



ACI NSW Agency
for Clinical
Innovation

GUIDE

Patient identification and selection handbook

NSW guide to risk stratification



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Executive summary

Delivering truly integrated care is one of three strategic directions in the *NSW State Health Plan: Towards 2021*.¹ With an ageing population and a growing number of people living with chronic or complex health conditions, people's health needs are changing and demands on the health system are increasing. NSW Health is responding to these challenges by investing in new, innovative models of integrated care that transform how care is delivered, to improve health outcomes for patients and reduce costs deriving from inappropriate and fragmented care, across hospital and primary care services.

Integrated care involves the provision of seamless, effective and efficient care that reflects the whole of a person's health needs. It requires greater focus on a person's needs, better communication and connectivity between healthcare providers in primary care, community and hospital settings, and better access to community-based services close to home.

Operationalising integrated care, and realising its benefits, relies on locally driven innovation and centrally supported enablers. New ways of working across state government agencies and with Commonwealth-funded programs are essential to delivering better outcomes for identified communities.

NSW Health is designing and implementing a range of integrated care 'enablers' including eHealth solutions to support an integrated care journey, the use of patient reported measures (PRMs) to support shared decision making, and the systematic application of 'risk stratification' approaches as described in this Handbook.

Risk stratification approaches support a focus on organising care to meet the needs of targeted patients and their carers, rather than organising services around provider structures. Early identification and selection of people at risk of poorer patient health outcomes will enable provision of appropriate integrated care interventions and mitigation strategies. Integrated care delivery benefits anyone with healthcare needs; however, it is particularly important for people with complex and chronic conditions, helping them to better manage and maintain their own health and independence, and stay out of hospital for as long as possible.

Risk stratification has an important role in ensuring that patients who can receive appropriate care within the community setting receive their care there, leading to a reduction in avoidable hospitalisations and the frequency of unnecessary hospital admissions and emergency department (ED) attendances.

Audience and purpose

Drawing on Australian and international evidence, the *Patient identification and selection handbook* is intended to provide practical and evidence-based guidance to health services establishing or expanding their risk stratification approaches to patient identification and selection.

This handbook is primarily intended for use by Local Health Districts (LHDs), Specialty Health Networks (SHNs), Primary Health Networks (PHNs) and other health, community and social care providers involved in identifying and delivering care to patients who are at risk of poorer health outcomes and likely to benefit from additional care interventions.

The evidence regarding implementation of risk stratification

Two Evidence Check rapid reviews were commissioned by the ACI and the Sax Institute in Australia to examine the evidence concerning the social and clinical risk factors which may be predictors of pre-hospital and hospital service utilisation, and the critical success and failure factors for implementing system-wide risk stratification approaches.^{2,3}

A current evidence review was an essential starting point to the consideration of the selection and/or development of risk stratification models to identify those at risk of health deterioration and hospitalisation who may benefit from integrated care interventions.

The Evidence Check focused on potentially preventable hospitalisations (PPHs) related to ambulatory care sensitive conditions (ACSCs), but also included research studies that assessed hospital admissions, readmissions, and variables such as bed days and length of stay (LOS) more broadly.

Key findings^{2,3}

- Risk stratification models can be successfully used for predicting events such as unplanned hospital admissions, which are undesirable, costly and potentially preventable.
- Risk stratification is central to linking people identified at the highest risk of health deterioration to the most appropriate evidence-based integrated care strategies.
- The term risk stratification tool can be used to refer to all models, tools and systems that use algorithms to predict future risk of mortality, morbidity or health service usage for a defined population.
- Twenty different risk stratification tools were identified and reviewed. These tools vary in origin (public/private/academic), how they can be purchased or licensed for use, the variables used to populate the tools, how they can be adapted for use in local contexts and how results can be accessed and manipulated by end users.
- The predictive accuracy of disease-specific risk stratification models examined within the review was modest and no better than that found for generic models, e.g. to predict the risk of hospital admission.
- Four critical enablers and/or barriers to implementation of a risk stratification approach are:
 1. The engagement of clinicians in tool selection, design, implementation, refinement and end use.
 2. The context in which the tool was introduced into the healthcare system, e.g. as part of a wider strategy.
 3. Data requirements and characteristics of the tool.
 4. Equity issues, such as consideration of data protection laws and regulations, and that all patients continue to receive usual high-quality, safe care.²

Definition of risk stratification approach

It is important to recognise that risk stratification is a planned process, not a solution. On its own, it cannot deliver better patient outcomes. It is the mechanism by which integrated care interventions are targeted to those who might benefit from them the most.

In the NSW Health integrated care context 'risk stratification' is defined as: a systematic process to target, identify and select patients who are at risk of poorer health outcomes, and who are expected to benefit most from a particular intervention or suite of interventions.⁴

There are three stages of risk stratification:

- **targeting** – choose and quantify the cohort of patients at risk of poorer health outcomes (e.g. PPHs) that are considered a priority for targeting with different or additional interventions
- **identification** – identify individuals within the target cohort. This is achieved through manual or automated searching of routinely collected clinical and demographic data held in electronic databases using a standardised set of risk predictors
- **selection** – use a selection tool to undertake further assessment of each identified patient's modifiable risk, and match their needs to the most appropriate integrated care interventions. This can be administered via telephone or face-to-face, and generally requires information not held in the electronic medical records (eMRs).

Principles of good practice risk stratification

Drawing on the Evidence Check,^{2,3} some key principles for successful implementation have been identified.

1. Understand and prioritise local population needs as a starting point for choosing a target cohort.
2. Use systematic patient selection and/or risk stratification approaches to align interventions and programs to patient cohorts that will benefit, i.e. whether the disease course of the people in the target cohort can be modified through additional or alternative interventions.
3. Take an evidence-based approach (published literature and analysis of local data) to understand which factors are likely to accurately predict that a person is in each target patient cohort.
4. Determine the most appropriate existing identification and selection tools for the targeted population. If no tool exists, it may be necessary to develop and validate a new tool. Considerations need to include the acceptability and usability of the tool by the patient and their family and carers, and relevant clinical, management and administration staff.
5. Base the choice of tool on having access to the necessary data elements and the quality of the available data needed for risk stratification.
6. Determine the process for identifying, selecting and referring people to receive evidence-based interventions in a timely manner.
7. Make risk stratification a continuous process that allows ongoing re-stratification as a person's clinical or personal circumstances change, e.g. they may benefit more from an alternative intervention.

Navigation of this Handbook

The Handbook is presented in three sections. These are described below for ease of navigation to the area of interest.

Section 1: Introduction

- The context for implementation of a risk stratification approach in NSW Health including the objectives of the Integrated Care Strategy and the Integrated Care Patient Journey Model.
- The evidence reviews commissioned in support of this Handbook including an overview of socio-demographic, social and clinical risk factors.
- Definition of risk stratification in the NSW context and an example of steps in planning a risk stratification approach.
- Discussion of the importance of collaboration with stakeholders across LHDs and SHNs, primary health care (including PHNs), consumers and carers, social care and others.

Section 2: Targeting and identification describes how at-risk patients are identified

- A discussion of key lessons learnt from the Chronic Disease Management Program (CDMP), including the limitations of not using primary care data for identifying people at risk of hospitalisation and the importance of robust monitoring and evaluation.
- Factors to be considered in predictive modelling, for example: applicability of existing models to local needs, population versus outcome specific modelling, resources required, experience in predicting hospitalisation and data required.
- Consideration of risk pyramid in targeting and developing a patient identification algorithm.
- Example of targeting and patient identification, including the Ontario Hospital Admission Risk Prediction (HARP) tool.

Section 3: Selection and stratification

- The progression from planning targeting and patient identification to patient selection and stratification.
- Factors to be considered in choosing a patient selection tool, including: definition of risk factors for the target cohort, understanding the evidence and availability of interventions which effectively address the key health and social risks, the ability for the tool to stratify the risk, whether there is a suitable validated tool or one will need to be developed and validated locally, how the tool will be e-enabled, resources available and mode of administration.
- Examples of the Hospital Admission Risk Program (HARP) (Victoria) patient selection tool in use and integrated care interventions are overviewed.
- A short discussion of monitoring and potential outcomes for evaluation.

Appendix A: provides a glossary of key terms and list of abbreviations.

Appendix B: provides the references cited throughout this Handbook.

