008	+10.2
4 rooms	1,338	3.9	+70	+5.5	179,989	3.8	+5,693	+3.3
5 rooms	2,552	7.5	-159	-5.9	378,691	8.0	-1,424	-0.4
6 rooms	2,610	7.7	-137	-5.0	299,371	6.3	-275	-0.1
7 rooms	1,639	4.8	-109	-6.2	222,308	4.7	-1,527	-0.7
8 or more rooms	1,817	5.4	-96	-5.0	238,043	5.0	-8,983	-3.6
Not stated	683	2.0	+308	+82.1	94,053	2.0	+27,725	+41.8
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Persons by permanent private household by number of rooms								
1 room	95	0.3	+35	+58.3	36,348	0.8	+2,959	+8.9
2 rooms	570	1.7	+60	+11.8	169,591	3.6	+31,039	+22.4
3 rooms	1,914	5.7	+231	+13.7	414,481	8.7	+63,717	+18.2
4 rooms	3,060	9.0	+332	+12.2	423,608	8.9	+33,490	+8.6
5 rooms	6,635	19.6	-439	-6.2	1,011,046	21.2	+17,910	+1.8
6 rooms	7,438	22.0	-660	-8.2	854,409	17.9	+6,608	+0.8
7 rooms	5,422	16.0	-465	-7.9	699,893	14.7	-8,694	-1.2
8 or more rooms	6,618	19.5	-445	-6.3	831,107	17.5	-47,978	-5.5
Not stated	1,656	4.9	+685	+70.5	225,893	4.7	+66,756	+41.9
Total	33,408	98.6	-666	-2.0	4,666,376	98.0	+165,807	+3.7
Permanent private households by heating								
No central heating	76	0.2	-22	-22.4	23,174	0.5	-3,778	-14.0
Oil	7,086	20.9	-570	-7.4	686,004	14.4	-25,326	-3.6
Natural gas	55	0.2	+3	+5.8	569,166	12.0	+18,951	+3.4
Electricity	229	0.7	+26	+12.8	146,302	3.1	+5,883	+4.2
Coal (incl. Anthracite)	2,120	6.3	+426	+25.1	86,611	1.8	+7,466	+9.4
Peat (incl. turf)	1,798	5.3	-148	-7.6	90,029	1.9	+11,391	+14.5
Liquid Petroleum Gas (LPG)	27	0.1	+4	+17.4	9,990	0.2	-462	-4.4
Wood (incl. wood pellets)	154	0.5	+15	+10.8	33,976	0.7	+12,581	+58.8
Other	156	0.5	+54	+52.9	11,068	0.2	+2,544	+29.8
Not stated	298	0.9	+222	+292.1	41,345	0.9	+19,007	+85.1
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9

Health Atlas Ireland - Population Profile
CHN - Inishowen

Housing	National % / Area %	Area 2016 #	Area 2016 %	Area change since 2011 #	Area change since 2011 %	National 2016 #	National 2016 %	National change since 2011 #	National change since 2011 %
Permanent private households by water supply									
Public main		8,538	25.2	-466	-5.2	1,306,678	27.4	+59,493	+4.8
Group scheme with public source		1,323	3.9	-29	-2.1	106,278	2.2	-38,150	-26.4
Group scheme with private source		352	1.0	+149	+73.4	40,952	0.9	-4,822	-10.5
Other private source		1,226	3.6	+85	+7.4	171,926	3.6	+10,394	+6.4
None		16	0.0	-1	-5.9	2,281	0.0	+201	+9.7
Not stated		544	1.6	+272	+100.0	69,550	1.5	+21,141	+43.7
Total		11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Permanent private households by sewerage facility									
Public scheme		4,837	14.3	-89	-1.8	1,118,401	23.5	+25,983	+2.4
Individual septic tank		5,821	17.2	-204	-3.4	438,319	9.2	+667	+0.2
Other individual treatment		508	1.5	+25	+5.2	50,750	1.1	+491	+1.0
Other		244	0.7	+35	+16.7	10,107	0.2	+737	+7.9
No sewerage facility		15	0.0	-7	-31.8	2,266	0.0	-289	-11.3
Not stated		574	1.7	+250	+77.2	77,822	1.6	+20,668	+36.2
Total		11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Occupancy status of permanent dwellings on Census night									
Occupied		12,202	36.0	+84	+0.7	1,707,453	35.9	+47,342	+2.9
Temporarily absent		374	1.1	-	-	50,732	1.1	-	-
Unoccupied				-5,057	-100.0			-334,734	-100.0
Unoccupied holiday homes		2,027	6.0	-	-	62,148	1.3	-	-
Other vacant dwellings		2,341	6.9	-	-	183,312	3.8	-	-
Total		16,944	50.0	-231	-1.3	2,003,645	42.1	+8,800	+0.4
Private households by type									
One person		3,117	9.2	+158	+5.3	399,815	8.4	+7,815	+2.0
Married couple		2,063	6.1	+176	+9.3	254,744	5.3	+14,598	+6.1
Cohabiting couple		243	0.7	-9	-3.6	68,396	1.4	-4,715	-6.4
Married couple & children		4,206	12.4	-260	-5.8	529,687	11.1	+6,728	+1.3
Cohabiting couple & children		389	1.1	+59	+17.9	68,979	1.4	+14,068	+25.6
Father & children		194	0.6	+5	+2.6	24,731	0.5	+234	+1.0
Mother & children		1,077	3.2	-96	-8.2	153,189	3.2	-2,075	-1.3
Couple & others		97	0.3	-12	-11.0	20,294	0.4	-1,403	-6.5
Couple, children & others		127	0.4	-19	-13.0	32,448	0.7	+1,989	+6.5
Father, children & others		8	0.0	-5	-38.5	3,413	0.1	+427	+14.3
Two or more family units		94	0.3	+1	+1.1	22,380	0.5	+3,611	+19.2
Mother, children & others		63	0.2	-10	-13.7	17,206	0.4	+2,016	+13.3
Non-family households & relations		194	0.6	-50	-20.5	37,648	0.8	-1,963	-5.0
Two or more non-related persons		158	0.5	+65	+69.9	69,359	1.5	+6,751	+10.8
Total		12,030	35.5	+3	+0.0	1,702,289	35.7	+48,081	+2.9

