Semantic mapping between the Australian NMHSPF and the DESDE-LTC. Applications in Western Australia

[redacted report]

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List of Acronyms

ACIT	Acute intervention team
ART	Acute Response Team
ANU	Australian National University
BPSD	Behavioural and Psychological Symptoms of Dementia
BSIC	Basic Stable Inputs of Care
CBT	Cognitive Behavioral Therapy
COPMI	Children Of Parents with a Mental Illness
DESDE-LTC	Description of Services and Directories for Long Term Care
ESMS	European Service Mapping Schedule
FTE	Full Time Equivalents
HiTH	Hospital in The Home
ICD	International classification of Diseases
ICF	International Classification of Functioning
ICHI	International Classification of Health Interventions
ICT	Information Technologies
ICU	Intensive Care Unit
LHN	Local Health Network
MH	Mental Health
MITT	Mental Illness Treatment Team
MTC	Main Type of Care
NMHSPF	National Mental Health Service Planning Framework
NPPHN	Northern Perth Primary Health Network
NSW	New South Wales
PEC	Psychiatric Emergency Care
PHN	Primary Health Network
PIMH	Perinatal and Infant Mental Health
PST	Planning Support Tool (NMHSPF)
REFINEMENT	REsearch on FINancing systems' Effect on the quality of MENTal health care (European Union funded project)
REMAST	REFINEMENT MApping Services Tool
UQ	University of Queensland
WA	Western Australia
WHO-FIC	World Health Organisation – Family of International Classifications

Executive Summary

This project has demonstrated that despite considerable differences in structure and purpose, it is possible to provisionally link critical classifications in the National Mental Health Service Planning Framework (NMHSPF) and Description of Services and Directories for Long Term Care (DESDE-LTC). As a first step towards incremental semantic interoperability, relational coding has been completed, and the relevant tables and linkage rules are provided in this report. Fifty two NMHSPF services types have been matched to a single MTC prototype code from the DESDE system. The majority of service types listed in the NMHSPF had equivalent codes in the DESDE system, with the possible exception of some community support services such as day services, flexible respite services, family support services, and individual carer support services.

The coding linkages were tested on samples of DESDE-LTC data gathered previously during the production of mental health service Atlases in Western Australia (WA). The Alpha version of the WA Atlas mapped all three Primary Healthcare Networks (PHNs) in Western Australia : the Perth North Primary Healthcare Network (PNPHN), the Perth South PHN (PSPHN) and the Country WA PHN.

The current testing of the semantic mapping between the NMHSPF and the DESDE systems incorporated the review of Perth North (PNPHN) and the Kimberley region in Country WA PHN. The Beta version of the PNPHN Atlas of Mental Health Care has been completed, as well as a preliminary gap analysis between available and projected bed numbers data for mental health care in this catchment area.

It is recommended that additional work be undertaken to fully test the reliability and validity of related DESDE and NMHSPF codes in another setting, using a fully completed Atlas (the final version including comments from the stakeholders). It would also be helpful to test the coding on additional data types that were not in scope for the WA Atlas – such as those mapped in layers 2 and 3 of the Atlas (services provided in general practice and private hospital beds). Once this validation has been completed, it is anticipated that linked codes should support future gap analyses on placement capacity (beds and places in day care), and workforce capacity in Full Time Equivalents (FTEs).

In summary, a set of provisionally linked DESDE-LTC and NMHSPF codes has been developed and tested on NPHN data for the Western Australian context. The challenges of theoretical and practical linking of service types have been explored. Further work will need to be undertaken to develop a full semantic interoperability of both systems for communication across health databases.

Recommendations

- Additional work is required to establish valid, reliable semantic interoperability between these two systems. This work would need to include testing of a practical application on another sample of DESDE-LTC data in an area where the process for developing a local mental health atlas has been completed, and where there is full information on placement and workforce capacity in FTEs.
- If this further work were to proceed, the required amount of work would have to be scoped accordingly.

1 Introduction

1.1 Background and context

In 2016, Primary Health Networks (PHNs) became responsible for planning and commissioning primary mental health services to improve regional and local service provision. However, in order to plan and commission mental health services effectively, it is imperative that PHNs have a good understanding of local population needs, and the capacity of services currently operating on the ground.

In 2015, the Western Australia Primary Health Alliance (WAPHA) commissioned the external firm ConNetica to map the existing mental health services in each of the state's three PHNs, using the Description and Evaluation of Services and DirectoriEs for Long-Term Care (DESDE-LTC) developed by the team of Prof Luis Salvador-Carulla, at the Centre for Mental Health Research, Australian National University. This work produced two reports: The Integrated Mental Health and Alcohol and Other Drugs Atlas of Western Australia – Volume I Metropolitan Perth, which describes the mental health services operating in Perth North PHN and Perth South PHN as of 2016 (Hopkins et al, 2017i); and The Integrated Mental Health and Alcohol and Other Drugs Atlas of Western Australia – Volume II Country WA, which describes the mental health services in Country WA PHN and its seven sub-regions (Hopkins et al, 2017ii). Collectively these two reports are referred to here as the Atlas.