1. Introduction

This section describes:

- the context for implementation of a risk stratification approach
- the audience and purpose for this Handbook
- the Australian and international evidence regarding implementation of a risk stratification approach
- a definition of a risk stratification approach
- the important role of stakeholders in implementation.

The context for implementation of a risk stratification approach

Currently, a disproportionately large percentage of healthcare costs is spent on a small proportion of the population with complex and chronic conditions.⁵ As a result, demands on the health system are increasing.⁴

Between 2009 and 2015 the NSW CDMP resulted in LHDs developing important skills and capacities, such as identification and enrolment of patients, case management, care navigation and health coaching, and the development of care pathways to better link community-based and hospital services with the needs of individual patients.

In March 2014, the Minister for Health announced a strategic investment of \$120 million over four years into the development of integrated care models; in June 2014 'delivering truly integrated care' was announced as the third key strategic direction in the State Health Plan alongside 'keeping people healthy' and 'providing world class clinical care'. In the 2015 state election, the Minister for Health committed an additional \$60 million to support LHDs develop partnerships to allow patients to access a seamless range of healthcare services, such as hospital treatment or community-based primary healthcare services provided by general practitioners (GPs), pharmacists, allied health professionals, or other non-government organisations (NGOs) or private providers.

Chronic disease management (CDM) is a key part of delivering integrated care and links to other related initiatives such as cardiac/pulmonary rehabilitation programs and Hospital in the Home (HITH).

The objectives of integrated care are to transform how we deliver care to improve health outcomes for patients and reduce costs deriving from inappropriate and fragmented care, across hospital and primary care services by:

- focusing on organising care to meet the needs of targeted patients and their carers, rather than organising services around provider structures
- designing better connected models of healthcare to leverage available service providers to meet the needs of our smaller rural communities
- improving the flow of information between hospitals, specialists, community and primary care providers
- developing new ways of working across state government agencies and with Commonwealth-funded programs to deliver better outcomes for identified communities
- providing greater access to out-of-hospital community-based care, to ensure patients receive care in the right place for them.

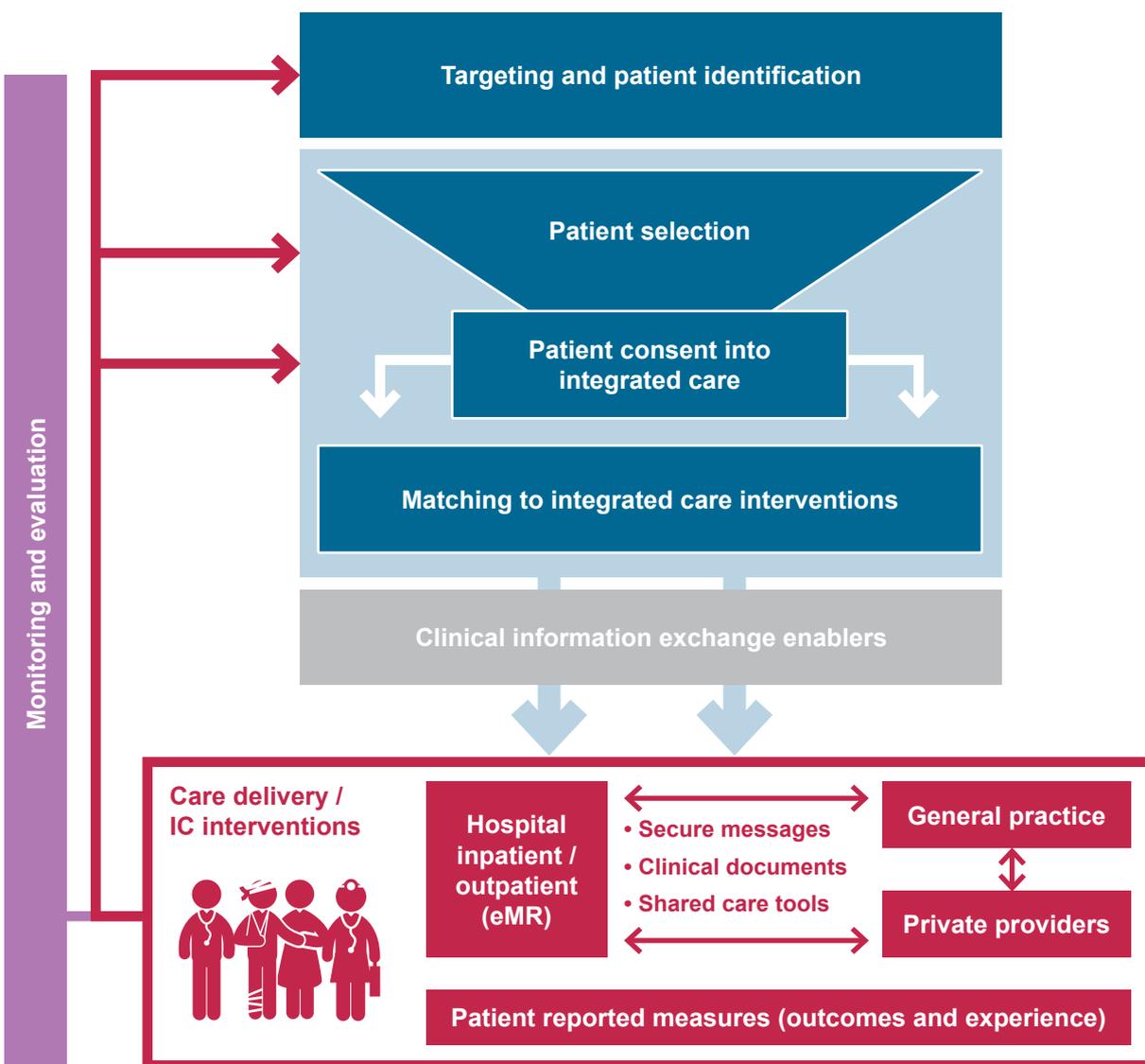
Integrated care delivery is beneficial to anyone with care needs, but is particularly important for helping people with complex and chronic healthcare needs to better manage and maintain their health, and stay independent and out of hospital for as long as possible.⁴

If people with, or at risk of developing, complex and chronic health conditions can be identified early and offered integrated care interventions, it may be possible to improve their health outcomes. At the same time, it may also be possible to make savings for the health service through prevented complications and reduced hospital admissions downstream.⁶

NSW Health is designing and implementing a range of integrated care enablers, including eHealth solutions to support an integrated care journey, the use of PRMs to support shared decision-making, and the systematic application of a risk stratification approach as described in this Handbook.

The planning for each step in the integrated care patient journey takes into account the steps and aims in Figure 1.

Figure 1 Integrated Care Patient Journey Model



Audience and purpose for this handbook

Drawing on Australian and international evidence, the *Patient identification and selection handbook* is intended to provide practical and evidence-based guidance to health services that are establishing or expanding their risk stratification approach to patient identification and selection.

This Handbook provides guidance based on current knowledge, and will be updated as the field continues to evolve. Visit the ACI website regularly for updated information and case stories.

This handbook is primarily intended for use by:

- LHDs and SHNs to inform the local risk stratification approach – suitable to local needs
- multi-disciplinary health professionals, including PHNs, GPs and NGOs, involved in identifying and providing care to patients who are at risk of poorer health outcomes and who are likely to benefit from additional care interventions.

The evidence regarding implementation of risk stratification

In early 2015, two Evidence Check rapid reviews were commissioned by the ACI and the Sax Institute in Australia to examine the evidence concerning:

1. social and clinical risk factors which may be predictors of both pre-hospital and hospital service utilisation³
2. the critical success and failure factors for implementing system-wide risk stratification approaches.²

A current evidence review was an essential starting point for considering the selection and/or development of predictive risk stratification approaches and models in NSW.

The Evidence Checks focused on PPHs related to ACSCs, but also included research studies that assessed hospital admissions, readmissions, and variables such as bed days and LOS more broadly.