Health Atlas Ireland - Population Profile
CHN - Inishowen

Housing	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Persons by private household type								
One person	3,117	9.2	+158	+5.3	399,815	8.4	+7,815	+2.0
Married couple	4,126	12.2	+352	+9.3	509,488	10.7	+29,196	+6.1
Cohabiting couple	486	1.4	-18	-3.6	136,792	2.9	-9,430	-6.4
Married couple & children	18,107	53.5	-1,138	-5.9	2,174,232	45.7	+27,165	+1.3
Cohabiting couple & children	1,536	4.5	+260	+20.4	265,523	5.6	+59,196	+28.7
Father & children	503	1.5	+16	+3.3	61,637	1.3	-377	-0.6
Mother & children	2,934	8.7	-235	-7.4	414,458	8.7	-5,553	-1.3
Couple & others	318	0.9	-35	-9.9	68,178	1.4	-4,582	-6.3
Couple, children & others	662	2.0	-100	-13.1	167,549	3.5	+11,035	+7.1
Father, children & others	31	0.1	-20	-39.2	12,564	0.3	+1,679	+15.4
Two or more family units	506	1.5	-11	-2.1	120,791	2.5	+19,853	+19.7
Mother, children & others	233	0.7	-39	-14.3	64,019	1.3	+7,885	+14.0
Non-family households & relations	441	1.3	-107	-19.5	89,483	1.9	-3,181	-3.4
Two or more non-related persons	476	1.4	+260	+120.4	192,119	4.0	+25,538	+15.3
Total	33,476	98.8	-657	-1.9	4,676,648	98.2	+166,239	+3.7
Private households by size								
1 person	3,117	9.2	+158	+5.3	399,815	8.4	+7,815	+2.0
2 persons	3,250	9.6	+59	+1.8	486,536	10.2	+7,265	+1.5
3 persons	1,818	5.4	-130	-6.7	297,565	6.2	+1,555	+0.5
4 persons	1,886	5.6	-26	-1.4	288,328	6.1	+20,192	+7.5
5 persons	1,215	3.6	+3	+0.2	154,841	3.3	+9,739	+6.7
6 persons	517	1.5	-2	-0.4	54,016	1.1	+1,241	+2.4
7 persons	160	0.5	-38	-19.2	14,282	0.3	+108	+0.8
8 or more persons	67	0.2	-21	-23.9	6,906	0.1	+166	+2.5
Total	12,030	35.5	+3	+0.0	1,702,289	35.7	-	-
Persons by private household size								
1 person	3,117	9.2	+158	+5.3	399,815	8.4	+7,815	+2.0
2 persons	6,500	19.2	+118	+1.8	973,072	20.4	+14,530	+1.5
3 persons	5,454	16.1	-390	-6.7	892,695	18.7	+4,665	+0.5
4 persons	7,544	22.3	-104	-1.4	1,153,312	24.2	+80,768	+7.5
5 persons	6,075	17.9	+15	+0.2	774,205	16.3	+48,695	+6.7
6 persons	3,102	9.2	-12	-0.4	324,096	6.8	+7,446	+2.4
7 persons	1,120	3.3	-266	-19.2	99,974	2.1	+756	+0.8
8 or more persons	564	1.7	-176	-23.8	59,479	1.2	+1,564	+2.7
Total	33,476	98.8	-657	-1.9	4,676,648	98.2	+166,239	+3.7
Number of communal establishments & persons in communal establishments								
Number of establishments	34	0.1	+9	+36.0	4,140	0.1	+105	+2.6
Number of persons	492	1.5	+163	+49.5	126,199	2.7	+16,302	+14.8