DESDE-LTC- based Atlases are generated by collecting service data to construct an Alpha version of the Atlas, and then obtaining and incorporating feedback from stakeholders. Three versions of the Atlas are produced:

1) Alpha version made by the working group based on surveys and interviews;
2) Beta version completed after revision with the public agencies and the key stakeholders;
3) Final version completed with feedback provided by the local stakeholders and consumer organisations after the launch of the Beta version (version for comments).

The Atlas of WA produced in 2017 was the Alpha version, prepared after conducting a survey and face to face interviews in WA. The steps undertaken to develop the Alpha version of the WA Atlas are shown in Figure 1.

The Alpha version of the Atlas of Western Australia (Hopkins et al, 2017) had not progressed through the full development process and feedback cycles in order to complete the external validation process. For an analysis of its comparability with other classification systems, at least a Beta version is required (version revised with the public agency and key stakeholders) (Fig. 1).

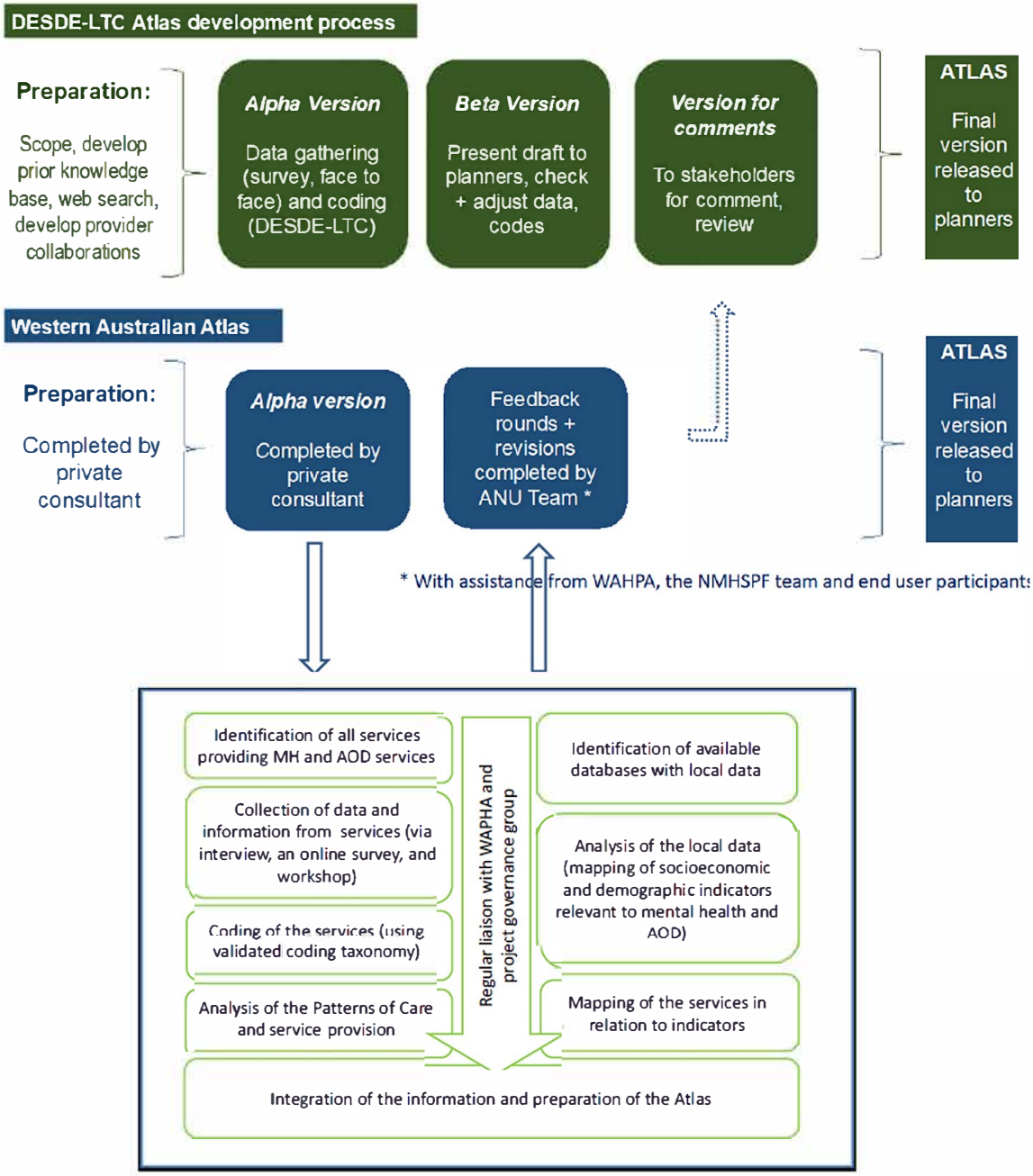

Figure 1 Steps for the completion of an Integrated Atlas of Local Mental Health Care

In June 2017, the University of Queensland began training PHN representatives to use the National Mental Health Service Planning Framework (NMHSPF), the first integrated modelling system for estimating mental health service demands across the entire needs spectrum in Australia. The NMHSPF predicts the mental health service activity and resource requirements for a given

population, and can therefore be used to identify priority areas for mental health planning and service development when compared to existing services.