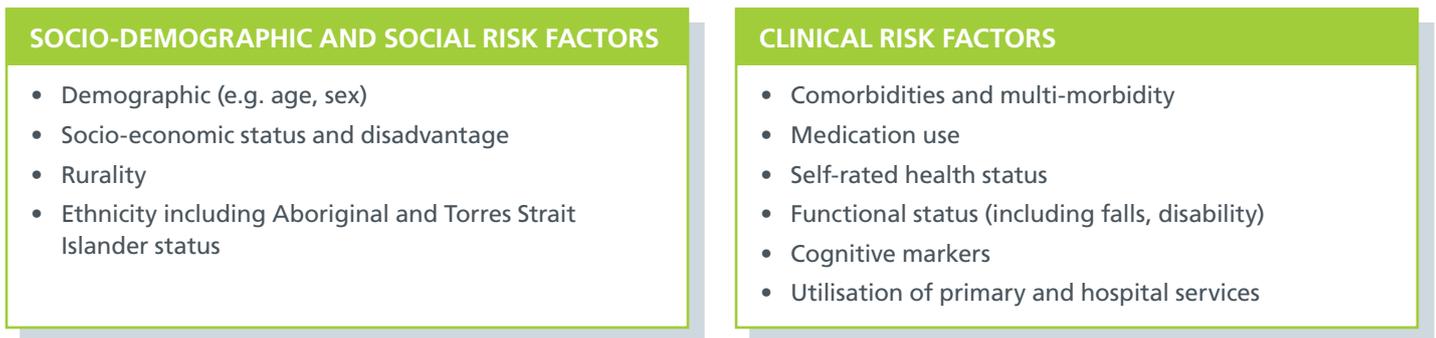
The aim of the Evidence Check for system-wide risk stratification approaches² was to identify issues associated with risk stratification implementation, understand how these have been addressed, and understand their relevance and applicability in the NSW context.

Key findings

- Risk stratification models can be successfully used for predicting events such as unplanned hospital admissions, which are undesirable, costly and potentially preventable. The most common focus of risk stratification approaches is PPHs related to ACSCs.
- The term risk stratification tool can be used to refer to all models, tools and systems that use algorithms to predict future risk of mortality, morbidity or health service usage for a defined population.
- Risk stratification is central to linking people identified at the highest risk of health deterioration to the most appropriate evidence-based integrated care strategies.
- Twenty different risk stratification tools were identified and reviewed within the second Evidence Check. These tools vary in origin (public/private/academic), how they can be purchased or licensed for use, the variables used to populate the tools, how they can be adapted for use in local contexts and how results can be accessed and manipulated by end users.
- The predictive accuracy of disease-specific risk stratification models examined within the review was modest and no better than that found for generic models, e.g. to predict the risk of hospital admission.

The Evidence Check for social and clinical risk factors³ identified important predictive factors related to the demographic, social, clinical and biochemical profile of patients, which could be included in risk stratification approaches for NSW. Figure 2 provides a summary of these predictive factors.

Figure 2 Predictive factors of poorer health outcomes



Some factors (e.g. functional status, cognitive impairment) were more often included in models predicting outcomes such as readmission and LOS than PPHs or hospital admission. Thus, for each desired outcome, the best predictors may be slightly different and any model utilised would need to be adjusted in relation to the particular outcome being assessed.

Where possible, it is useful to include social care data in a risk prediction model, so that risk stratification can be used to identify the health and social care determinants of risk of admission to hospital, or other adverse social care outcomes.⁷ Identification and selection of at-risk patients for the most appropriate strategy can be improved through the enhanced information.

As Lewis *et al.*⁶ commented, the predictive accuracy of many risk stratification tools is only moderate, and is influenced by the adverse event predicted, the set of patient variables used, time period for prediction and statistical techniques employed.⁶

The aim of an effective risk stratification approach is to ensure the benefits to the population outweigh the costs.⁷ Therefore, it is important to consider the adverse effects of false positive and false negative results as well as the benefits of true positive and true negative results when targeting particular interventions. Poor predictive accuracy (due to the tool or the data quality) may result in individuals receiving programs that are not appropriate to them or failing to receive programs that would have been appropriate for them.

Assessment of accuracy is important in choosing a predictive risk model; however, the decision to implement a model may also depend on the importance of the outcome predicted and the practicalities related to implementing the tool. In some cases statistical accuracy will be more important, while in others the ease of model implementation or cost-effectiveness will take priority.

Four critical enablers and/or barriers to implementation of a risk stratification approach are:

1. The engagement of clinicians in tool selection, design, implementation, refinement and end use.
2. The context in which the tool is introduced into the healthcare system, e.g. as part of a wider strategy.
3. Data requirements and characteristics of the tool.
4. Equity issues, such as all patients continuing to receive usual high quality/safe care and consideration of data protection laws and regulation.²

Definition of a risk stratification approach

It is important to recognise that risk stratification is a planned process, not a solution. On its own, it cannot deliver better patient outcomes. It is the mechanism by which integrated care interventions are targeted to those who might benefit from them the most.

In the NSW Health Integrated Care context 'risk stratification' is defined as: a systematic process to target, identify and select patients who are at risk of poorer health outcomes, and who are expected to benefit most from a particular intervention or suite of interventions.⁴

There are three stages of risk stratification:

- **targeting** – choose and quantify the cohort of patients at risk of poorer health outcomes (e.g. PPHs) that are considered a priority for targeting with different or additional interventions (see Section 2)
- **identification** – identify individuals within the target cohort. This is achieved through manual or automated searching of routinely collected clinical and demographic data held in electronic databases using a standardised set of risk predictors (see Section 2)
- **selection** – use a selection tool to undertake further assessment of each identified patient's modifiable risk, and match their needs to the most appropriate integrated care interventions. This can be administered via telephone or face-to-face, and generally requires information not held in the eMR (see Section 3).

The distinction drawn in the Patient Integrated Care Patient Journey Model (Figure 1) and throughout this Handbook between two stages reflects two important points.

1. The sequencing of activities – a risk stratification approach begins with (1) targeting and identification, and is completed by (2) selection and stratification to appropriate strategies and interventions.
2. The mechanisms of the approach – targeting and identification will (ideally) be achieved electronically; selection and stratification uses a tool administered via telephone or face to face.

Planning a risk stratification approach is iterative: defining a target cohort, identifying and selecting patients for integrated care strategies and designing integrated care interventions. These iterations are interdependent and will be influenced by factors such as availability of reliable electronic data, availability of resources for identification and selection, and capacity for refinement based on monitoring and evaluation of outcomes. Development of a program logic map can support planning in overviewing the connections between objectives, activities, inputs, outputs and outcomes.

Importantly, approaches to patient selection and risk stratification have no direct effect on a patient's health outcomes. The effectiveness of an approach depends on the care provided to the selected patients once they have been identified as being at-risk.^{8,9} Successful risk stratification approaches should be locally defined for specific targeted patient populations, and embedded in clearly explained, broader disease management and care integration strategies.

Table 1 Principles of good practice risk stratification

Principles of good practice risk stratification	
1.	Understand and prioritise local population needs as a starting point for choosing a target cohort.
2.	Use systematic patient selection and/or risk stratification approaches to align interventions and programs to patient cohorts that will benefit, i.e. whether the disease course of the people in the target cohort can be modified through additional or alternative interventions.
3.	Take an evidence-based approach (published literature and analysis of local data) to understand which factors are likely to accurately predict that a person is in each target patient cohort.
4.	Determine the most appropriate existing identification and selection tools for the targeted population. If no tool exists, it may be necessary to develop and validate a new tool. Considerations need to include the acceptability and usability of the tool, by the patient and their family and carers, and by relevant clinical, management and administration staff.
5.	Base the choice of tool on having access to the necessary data elements and the quality of the available data needed for risk stratification.
6.	Determine the process for identifying, selecting and referring people to receive the evidence-based interventions in a timely manner.
7.	Make risk stratification a continuous process that allows ongoing re-stratification as a person's clinical or personal circumstances change, e.g. they may benefit more from an alternative intervention.

Table 2 provides an overview of a risk stratification planning phase; the example is included for illustration purposes only.

Table 2 Questions to consider when planning patient selection and risk stratification

RISK STRATIFICATION STEPS	EXAMPLE
1. DEFINE TARGET COHORT What are the population health characteristics to which you want to apply risk stratification?	High prevalence of diabetes, ageing population, socio-economic disadvantage.
2. DEFINE MODIFIABLE RISK What is the adverse outcome you seek to mitigate?	Foot amputations due to complications of diabetes.
3. IDENTIFY AT-RISK PATIENTS What is the criteria set or algorithm for identifying the target cohort? What information systems contain the data required?	Patients with poor glycaemic control, previous hospitalisation for foot complication, renal disease or failure, etc. General practice software, eMR including ED presentations, diabetes centre, and endocrine specialist data.
4. SELECT/STRATIFY PATIENTS FOR FURTHER INTERVENTION(S) What is the assessment tool that will identify the priority risk factors?	Clinical screening tool that scores, for example: <ul style="list-style-type: none"> • patient's level of glycaemic control • presence of or emerging foot complications, e.g. wounds, loss of sensation • compliance with clinical regimens and health literacy.
5. EVIDENCE-BASE FOR MODIFYING DEFINED ADVERSE OUTCOME What intervention(s) will you apply to mitigate the risk?	Early referral to high-risk foot clinic, shared care plan (patient, GP, all relevant health professionals), systematic assessment and review, and uploading of clinical metrics (with care coordination if necessary).