Health Atlas Ireland - Population Profile
CHN - Inishowen

Migration & Ethnicity	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Nationality								
Irish	30,519	90.1	-587	-1.9	4,082,513	85.7	+155,370	+4.0
UK	1,259	3.7	-237	-15.8	103,113	2.2	-9,146	-8.1
Polish	285	0.8	-6	-2.1	122,515	2.6	-70	-0.1
Lithuanian	93	0.3	-9	-8.8	36,552	0.8	-131	-0.4
Elsewhere in EU	257	0.8	-5	-1.9	146,738	3.1	+31,501	+27.3
Elsewhere in world	204	0.6	-47	-18.7	126,557	2.7	-31,036	-19.7
Visitors/Not stated	1,258	3.7	+417	+49.6	143,877	3.0	+27,125	+23.2
Birthplace								
Ireland	24,625	72.7	+47	+0.2	3,879,515	81.5	+121,004	+3.2
UK	7,314	21.6	-654	-8.2	277,206	5.8	-11,421	-4.0
Poland	259	0.8	-19	-6.8	115,161	2.4	-32	-0.0
Lithuania	87	0.3	-10	-10.3	33,344	0.7	-1,503	-4.3
Other EU 28	249	0.7	-17	-6.4	145,282	3.1	+28,355	+24.3
Rest of world	529	1.6	-38	-6.7	239,413	5.0	+28,237	+13.4
Not stated			-	-			-	-
Total	33,063	97.6	-691	-2.0	4,689,921	98.5	+164,640	+3.6
Ethnic or cultural background								
White Irish	30,162	89.0	-1,073	-3.4	3,854,226	80.9	+32,231	+0.8
White Irish Traveller	48	0.1	-21	-30.4	30,987	0.7	+1,492	+5.1
White Other	1,669	4.9	-270	-13.9	446,727	9.4	+33,752	+8.2
Black or Black Irish	38	0.1	-3	-7.3	64,639	1.4	-439	-0.7
Asian or Asian Irish	131	0.4			98,720	2.1	+14,030	+16.6
Other	199	0.6	+86	+76.1	70,603	1.5	+29,879	+73.4
Not stated	816	2.4	+590	+261.1	124,019	2.6	+53,695	+76.4
Total	33,063	97.6	-691	-2.0	4,689,921	98.5	+164,640	+3.6
Usual residence 1 year ago								
Same address	31,253	92.3	-444	-1.4	4,282,184	89.9	+155,414	+3.8
Elsewhere in county	723	2.1	-176	-19.6	195,710	4.1	-13,907	-6.6
Elsewhere in Ireland	174	0.5	+7	+4.2	67,841	1.4	+4,219	+6.6
Outside Ireland	467	1.4	+45	+10.7	82,346	1.7	+29,079	+54.6
Total	32,617	96.3	-568	-1.7	4,628,081	97.2	+174,805	+3.9
Population by religion								
Catholic	29,546	87.2	-1,558	-5.0	3,729,115	78.3	-132,220	-3.4
Other stated religion	2,004	5.9	+41	+2.1	439,055	9.2	+54,863	+14.3
No religion	1,559	4.6	+454	+41.1	468,421	9.8	+198,610	+73.6
Not stated	766	2.3	+589	+332.8	125,274	2.6	+52,360	+71.8
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Vulnerable groups								
Travellers	48	0.1	-21	-30.4	30,987	0.7	+1,492	+5.1

Health Atlas Ireland - Population Profile
CHN - Inishowen

Language	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 3+ years by ability to speak Irish								
Yes	9,063	26.8	-222	-2.4	1,761,420	37.0	-13,017	-0.7
No	22,468	66.3	-453	-2.0	2,667,945	56.0	+160,633	+6.4
Not stated	922	2.7	+560	+154.7	139,896	2.9	+51,014	+57.4
Total	32,453	95.8	-115	-0.4	4,569,261	96.0	+198,630	+4.5
Irish speakers aged 3+ years by frequency of speaking Irish								
Speaks Irish daily only within the education system	3,871	11.4	-	-	555,754	11.7	-	-
Speaks Irish daily within & daily outside the education system	143	0.4	-15	-9.5	20,641	0.4	-990	-4.6
Speaks Irish daily within & weekly outside the education system	49	0.1	+11	+28.9	6,665	0.1	-845	-11.3
Speaks Irish daily within & less often outside the education system	30	0.1	-2	-6.3	4,626	0.1	-1,150	-19.9
Speaks Irish daily within & never outside the education system	22	0.1	-15	-40.5	2,854	0.1	-709	-19.9
Speaks Irish daily only outside the education system	226	0.7	-	-	53,162	1.1	-	-
Speaks Irish weekly only outside the education system	493	1.5	-	-	104,808	2.2	-	-
Speaks Irish less often only outside the education system	2,416	7.1	-	-	581,909	12.2	-	-
Never speaks Irish	1,777	5.2	-	-	418,420	8.8	-	-
Not stated	36	0.1	-43	-54.4	12,581	0.3	-2,830	-18.4
Total	9,063	26.8	+8,719	+2,534.6	1,761,420	37.0	+1,707,529	+3,168.5
Irish speakers aged 3+ years by frequency of speaking Irish - female								
Speaks Irish daily only within the education system	2,124	6.3	-	-	304,274	6.4	-	-
Speaks Irish daily only outside the education system	124	0.4	-	-	28,314	0.6	-	-
Speaks Irish weekly only outside the education system	268	0.8	-	-	58,382	1.2	-	-
Speaks Irish less often only outside the education system	1,441	4.3	-	-	321,787	6.8	-	-
Never speaks Irish	1,054	3.1	-	-	230,013	4.8	-	-
Not stated	18	0.1	-	-	6,357	0.1	-	-
Total	5,029	14.8	-	-	949,127	19.9	-	-

Health Atlas Ireland - Population Profile
CHN - Inishowen

Language	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Irish speakers aged 3+ years by frequency of speaking Irish - male								
Speaks Irish daily only within the education system	1,747	5.2	-	-	251,480	5.3	-	-
Speaks Irish daily only outside the education system	102	0.3	-	-	24,848	0.5	-	-
Speaks Irish weekly only outside the education system	225	0.7	-	-	46,426	1.0	-	-
Speaks Irish less often only outside the education system	975	2.9	-	-	260,122	5.5	-	-
Never speaks Irish	723	2.1	-	-	188,407	4.0	-	-
Not stated	18	0.1	-	-	6,224	0.1	-	-
Total	3,790	11.2	-	-	777,507	16.3	-	-
Speakers of foreign languages by language spoken								
Polish	309	0.9	+36	+13.2	135,895	2.9	+16,369	+13.7
French	140	0.4	-19	-11.9	54,948	1.2	-1,482	-2.6
Lithuanian	97	0.3	+14	+16.9	35,362	0.7	+3,727	+11.8
Other	712	2.1	+62	+9.5	385,813	8.1	+79,336	+25.9
Total	1,258	3.7	+93	+8.0	612,018	12.9	+97,950	+19.1
Speakers of foreign languages by ability to speak English								
Very well	623	1.8	+96	+18.2	328,912	6.9	+83,521	+34.0
Well	344	1.0	+29	+9.2	179,104	3.8	+17,643	+10.9
Not well	186	0.5	-34	-15.5	72,713	1.5	-1,734	-2.3
Not at all	42	0.1	-3	-6.7	13,895	0.3	-1,219	-8.1
Not stated	63	0.2	+5	+8.6	17,394	0.4	-261	-1.5
Total	1,258	3.7	+93	+8.0	612,018	12.9	+97,950	+19.1

Family	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population by marital status								
Single	17,097	50.5	-710	-4.0	2,551,414	53.6	+66,789	+2.7
Married (incl. same sex civil partnership)	13,894	41.0	+168	+1.2	1,792,151	37.6	+83,547	+4.9
Separated	752	2.2	+31	+4.3	118,178	2.5	+1,984	+1.7
Divorced	702	2.1	+50	+7.7	103,895	2.2	+16,125	+18.4
Widowed	1,430	4.2	-13	-0.9	196,227	4.1	+5,168	+2.7
Total	33,875	100.0	-474	-1.4	4,761,865	100.0	+173,613	+3.8
Population by marital status - female								
Single	8,194	24.2	-190	-2.3	1,236,634	26.0	+37,621	+3.1
Married (incl. same sex civil partnership)	7,012	20.7	+128	+1.9	895,037	18.8	+41,520	+4.9
Separated	425	1.3	+15	+3.7	66,563	1.4	+1,202	+1.8
Divorced	426	1.3	+61	+16.7	60,586	1.3	+10,901	+21.9
Widowed	1,106	3.3	-25	-2.2	148,617	3.1	+640	+0.4
Total	17,163	50.7	-11	-0.1	2,407,437	50.6	+91,884	+4.0