Stakeholder engagement and partnerships

A critical success factor for the implementation of a risk stratification approach is engagement of clinicians in tool selection, design, implementation and refinement.²

Successful implementation relies on stakeholder partnerships to facilitate information sharing, mutual goal-setting, shared care and coordination of services between providers.⁸

Table 3 provides an overview of different stakeholders and the roles they may play in patient identification and selection.

Table 3 Stakeholders involved in patient identification and selection

	LHD/SHN	PRIMARY HEALTHCARE	CONSUMERS AND CARERS	OTHER STAKEHOLDERS
Including	<ul style="list-style-type: none"> • Cross-specialty/multi-disciplinary team • Inpatient • Outpatient • ED • Community health • Health One • Aged care • Mental health • Ambulance 	<ul style="list-style-type: none"> • GP • Pharmacy • Allied health • Psychology 	<ul style="list-style-type: none"> • Patient • Carer/family 	<ul style="list-style-type: none"> • Department of Family and Community Services (FACS) • Housing • Education • Justice/police • Local government • NGOs • Private hospitals • Insurance companies • Product providers (e.g. Medical Director, Telstra etc.)
Purpose	<ul style="list-style-type: none"> • Access to data which can inform understanding of service utilisation and patient outcomes across acute, primary and community health settings. • Undertake patient identification, selection and risk stratification. • Involvement in local needs assessment and developing a whole-of-population view. • Design interventions that enable more care in primary and community settings. • Involved in local governance and decision-making structures. 		<ul style="list-style-type: none"> • Patient needs and preferences are central to disease management strategies. • Provide consent for data use and sharing. • Can provide information not held in accessible datasets. 	<ul style="list-style-type: none"> • As patients commonly cross public and private health services, or move between public services, they hold useful data including broader social determinants of health, service utilisation and patient data. • Product providers can provide useful information and communications technology (ICT) solutions.

When local stakeholders have a shared understanding of their roles in patient selection and risk stratification, and the interdependencies of these, partnerships are more likely to develop and support a whole-of-population view.

Table 4 provides guidance for building cross-sector partnerships with stakeholders in your local area.

Table 4 Guidance for building cross-sector partnerships

AREA OF PARTNERSHIP	HELPFUL TIPS
Communication	<ul style="list-style-type: none">• Effective communication among service providers is key.• As perspectives and terminology can vary between stakeholders, it may be necessary to implement a shared governance structure and mechanisms for effective communication (e.g. common definitions and a shared set of processes).• Minimum requirements for information and involvement need to be co-developed and outlined in a shared communication framework.
Processes	<ul style="list-style-type: none">• Working across services, sectors and providers requires standardisation of processes and protocols.• Where possible, standardise care plans and IT systems, and have consistent use of technology.
Networking	<ul style="list-style-type: none">• Establish or actively participate in local health networks, such as aged care networks, to develop and facilitate working relationships with stakeholders, identify key issues and prioritise areas of need across services.

2. Targeting and identification

This section describes how at-risk patients are identified, including:

- the role of population health data in choosing target cohorts
- lessons learnt from the CDMP
- predictive modelling
- developing identification criteria and algorithms
- data sources and data availability to support patient identification
- an example of targeting and patient identification.

Using population health data to choose target cohorts

As health services begin or expand their approach to patient selection and risk stratification, a review of population needs assessments is an appropriate starting point.⁷ Assessing the health needs and market capabilities of the local community is an important step to defining a target cohort and includes:

- identifying the key health issues for the local area, including the causes of ill health, levels of risk and burden of disease
- prioritising the population groups or localities most affected and the social determinants at play and/or health inequities present.

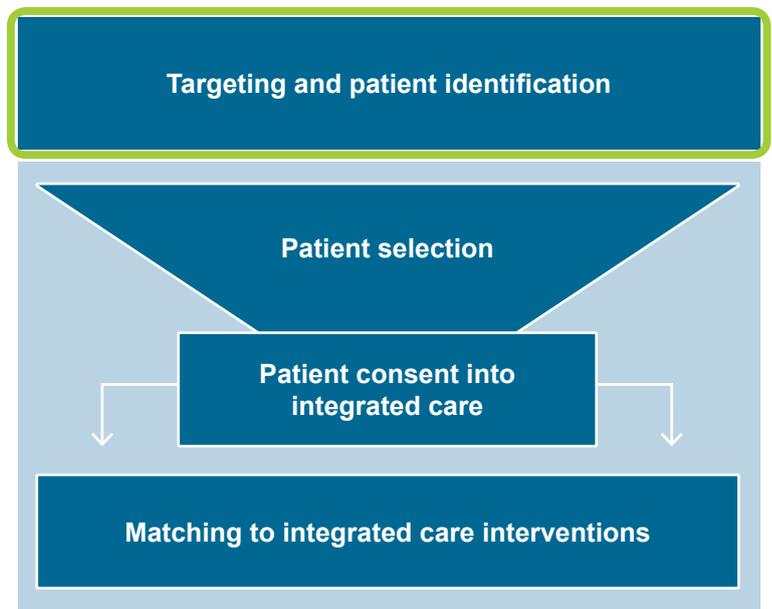
Lessons learnt from 2009 – 2014 Chronic Disease Management Program

The 2009 NSW CDMP targeted people with at least one of five chronic conditions who were deemed to be at risk of unplanned hospital stays and/or ED visits.¹⁰ The program aimed to deliver a suite of interventions to better integrate the healthcare delivered, improve management of chronic health conditions and reduce reliance on acute care services. These aims would be reflected in the rate of PPHs.

Patient identification was based on an algorithm of three or more hospital admissions within the previous 12 months and at least one of the following diagnoses: diabetes, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease and hypertension. The key data source was hospital eMR systems. Key findings include:

Enrolment to the program and its interventions predominantly occurred at times of peak acute service utilisation.

- *This evaluation suggests acute care is not the best place to identify people who could benefit from care coordination and self-management support. By the time they are identified it is too late: their condition has already been significantly exacerbated, and indeed many are already on the road to recovery, with or without extra intervention.¹⁰*



Harnessing the potential of extending into primary care.

- *Risk stratification can be used in primary care to identify people at risk of hospitalisation so that appropriate preventive measures can be put in place. Risks are likely to be better understood and preventive measures better implemented in primary rather than acute care. The international evidence suggests that selecting patients based on high utilisation of acute care misses high-risk patients who do not use acute care, and as an approach did not identify the factors that drive admissions. Integrating chronic disease management into routine funding and care, in contrast, has shown the best combination of health outcomes and cost savings.¹⁰*

The value of commitment to robust monitoring and evaluation.

- *A clear legacy of the evaluation relates to the criticality of appropriately assessing the measurable benefit of investment in service innovation over and above usual care. Focusing on areas of need in public health systems often equates with focusing on high-risk patients, bringing with it a host of measurement-related challenges... CDMP staff who had direct patient contact thought that care for their patients had improved... This evaluation was able to take account of the natural drop in admissions that occurs when high-risk cases are selected for an intervention. Measurement of what happens in the absence of the intervention and innovation is often difficult and imperfect, but cannot be considered optional.¹⁰*

Additional lessons learnt from the CDMP include the downsides of a singular focus on monitoring enrolment numbers, the variability in the definition and processes for enrolling patients and the lack of data regarding interventions delivered.

Predictive risk modelling

The concept of predicting patient risk is not new to the Australian healthcare setting. Historically, approaches for predicting patient risk have been developed within medical specialities and for specific conditions.⁹

The aim of an effective risk stratification approach is to ensure the benefits of additional interventions delivered to the selected population outweigh the costs.⁶

The predictive accuracy of a model is influenced by the adverse event (risk) predicted, the set of patient variables used, time period for prediction and statistical techniques employed.⁵ No model can perfectly predict, therefore it is important for health services to consider the adverse impact of false positive and false negative results as well as the benefits of true positive and true negative results.

An advantage of predictive risk models is that the interventions resulting from stratification can be examined to determine if the benefits of the interventions outweigh the cost of the model. Some interventions offered in risk stratification programs appear to increase cost. As there is a lack of robust evidence to support hospital avoidance programs to date, further research is required in this area.³

A recent report by the Primary Health Care Research and Information Service (PHCRIS)⁹ reviewed the use of predictive risk models to identify people with chronic conditions at risk of hospitalisation. Recommendations for factors to consider before investing in, or implementing, a particular model are provided in Table 5.

Table 5 Factors to consider in predictive risk modelling⁹

PRINCIPLES OF GOOD PRACTICE RISK STRATIFICATION

1. There are a variety of risk prediction models available, some of which have been previously validated. However, it is important to note that for any existing model, the underlying populations, data sources and coding may differ substantially to the local needs of a health service, and significant adaptation would likely be required prior to use.⁹
2. Risk prediction models can vary in their approach: some take a whole-of-population approach; some focus on specific population segments, such as people over 65 years; and some models focus on specific adverse outcomes, such as predicting hospital admissions and readmissions.⁹
3. Each model (and application of the model) needs to be taken on its own merits, i.e. fit with your target specification and relevant to your risk mitigation strategy.
4. Investment in predictive risk modelling can be substantial. At the system level, options include procuring an established model and modifying it to meet local needs, or building an entirely new model for the local or regional Australian setting.
5. Readmissions are easier to predict than admissions.
6. Predicting risk for hospitalisation in the subsequent year in a general population (versus target cohort) is much more difficult as there is more variability and therefore less accurate.
7. Models should target predictors of avoidable hospital admissions (e.g. age, social deprivation, morbidity [i.e. chronic disease diagnosis], area of residence [urban versus rural] and ethnicity). Two main reasons for this are: accuracy may improve plus relevant variables that are modifiable can be identified, which can inform more targeted interventions.
8. Routinely available data ensure that predictive risk models can be implemented in a variety of healthcare settings without adding excessive burden associated with data collection and management.
9. To improve performance of models, detailed data on individual patients needs to be available. Reliable, up-to-date, locally-relevant data are critical for the accuracy and relevance of using predictive risk models to target particular outcomes.
10. Clarity and consistency of disease coding is essential.
11. Predictive risk models generally include data on social factors; which requires reliable data linkage across health (both hospital and primary care) and social care.
12. Robust processes, procedures and information technology are critical to protect privacy and confidentiality as sensitive person-level healthcare data are needed to populate these models.

Other factors also impact on hospital admission and thus the predictive ability of risk modelling, such as variation in accessibility to healthcare (e.g. after hours primary healthcare, distance from ED).

Developing or adapting a predictive model can be costly. Health services may consider choosing smaller or locally developed applications, rather than larger, international models that will require a high degree of customisation. The costs associated with implementing a risk prediction model include:

1. developing or adapting a model
2. the software
3. obtaining the data
4. labour to set up the system
5. engaging with those charged with implementation.

All five factors are important to consider when calculating the anticipated cost of a model.

Health services should also consider whether predictive modelling is suitable locally, taking into account the available data, and whether an evidence-based and acceptable intervention can be provided to the selected patient cohort.

Choosing patient identification criteria and algorithms

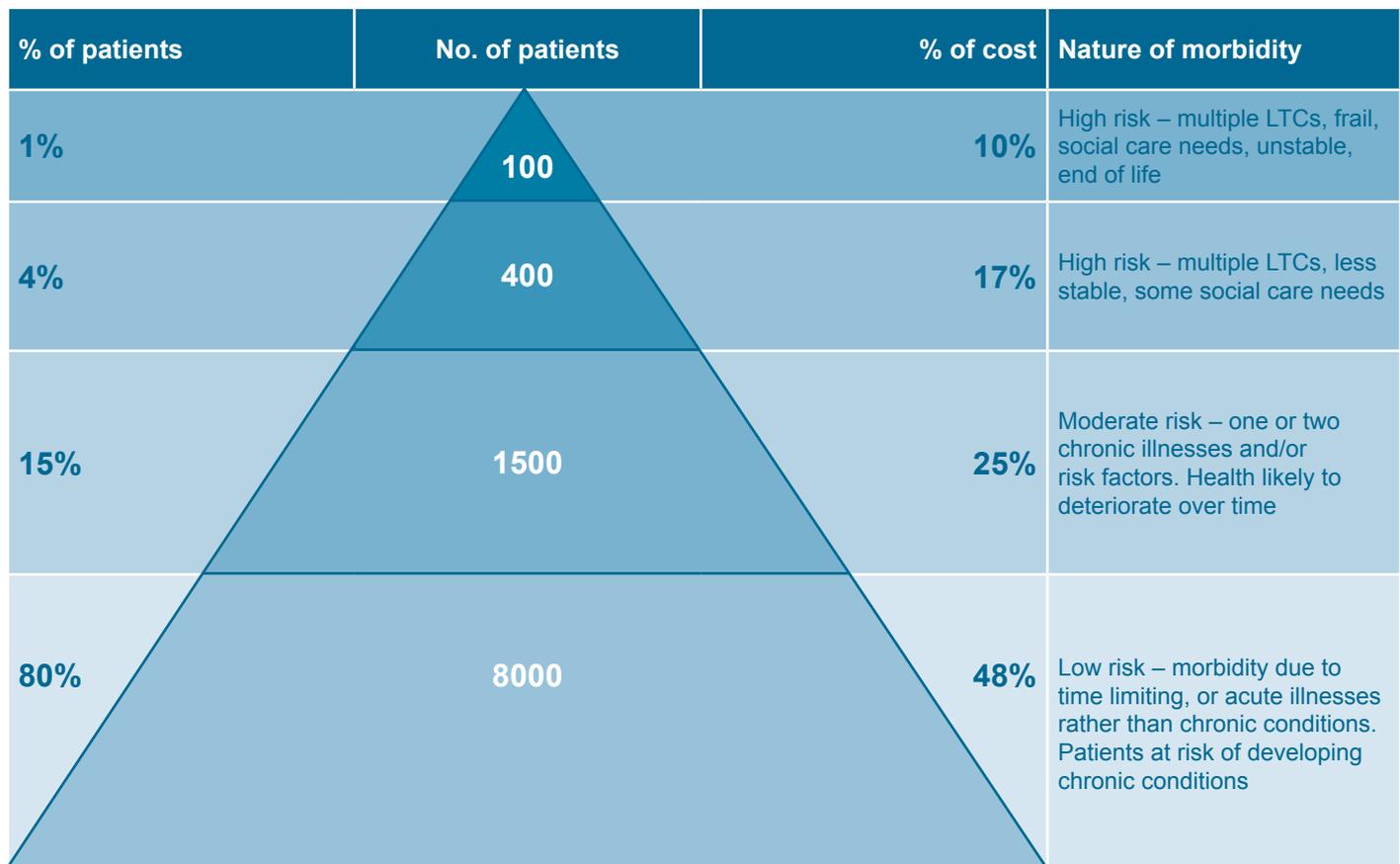
As demonstrated in Table 2 in Section 1, criteria or an algorithm for the target cohort will need to be developed.

It is essential to consider at what stage of the patient’s clinical trajectory any additional interventions should be offered to mitigate poorer outcomes, and the data required to identify the target cohort from the population of patients receiving health services.

The classification of patients into groups based on their risk of a future event, for example hospitalisation, is one part of the foundation of risk stratification. Another part is identifying who among those at risk of the future event could have their outcome modified through appropriate interventions.

A variant of the Kaiser Permanente pyramid¹¹ is shown in Figure 3. It segments the risks, hospitalisation and associated health system costs for a population in primary care.

Figure 3 Risk of hospital care and cost distribution for a GP practice with 10,000 patients in the UK¹¹



Patients at all levels of risk can benefit from some form of preventive intervention or care. The aim of patient selection and risk stratification is to direct care appropriately.

As illustrated in Figure 3, the top 5% of patients are at high risk, are already clinically unstable, and consume 27% of health system costs. The NSW CDMP evaluation calls into question how modifiable future outcomes may be for this group.¹⁰ In contrast, 80% of patients who have a low risk of hospitalisation and consume 48% of costs may only require lower-intensity preventative interventions.