Health Atlas Ireland - Population Profile
CHN - Inishowen

Family	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population by marital status - male								
Single	8,903	26.3	-520	-5.5	1,314,780	27.6	+29,168	+2.3
Married (incl. same sex civil partnership)	6,882	20.3	+40	+0.6	897,114	18.8	+42,027	+4.9
Separated	327	1.0	+16	+5.1	51,615	1.1	+782	+1.5
Divorced	276	0.8	-11	-3.8	43,309	0.9	+5,224	+13.7
Widowed	324	1.0	+12	+3.8	47,610	1.0	+4,528	+10.5
Total	16,712	49.3	-463	-2.7	2,354,428	49.4	+81,729	+3.6
Families, family members & children in families, by size of family								
2 persons	6,524	19.3	+134	+2.1	962,978	20.2	+23,560	+2.5
3 persons	5,295	15.6	-348	-6.2	829,914	17.4	+9,666	+1.2
4 persons	7,320	21.6	-108	-1.5	1,073,308	22.5	+75,936	+7.6
5 persons	5,655	16.7	-165	-2.8	682,940	14.3	+35,135	+5.4
6 or more persons	4,281	12.6	-454	-9.6	351,384	7.4	-12,853	-3.5
Total	29,075	85.8	-941	-3.1	3,900,524	81.9	+131,444	+3.5
Family units with children, by number of children								
No children	2,443	7.2	+163	+7.1	355,649	7.5	+10,705	+3.1
1 child	2,202	6.5	-201	-8.4	341,160	7.2	+1,564	+0.5
2 children	2,064	6.1	-30	-1.4	307,298	6.5	+21,346	+7.5
3 children	1,214	3.6	-43	-3.4	152,071	3.2	+7,601	+5.3
4 children	525	1.5	-8	-1.5	47,002	1.0	-600	-1.3
5 or more children	208	0.6	-53	-20.3	15,190	0.3	-1,456	-8.7
Total	8,656	25.6	-172	-1.9	1,218,370	25.6	+39,160	+3.3
Family units by age of youngest child								
0-4	1,738	5.1	-392	-18.4	249,091	5.2	-17,050	-6.4
5-9	1,204	3.6	+76	+6.7	160,952	3.4	+21,191	+15.2
10-14	963	2.8	+48	+5.2	123,994	2.6	+4,805	+4.0
15-19	857	2.5	+12	+1.4	112,212	2.4	+8,187	+7.9
20+	1,451	4.3	-79	-5.2	216,472	4.5	+11,322	+5.5
Total	6,213	18.3	-335	-5.1	862,721	18.1	+28,455	+3.4
Family units by family cycle								
Pre-family	433	1.3	-148	-25.5	111,525	2.3	-20,352	-15.4
Empty nest	1,024	3.0	+51	+5.2	121,720	2.6	+2,781	+2.3
Retired	986	2.9	+260	+35.8	122,404	2.6	+28,276	+30.0
Pre-school	728	2.1	-295	-28.8	122,285	2.6	-19,035	-13.5
Early school	1,002	3.0	-53	-5.0	144,861	3.0	+11,858	+8.9
Pre-adolescent	1,074	3.2	+43	+4.2	139,045	2.9	+7,782	+5.9
Adolescent	1,284	3.8	+103	+8.7	150,353	3.2	+15,135	+11.2
Adult	2,125	6.3	-133	-5.9	306,177	6.4	+12,715	+4.3
Total	8,656	25.6	-172	-1.9	1,218,370	25.6	+39,160	+3.3