A key decision in planning a risk stratification approach is to decide between using tools already in use and developing new ones. The literature demonstrates some of the benefits of starting afresh, especially in developing the tool to address local data sources and any related problems. The pitfalls are also clear, mainly around the validation of tools, workforce and cost.

Choosing to design a new tool or adapt a ready-made one relies on the availability of relevant linked data, for example, hospital, ED, primary care, and resources such as costs and workforce capability.²

The ACI has developed a summary of the risk stratification tools examined within the evidence reviews to assist health services with choosing tools against parameters such as:

- target cohort description
- patient risk or adverse outcome to be addressed
- available (electronic) data sources
- case finding for identification or screen for patient selection at point of care.

As discussed throughout this Handbook, the type of interventions provided to selected patients will influence the choice of tools.

An online decision tree will also be available on the ACI website to help navigate the summary of risk stratification tools. It will be updated as additional tools or models are identified and additional information becomes available. It will initially focus on generic models for chronic disease in adults and will be updated over time to include disease-specific models and other generic tools (e.g. for palliative care).

Data management

Access to reliable, up-to-date data is critical for accurate risk prediction. Electronic data systems facilitate access to personal health and demographic information used for, and generated by, targeting and patient identification.

NSW Health data is currently held in a range of databases across settings and clinical specialties. Much of the NSW Health data required for patient identification will be accessible via the eMR. However, as highlighted by the CDMP evaluation and literature, patients may need to be identified in primary care. LHDs will need to work with their local health and community stakeholder partners to agree to the use of the necessary data sources and processes related to targeting, patient identification and selection.

Specific information on legislative requirements related to the use and sharing of patient information is available within the NSW Health Privacy Manual for Health Information:¹²

<http://www.health.nsw.gov.au/policies/manuals/pages/privacy-manual-for-health-information.aspx> or by contacting the privacy officer in your LHD: <http://www.health.nsw.gov.au/patients/privacy/pages/privacy-contact.aspx>

Additional advice related to privacy, consent and ethics issues is being developed by the Ministry of Health to support the implementation of integrated care initiatives.

Example of targeting and patient identification

Hospital Admission Risk Prediction, Ontario, Canada¹³

Health Quality Ontario developed a predictive risk model to identify an individual patient's near-term (30 days) and longer-term (15 months) risk of future hospitalisation. The model was designed to generate a patient risk score that could be integrated into clinical information systems.

The variables most predictive of future hospitalisation were: patient age, number of admissions and ED visits in the past six months, location discharged to, intensity of previous admission, presence of one of 18 top conditions, whether an admission was through the ED, the Charlson Comorbidity Index, occurrence of paracentesis, and previous LOS.

HARP, Ontario weights these factors according to relative predictive power. A simplified model was also developed as a strong substitute for use in community care settings with limited access to acute data.

Further information can be found at: <http://www.hqontario.ca/Quality-Improvement/Tools-and-Resources/HARP>.

3. Selection and stratification

This section describes:

- the aims of patient selection and stratification
- choosing a patient selection tool
- example of a patient selection tool in use – HARP
- examples of integrated care clinical interventions.

The aims of patient selection and stratification

The process of targeting and identifying at-risk patients is primarily a data-based exercise and as such there are inherent limitations based on the availability of data.

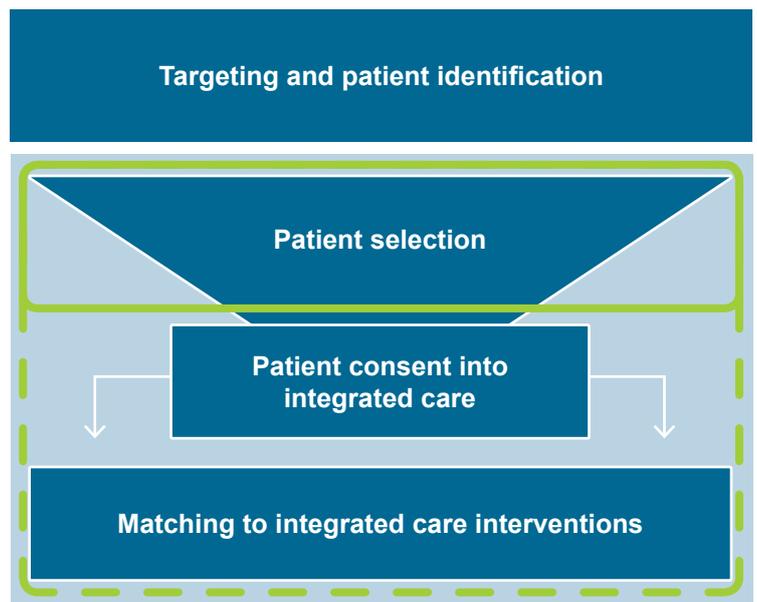
Selection and stratification aims to expand knowledge of individual patients in order to select integrated care interventions that are likely to modify potentially avoidable adverse outcomes, for example, their psychological and emotional factors and functional measures, and PRMs such as quality of life.

Patient selection requires interaction with individual patients and their carers, and:

- may be via telephone or face-to-face
- can be achieved by systematically contacting identified patients or administered at point of care, e.g. upon presentation or discharge from accessing health services.

As outlined in Figure 3, patients at all levels of risk can benefit from some form of preventive intervention or care. The aim of patient selection and risk stratification is to direct care appropriately.

Targeting the appropriate level of integrated care intervention for patients is important – it would be costly and undesirable to target intensive care-management interventions for those at a low risk who have less need for such interventions. However, it is important not to ignore those with moderate levels of risk (15%) as they are a group likely to represent future admissions³ and may be sensitive to evidence-based interventions that address their key risk factors. They may become more vulnerable to hospitalisation if these risk factors are not addressed.³ Similar analysis at local or regional levels may be useful in understanding the population profile and guide the focus of local initiatives.



Choosing a patient selection tool

As with patient identification tools, it is necessary to decide between using tools already in use or developing new ones. The choice of a patient selection tool involves local decision-making regarding key factors listed in Table 6.

Table 6 Factors to consider in choosing a patient selection tool

FACTORS TO CONSIDER IN CHOOSING A PATIENT SELECTION TOOL

1. Understanding the evidence and availability of interventions which effectively address the key health and social risks.
 - Some interventions will be the result of care planning, such as referral to a dietitian, psychologist or rehabilitation services. Additional integrated care interventions may involve the design and delivery of bespoke services, e.g. care navigation, care coordination, care management and health coaching (see *Examples of integrated care interventions* on page 21).
2. The ability of the tool to stratify the level of risk – will it guide the intensity or type of intervention offered to the patient?
3. Whether there is a suitable validated tool or one will need to be developed and validated locally.
 - Tools that have been adapted to Australian settings, using locally relevant indicators and having been locally validated, may be more reliable. Tools developed in other countries may over- or under-predict risk when locally applied, and their adoption will require close monitoring and likely ongoing adaptation.
 - There is no strong evidence to indicate which option is more cost-effective; however, where possible, health services are encouraged to adapt an existing validated tool and validate for use in a NSW setting.
4. How the tool will fit into available eHealth tools, for example:
 - can identified patients be flagged in LHDs and primary care eMRs and electronic reports that will support handoff between patient identification, selection, enrolment and care delivery?
 - will the patient selection tool be automated and support enrolment?
 - can the patient selection tool be embedded in a shared care planning tool?
 - can the patient selection tool import PRMs?
 - is the patient selection tool a stand-alone tool that will need to be imported to eMR and other systems?
5. The resources available and mode of administration of the tool, for example:
 - over the phone by a non-clinician
 - face to face in the patient's home by a care coordinator
 - at point of care (upon patient presentation or discharge from health services). For example, the LACE index is used to assess patients as part of discharge planning.