Health Atlas Ireland - Population Profile
CHN - Inishowen

Family	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Females aged 20+ years by number of children born								
No child	2,600	7.7	-287	-9.9	513,176	10.8	-13,784	-2.6
1 child	1,269	3.7	-146	-10.3	216,177	4.5	+1,691	+0.8
2 children	2,335	6.9	+96	+4.3	371,328	7.8	+42,662	+13.0
3 children	2,049	6.0	+142	+7.4	280,935	5.9	+25,978	+10.2
4 or more children	3,049	9.0	-39	-1.3	296,628	6.2	-9,449	-3.1
Total	11,302	33.4	-234	-2.0	1,678,244	35.2	+47,098	+2.9
Family units with children by size and age of children								
1 child under 15	859	2.5	-221	-20.5	149,471	3.1	-12,113	-7.5
2 children under 15	1,082	3.2	-53	-4.7	162,999	3.4	+11,058	+7.3
3 children under 15	608	1.8	+1	+0.2	71,901	1.5	+3,344	+4.9
4 children under 15	211	0.6	-1	-0.5	17,799	0.4	-1,104	-5.8
5 or more children under 15	44	0.1	-31	-41.3	4,021	0.1	-580	-12.6
2 children both under 15 and 15 and over	297	0.9	+31	+11.7	46,045	1.0	+4,860	+11.8
3 children both under 15 and 15 and over	400	1.2	+4	+1.0	49,275	1.0	+3,372	+7.3
4 children both under 15 and 15 and over	255	0.8	+13	+5.4	22,645	0.5	+679	+3.1
5 or more children both under 15 and 15 and over	149	0.4	-11	-6.9	9,881	0.2	-570	-5.5
1 child 15 and over	1,343	4.0	+20	+1.5	191,689	4.0	+13,677	+7.7
2 children 15 and over	685	2.0	-8	-1.2	98,254	2.1	+5,428	+5.8
3 children 15 and over	206	0.6	-48	-18.9	30,895	0.6	+885	+2.9
4 children 15 and over	59	0.2	-20	-25.3	6,558	0.1	-175	-2.6
5 or more children 15 and over	15	0.0	-11	-42.3	1,288	0.0	-306	-19.2
Total	6,213	18.3	-335	-5.1	862,721	18.1	+28,455	+3.4
Family units with children by type of family and age of children								
Couples - children aged under 15	2,273	6.7	-180	-7.3	325,221	6.8	+9,247	+2.9
Mother - children aged under 15	483	1.4	-126	-20.7	75,042	1.6	-8,434	-10.1
Father - children aged under 15	48	0.1	+1	+2.1	5,928	0.1	-208	-3.4
Couples - children aged both under 15 and 15 and over	917	2.7	+12	+1.3	101,769	2.1	+6,008	+6.3
Mother - children aged both under 15 and 15 and over	167	0.5	+23	+16.0	24,004	0.5	+2,402	+11.1
Father - children aged both under 15 and 15 and over	17	0.1	+2	+13.3	2,073	0.0	-69	-3.2
Couples - children aged 15 and over	1,589	4.7	-48	-2.9	216,914	4.6	+9,698	+4.7
Mother - children aged 15 and over	576	1.7	-17	-2.9	90,066	1.9	+8,860	+10.9
Father - children aged 15 and over	143	0.4	-2	-1.4	21,704	0.5	+951	+4.6
Total	6,213	18.3	-335	-5.1	862,721	18.1	+28,455	+3.4

Health Atlas Ireland - Population Profile
CHN - Inishowen

Access	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Number of households with cars								
No motor car	1,503	4.4	-260	-14.7	257,567	5.4	-32,155	-11.1
One motor car	5,655	16.7	+72	+1.3	696,684	14.6	+27,918	+4.2
Two motor cars	3,801	11.2	-79	-2.0	567,414	11.9	+11,378	+2.0
Three motor cars	545	1.6	-32	-5.5	95,238	2.0	-6,026	-6.0
Four or more motor cars	133	0.4	-53	-28.5	30,413	0.6	-3,207	-9.5
Not stated	362	1.1	-	-	50,349	1.1	-	-
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Number of households with a personal computer								
Yes	7,359	21.7	-647	-8.1	1,160,603	24.4	-38,695	-3.2
No	4,210	12.4	+383	+10.0	478,487	10.0	+63,890	+15.4
Not stated	430	1.3	+274	+175.6	58,575	1.2	+23,062	+64.9
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9
Number of households with internet access								
Broadband	7,645	22.6	+843	+12.4	1,200,067	25.2	+148,125	+14.1
Other	1,101	3.3	+237	+27.4	131,676	2.8	-1,297	-1.0
No	2,864	8.5	-1,257	-30.5	312,982	6.6	-113,114	-26.5
Not stated	389	1.1	+187	+92.6	52,940	1.1	+14,543	+37.9
Total	11,999	35.4	+10	+0.1	1,697,665	35.7	+48,257	+2.9

Commuting	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 5+ years by means of travel to school or college								
On foot	739	2.2	-	-	251,141	5.3	-163,797	-39.5
Bicycle	31	0.1	-	-	25,286	0.5	-35,891	-58.7
Bus, minibus or coach	2,869	8.5	-	-	201,661	4.2	-86,901	-30.1
Train, DART or Luas	8	0.0	-	-	19,494	0.4	-51,482	-72.5
Motorcycle or Scooter	1	0.0	-	-	575	0.0	-8,737	-93.8
Car driver	310	0.9	-	-	49,810	1.0	-1,077,586	-95.6
Car passenger	3,991	11.8	-	-	492,919	10.4	-15,419	-3.0
Van	31	0.1	-	-	2,281	0.0	-116,710	-98.1
Other (incl. lorry)	2	0.0	-	-	324	0.0	-104,529	-99.7
Work mainly at or from home	6	0.0	-	-	1,102	0.0	-	-
Not stated	343	1.0	-	-	43,286	0.9	-46,304	-51.7
Total	8,331	24.6	-	-	1,087,879	22.8	-1,706,254	-61.1

Health Atlas Ireland - Population Profile
CHN - Inishowen

Commuting	Area 2016		Area change since 2011		National 2016		National change since 2011	
National % Area %	#	%	#	%	#	%	#	%
Population aged 5+ years by means of travel to work								
On foot	654	1.9	-	-	175,080	3.7	-	-
Bicycle	53	0.2	-	-	56,837	1.2	-	-
Bus, minibus or coach	201	0.6	-	-	111,436	2.3	-	-
Train, DART or Luas	14	0.0	-	-	63,133	1.3	-	-
Motorcycle or Scooter	17	0.1	-	-	7,990	0.2	-	-
Car driver	6,736	19.9	-	-	1,152,631	24.2	-	-
Car passenger	712	2.1	-	-	77,335	1.6	-	-
Van	1,595	4.7	-	-	126,029	2.6	-	-
Other (incl. lorry)	152	0.4	-	-	11,593	0.2	-	-
Work mainly at or from home	778	2.3	-	-	94,955	2.0	-	-
Not stated	677	2.0	-	-	93,709	2.0	-	-
Total	11,589	34.2	-	-	1,970,728	41.4	-	-
Population aged 5+ years by time leaving home to travel to work, school or college								
Before 06:30	766	2.3	+252	+49.0	170,281	3.6	+48,225	+39.5
06:31-07:00	881	2.6	+243	+38.1	210,930	4.4	+49,336	+30.5
07:01-07:30	1,141	3.4	+213	+23.0	270,733	5.7	+42,138	+18.4
07:31-08:00	2,349	6.9	+35	+1.5	440,220	9.2	+48,312	+12.3
08:01-08:30	3,765	11.1	+229	+6.5	616,905	13.0	+56,157	+10.0
08:31-09:00	4,751	14.0	+91	+2.0	648,295	13.6	-8,076	-1.2
09:01-09:30	3,016	8.9	-40	-1.3	237,247	5.0	-25,222	-9.6
09:30+	1,327	3.9	+35	+2.7	215,199	4.5	-844	-0.4
Not stated	1,140	3.4	+452	+65.7	152,740	3.2	+48,120	+46.0
Total	19,136	56.5	+1,510	+8.6	2,962,550	62.2	+258,146	+9.5
Population aged 5+ years by journey time to work, school or college								
Under 15 mins	8,034	23.7	+547	+7.3	956,370	20.1	+34,646	+3.8
1/4 hour - under 1/2 hour	4,863	14.4	+234	+5.1	853,885	17.9	+41,112	+5.1
1/2 hour - under 3/4 hour	2,604	7.7	+26	+1.0	511,843	10.7	+48,661	+10.5
3/4 hour - under 1 hour	778	2.3	-29	-3.6	174,254	3.7	+21,360	+14.0
1 hour - under 1 1/2 hours	697	2.1	+44	+6.7	179,233	3.8	+38,688	+27.5
1 1/2 hours+	469	1.4	+59	+14.4	67,066	1.4	+16,028	+31.4
Not stated	1,691	5.0	+629	+59.2	219,899	4.6	+57,651	+35.5
Total	19,136	56.5	+1,510	+8.6	2,962,550	62.2	+258,146	+9.5

Census Data source - CSO Census 2016

Appendix 5. Examples of Population Segmentation and Risk Stratification

Population Segmentation and Integrated Care

The current health care system essentially segments the population according to the setting in which a service is provided e.g. community care, hospital care, nursing home population, and it is funded on that basis. A practical alternative, widely used in other industries such as the insurance industry, is to stratify the population into groups that are sufficiently homogeneous to enable arranging a set of commonly needed supports and services to meet their expected needs.

Integrated care aims to organize care around the patient instead of the provider. Three levels of integration have been described in the literature: macro-, meso-, and micro-level integration (Vuik et al., 2016). For each level, a corresponding population segmentation strategy can be identified.

Macro-level integration - 'Bridges to Health'

Macro-level integration applies to the entire population. The 'Bridges to Health' model is a person-focused whole population segmentation approach, with the principal goal of 'pursuing the health of each population segment' (Outcomes Based Healthcare, 2016). The 'Bridges to Health' tool segments' the entire population into eight core groups, shown in Table A1. The proposal of the eight groups was shaped around three considerations (Lynn, Straube, Bell, Jencks, & Kambic, 2007):

I. The set of population segments must be limited if the health care system is to offer a sensible array of integrated services for each segment.