Example of a patient selection tool in use: Hospital Admission Risk Program, Victoria⁷

An example of an integrated CDM program in use in Australia is the HARP.¹⁴

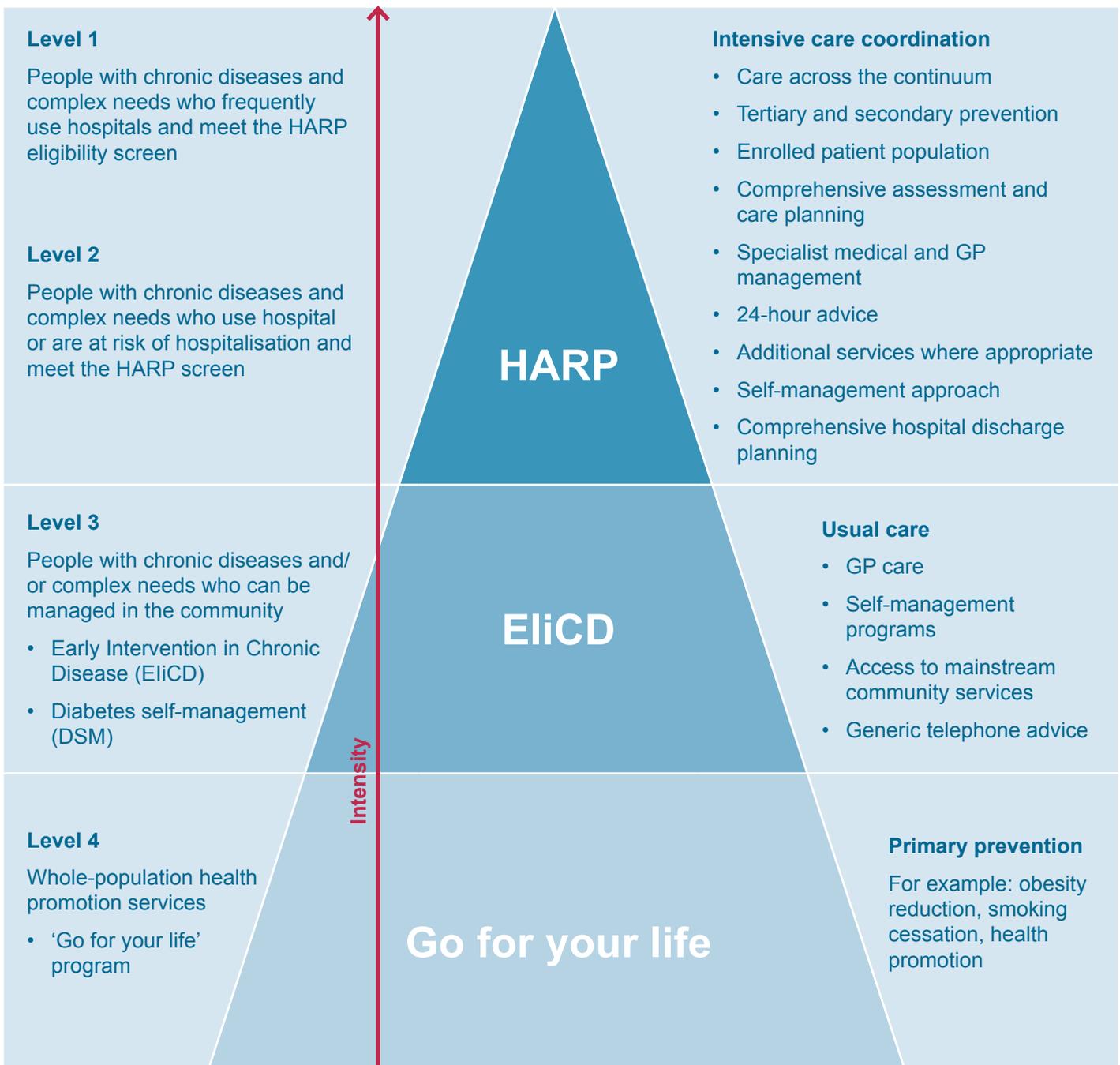
HARP was developed in Victoria, Australia, in the late 1990s (based on the Kaiser Permanente Chronic Care framework and the Wagner Chronic Care model) to address the increased demand in acute healthcare services by people with chronic disease, aged and/or complex needs. It is one component of the Health Independence Programs (HIPs).

HARP (Victoria)

- Designed for a target cohort with chronic disease (heart disease, respiratory disease, and diabetes) and/or with complex needs (older people, people with complex psychosocial needs or complex comorbidities) who have had at least one ED presentation or hospital admission in the last 12 months.
- Stratifies selected patients to one of three levels of risk, each with a model of care regarding interventions suitable for that level of risk. For example, patients stratified to the highest level of risk are enrolled in an intensive model of care, as outlined in Figure 4.
- Recognises that as a patient's condition and circumstances change, their needs will change, and they will likely require different services. Therefore, the HIPs (including HARP) need to have close links with other programs and initiatives.

^a Note: there is no relationship between the HARP (Ontario) tool described on page 17 and the HARP (Victoria) model described on page 19.

Figure 4 Kaiser Permanente Pyramid and HARP (Victoria) model of care



Local Hospital and Health Services have developed tools that are suitable for electronic patient identification and selection, such as the Chronic Condition Risk Calculator developed by Western Health (Victoria, Australia).¹⁴

The calculator was developed to measure the risk of a person with chronic or complex care needs presenting to hospital for treatment in the following 12 months, and define the entry point for HARP services. The risk calculator includes questions that screen a patient's presenting clinical symptoms, service access profile, self-management and psychosocial issues. The weightings in the calculator stratify a person into one of four risk categories: low, medium, high and urgent.¹⁴

Integrated care interventions

Throughout the discussions of targeting, and identification, selection and stratification in this Handbook, there has been continuous reference to integrated care interventions that will modify adverse outcomes. The choice of appropriate interventions is interdependent with selection and stratification, and care planning.

To monitor the effectiveness of interventions, it is essential that there is consistency in the definition of these interventions.

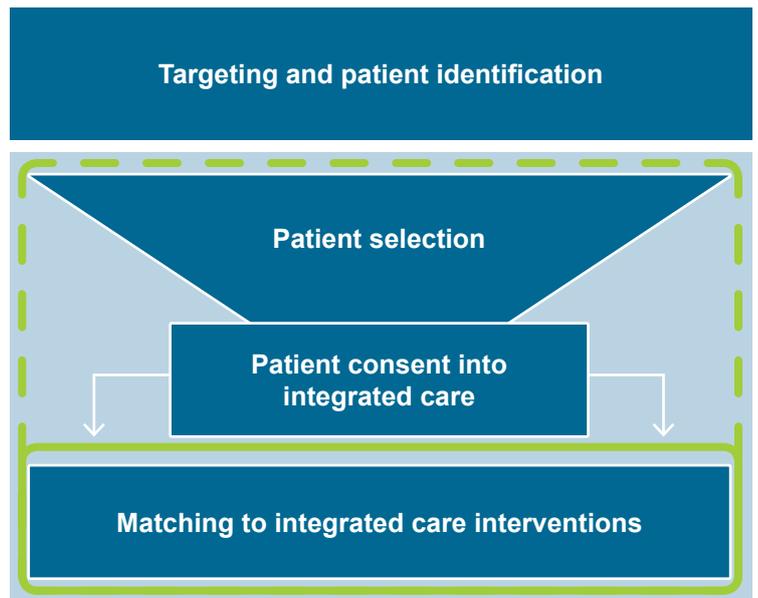
Examples of integrated care interventions

As an example, the following intervention types could be used as CDM strategies. Note that these example interventions are used to describe functions and not position descriptions. In practice, one position may provide a range of intervention types to a range of patients.

1. **Usual care** – the full range of patient care options that a clinician could choose to provide or offer to meet an individual patient’s needs, such as medication reviews, and referral to specialist, social care, rehabilitation and community nursing services.

Additional interventions available for stratified patients that could be offered, matched to their level of need or risk, include:

2. **Health coaching** – provides services in health literacy, patient activation and motivation, psychological aspects of illness impacting health status and adherence to care plans, and self-management skill building. The person delivering health coaching is a psychologist, social worker, or has undergone training in health coaching. Service delivery may be by telephone or face to face and is primarily in the home or clinic setting. Health coaching can be based in hospital, community care or primary care.
3. **Shared care planning** – develops a multi-disciplinary, patient-centred care plan for patients who require more intensive care delivery and coordination than usual care. The care plan is under the direction of primary care, with exceptions for complex patients who may be primarily under the care of a specialist. Shared care planning should systematically monitor relevant clinical metrics that may indicate clinical deterioration, as these are likely to require different interventions over time. The allocation of interventions (both usual and integrated care) is tailored to the needs of each patient as part of the shared care plan.
4. **Care navigation** – provides information and referral support that enhances timely access, for example, between primary and specialist care, for diagnostics and for social support, as well as ensuring timely review. Care navigation can be delivered via telephone by a non-clinician.
5. **Care coordination** – provides support in the identification of patient-level clinical requirements, the communication of clinical information across the care team (including the shared care plan, routine clinical assessment and uploading of clinical metrics) and tracking of follow-up to care plan. The person delivering care coordination has a clinical background, e.g. in nursing, social work, or allied health; is familiar with a range of medical conditions, health services and medical terminology; and is capable of writing clinical notes. Service is principally delivered by telephone or electronically. Care coordination can be based in hospital, community care or primary care.