II. The set of population segments should include everyone; that is, at every point in their life, every person should fit into one of these categories.

III. The people in each population segment must have sufficiently similar health care needs, but each segment must be different enough to justify separate consideration.

Matching the priorities of each population segment to the six specific Institute of Medicine aims for quality of care (safety, effectiveness, efficiency, patient centeredness, timeliness, and equity) is the core structure of the Bridges to Health model (Lynn et al., 2007). This offers a way to define and prioritise interventions that will lead to optimal health in each population for each of these factors. It allows for estimation of costs of providing care for each segment.

The 'Bridges to Health' model (or very close variants) appear to be one of the most suitable, and increasingly widely adopted models internationally, for whole population, outcomes-based commissioning. As it does not depend on health care setting, the model lends itself well to meaningful population outcomes measurement, reporting and incentivisation.

Table A1: 'Bridges to Health' Population Segments

Segment	Description	IOM/AHRQ Goals for Healthcare
1	Healthy	Staying healthy
2	Maternal and Infant Health	Staying healthy
3	Acutely ill	Getting well
4	Chronic conditions, normal function	Living with illness or disability
5	Stable but serious disability	Living with illness or disability
6	Short period of decline before dying (mostly cancer)	Coping with illness at the end of life
7	Limited reserve and exacerbations (organ failure)	Coping with illness at the end of life
8	Long period of decline form frailty with or without dementia	Coping with illness at the end of life

Source: Lynn et al, 2007

Organising integrated care programs around segments instead of by provider or condition makes it possible for all relevant stakeholders across the health system to be involved. For some segments this involvement will include social and community care or mental health services.

There is emerging international evidence of use of the model, or close variants for the purposes of population health management approaches. The North West London, London Health Commission (NHS North West London Whole Systems Integrated Care), uses eight segments divided into three distinct age groups.

'Bridges to Health' is currently being adapted by the Irish Department of Health for their Population Based Resource Allocation Programme under the Slaintecare programme for use in the Population .

The future development of the model will require estimating the frequency and importance of transitions among population segments, examining the nature of outliers, and sharpening definitions and providing more reliable estimates of costs. Important issues for policy makers to consider are trade-offs between simplicity and precision, trade-offs between customized and off-the-shelf solutions, and the availability of linked data sets (Vuik et al., 2016).

Meso level integrated care models

Meso level integrated care models focus on specific sub populations and uses segmentation to choose the sub population (Vuik et al., 2016). In Delaware, the State Health Care Innovation Plan segments the state's population and uses this information to select priority subgroups for improved care coordination for patients with multiple long-term conditions or mental health needs, and overall effective detection and management for people with no long-term conditions (Delaware Center for Health Innovation, 2013).

The ValCronic-CARS pilot program in Spain(Advancing Integration for a Dignified Aging (AIDA), 2013; Vuik et al., 2016), focuses on the subpopulation with long-term conditions, which is segmented by risk level to adjust the intensity of telemonitoring interventions. The initiative is based on the stratification of patients with chronic diseases in three risk levels: High risk (level 3), patients with more complex and frequent comorbidity; Medium risk (level 2), low complexity with respect to their comorbidity; and Low risk (level 1), chronic patients in early stages. The programme includes technological devices at patients' homes to enable biomedical information to be transmitted to health centre professionals through different systems (Tablet PC or Smartphone). Once patients are detected through the CARS system (which appears as an alert in the electronic health record of patients) and confirmed by a doctor, it is included in 'Valcronic-CARS' and activates a training programme for the patient and caregiver, taking place in person at a health centre. A matrix of 16 actions has been built and adapted to the care needs of each patient) depending on the risk level.

Micro-level integrated care models

Micro-level integrated care models requires high risk patients to be identified. Counties Manukau district health board in New Zealand is including an automated risk score in its e-summary health record, which is available to all system providers across care settings (Love et al., 2014). The risk algorithm stratifies patients into two groups: patients at very high risk, who receive intensive care management, and those at risk who are assigned a care coordinator from their local practice. Patients' e-summary health records and personal care plans may be viewed by providers across the system.

Primary care practices within Counties Manukau are beginning to use the Combined Predictive Risk Model to stratify their enrolled populations. The aim is to allow primary care providers to identify patients at risk of poor health outcomes and proactively provide them with patient-centred care plans and care coordination services. Implementation of the algorithm in practice requires primary care providers to have up-to-date access to linked data sets in which patients are identified. A study that compared the six-month periods before and after introduction of the programme has shown a 45% reduction in the number of emergency care presentations and a 35%reduction in acute care bed days.