6. **Care management** – works closely with care plan custodians, provides complementary clinical assessment as part of care planning and supports follow-up systematic assessment of the patient. The care manager may be responsible for a defined case load of enrolled patients and/or picking up referrals based on clinical deterioration following ED presentation, hospitalisation, or at the request of the specialist or GP care plan custodian. The person delivering care management has a clinical background, e.g. in nursing, social work, or allied health; usually with several years of clinical practice experience or advanced training. Service is delivered primarily face to face with a patient and is primarily in a home or clinic setting. Care management can be based in hospital, community care or primary care.

Continuous improvement

To assess the measurable benefit of investments in predictive modelling and e-enablement of risk stratification and service innovation over and above usual care, risk stratification requires a robust monitoring regimen. This should enable ongoing analysis and refinement of the planned risk stratification approach: definition of target cohort, identification algorithm, access to relevant data sources in primary care, evidence base for modifiable risk factors, validity of the patient selection tool and processes across stakeholders.

When monitoring and evaluating a risk stratification approach you may choose to review a variety of outcomes in order to determine the effectiveness, efficiency and appropriateness of the approach.

Table 7 provides an overview of some potential outcomes that could be evaluated.

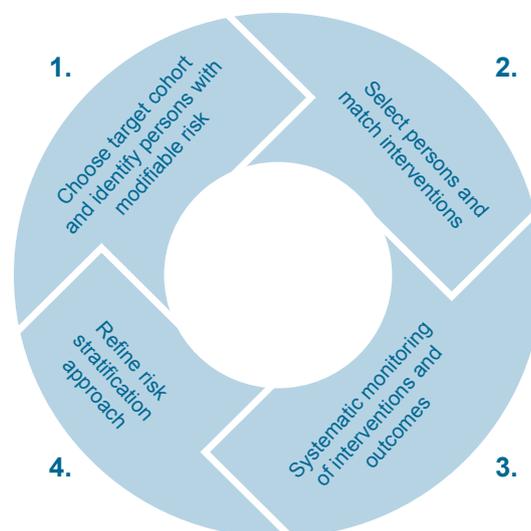


Table 7 Potential outcomes for evaluation¹⁵

OUTCOME GROUP	EXAMPLES
Patient-oriented	<ul style="list-style-type: none"> Whether those patients who were selected, did receive the intended intervention. When and how patients were re-stratified and re-assessed to take into account any changes in their clinical or personal circumstances. Improved care experience.
Carer-oriented	<ul style="list-style-type: none"> Improved care experience. Increased knowledge to support at-risk patients.
Staff-oriented	<ul style="list-style-type: none"> Improved experience. Increased knowledge to support at-risk patients.
System-oriented	<ul style="list-style-type: none"> Whether the strategy or program has become a sustainable system-level change that is now 'business as usual'. Acceptability and usability of the model or tool. Barriers and enablers to implementing the selected model or tool. Whether the necessary data could be accessed and was of sufficient quality. Utilisation of hospital and other healthcare services and the associated cost implications. Cost-effectiveness of the risk stratification approach alone, and in combination with the intervention. Improved communication between care providers.
Quality-related	<ul style="list-style-type: none"> Whether the tool identified people within the target cohort, with an acceptable level of accuracy.

Appendix A – Glossary of terms and abbreviations

Glossary of terms

A glossary of terms that are either used in this document or commonly used in literature and documents related to patient selection and risk stratification is provided below.

TERM	DESCRIPTION
Risk stratification	A systematic process to target, identify and select patients who are at risk of poorer health outcomes, and who are expected to benefit most from a particular intervention or suite of interventions.
Targeting	Choose and quantify the cohort of patients at risk of poorer health outcomes (e.g. PPHs) that are considered a priority for targeting with different or additional interventions.
Identification	Identify individual patients within the target cohort. This is achieved through manual or automated searching of routinely collected clinical and demographic data held in electronic databases using a standardised set of risk predictors.
Selection	Use a selection tool to undertake further assessment of each identified patient's modifiable risk, and match their needs to the most appropriate integrated care interventions. This can be administered via telephone or face to face, and generally requires information not held in the eMR.
True positive	Using the example of risk of hospital admission, a true positive is the number of individuals who are admitted and were predicted as at risk. Conversely, a false positive is the number of individuals who are not admitted, but were predicted to be at risk. ⁹
True negative	Using the example of risk of hospital admission, a true negative is the number of individuals who are not admitted and were not predicted as at risk. Conversely, a false negative is the number of individuals who are admitted, but were not predicted to be at risk. ⁹
Regression to the mean	Regression to the mean (RTM) is a statistical phenomenon that can make natural variation in repeated data look like real change. Observational evidence that those people who are extreme one year are rarely extreme in the next. Therefore, when individuals identified as 'outliers' because they represent high-risk individuals are invited to participate in an intervention intended to reduce their level of risk, RTM results in their risk being less than in the previous year, effectively biasing outcomes. ⁹
Sensitivity	The ability of a predictive risk model to detect all people within the original cohort screened who were admitted to hospital. For example, a sensitivity of 40% means that 40% of those actually hospitalised were correctly identified as being at risk of hospitalisation. ⁹
Specificity	The ability of the predictive risk model to correctly identify those not admitted to hospital. For example, a specificity of 80% means that 80% of those who were not admitted to hospital were correctly identified 80% as being at low risk of hospitalisation. ⁹
Positive predictive value	Also known as the 'event rate', positive predictive value (PPV) reflects the proportion of patients who are identified by the model as being high risk and actually experience the outcome being predicted. For example, a low PPV of 20% means that 20% of those identified as being at risk would experience the hospital admission, but many others identified as being at risk would not have been hospitalised, and therefore, an intervention could be seen as 'wasted' on these individuals. ¹⁶ In contrast, a high PPV means that a high proportion of those identified as being at risk would without intervention be admitted to hospital and, in this case, intervening is likely to be highly cost-effective.
c-statistic	Reflects the proportion of times a predictive risk model correctly discriminates between high- and low-risk individuals. That is, a c-statistic of 0.5 indicates that the model performs no better than chance, 0.7–0.8 indicates acceptable discrimination, and >0.8 reflects good discrimination. ¹⁷

Abbreviations

ABBREVIATION	DESCRIPTION
ACI	The Agency for Clinical Innovation
ACSC	ambulatory care sensitive conditions
CDM	chronic disease management
CDMP	the Chronic Disease Management Program
DSM	diabetes self-management
ED	emergency department
EIICD	Early Intervention in Chronic Disease
eMR	electronic medical record
FACS	Department of Family and Community Services
GP	general practitioner
HARP (Ontario)	Hospital Admission Risk Prediction
HARP (Victoria)	Hospital Admission Risk Program
HIP	Health Independence Program
HITH	Hospital in the Home
IC	integrated care
ICT	information and communications technology
LHD	Local Health District
LOS	length of stay
LTC	long-term condition
NGO	non-government organisation
PHCRIS	Primary Health Care Research and Information Service
PHN	Primary Health Network
PPH	potentially preventable hospitalisation
PPV	positive predictive value
PRM	patient reported measure
RTM	regression to the mean
SHN	Specialty Health Network

Appendix B – References

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Additional reading

NSW Integrated Care Strategy Summary (NSW Health, 2014)

<http://www.health.nsw.gov.au/integratedcare/Documents/integrated-care-info-summary.pdf>

ACI website

<http://www.aci.health.nsw.gov.au/resources/integrated-care/acil/integrated-care#risk-stratification-program>

PHCRIS Policy Issue Review (May 2015)

Predictive risk models to identify people with chronic conditions at risk of hospitalisation

NSW Health Privacy Manual

<http://www.health.nsw.gov.au/policies/manuals/Pages/privacy-manual-for-health-information.aspx>

PARR predictive risk literature review summary

http://www.kingsfund.org.uk/sites/files/kf/predictive-risk-literature-review-summary-june2005_0.pdf