Following the NMHSPF training, WAPHA identified the need to compare and explore the complementarity of both approaches, and its potential combined use for health planning in WA. WAPHA commissioned the development of semantic mapping between the two systems of University of Queensland (UQ) and Australian National University (ANU).

1.2 Classifications systems in health care

Classification is a process by which elements are systematically arranged into previously established classes or groups. This knowledge representation allows entities (ideas and objects) to be recognized, differentiated, analysed and understood. There is an increasing interest in classification in science (Thomson et al, 2018) partly due to the new advances in conceptualising complexity and systems thinking in natural and social sciences. This is particularly relevant in health care where interoperable classification systems are needed for modelling efficiency, accountability, and evidence-informed planning. An example of the use of a standard classification of services for modelling regional policy and planning has been recently published (Chung et al, 2018). As the description of these formalisms vary in different disciplines, it is necessary to clarify some key concepts related to classification in order to understand the process followed in this project. Three major types of classification systems can be differentiated according to their level of standardisation and operationalisation: typologies, taxonomies and (formal) ontologies (e.g. Marradi, 1990; Doty & Glick, 1994; Guarino, 1998).

A "**Typology**" is a system used for grouping things according to how they are similar: the study of how things can be divided into different types. The key characteristic of a typology is that its dimensions represent concepts rather than empirical cases. The dimensions are based on the notion of an ideal type, a standard case or a prototype. As such, typologies create useful heuristics and provide a systematic basis for comparison. Their chief drawbacks are categories that are neither exhaustive nor mutually exclusive, often based on arbitrary or ad hoc criteria, descriptive rather than explanatory or predictive, and frequently subject to the problem of reification (Bailey, 1994). Typologies do not provide decision rules for classifying organizations. Instead, typologies identify multiple ideal types, each of which represents a unique combination of the organizational attributes that are believed to determine the relevant outcome(s).

A "**Taxonomy**" is a formal tool that can operationalize a typology, by associating types with a certain set of measureable characteristics that permits assignment of individual cases to a certain class. It classifies cases on the basis of empirically observable and measurable characteristics, according to the links between the categories and their hierarchy. The hierarchy can be constructed using rules. For example, these rules define mutually exclusive entities (e.g., <is-a> rule) or the relation of parent and children categories (e.g., <part-of> rule). In numerical taxonomy every finite ultrametric space

is known to admit a natural hierarchical description called a dendogram where the input to the clustering algorithm is a distance matrix.

A "**Formal Ontology**" is a conceptual network with explicit definitions of the semantic relations among all the concepts in the network. These relations are expressed by axioms in a formal language with the goal to provide a machine readable, application-independent and interoperable view on reality in information systems and computer science. A formal ontology can adopt a taxonomy structure when these formal relations follow a single hierarchy with increasing granularity at every level of the hierarchy. Formal ontology is used in conceptual modelling, database design, software engineering, organizational modelling, artificial intelligence, computational linguistics, the life sciences, bioinformatics, geographic information science, knowledge engineering, information retrieval, and the semantic web.

The terms and definitions used in a classification system can be arranged in indexes, dictionaries, vocabularies, and glossaries of terms. An index is an alphabetical list of words and phrases. A vocabulary is a simple listing of terms that may include definitions. A dictionary is an organised collection of definitions and uses of terms, where terms may have more than one definition, and more than one use. A glossary is a vocabulary where every item has a single definition. A conceptual taxonomy requires a "formal glossary" of operational definitions developed by a process of consensus. The definitions of categories at the same level in a hierarchy tree should be mutually exclusive. A formal ontology in information technology (IT) requires information about the use of the terms apart from their formal definition (these are also called "formal vocabularies").

The fact that taxonomies are more elaborated and operationalised than a typology does not imply that a taxonomy should always be preferred over a typology. As an example, a health economics analysis combines very different types of units of analysis (e.g. activities such as a medical visit, interventions, and aggregates of highly complex types of healthcare delivery, such as a day of stay in an acute hospital ward). In this case, a typology may be preferred over a taxonomy to describe the different categories used in this analysis.

The World Health Organisation Family of International Classifications (WHO FIC) encompasses three "reference" classification systems: ICD (International Classification of Diseases), ICF (International Classification of Functioning) and ICHI (International Classification of Health Interventions) (Jakob et al, 2007). Different groups in the WHO FIC network (http://www.who.int/classifications/ network/ en/) are currently mapping the reference classifications to a series of related and derived classifications used at national level or by international professional organisations (Fig. 2).

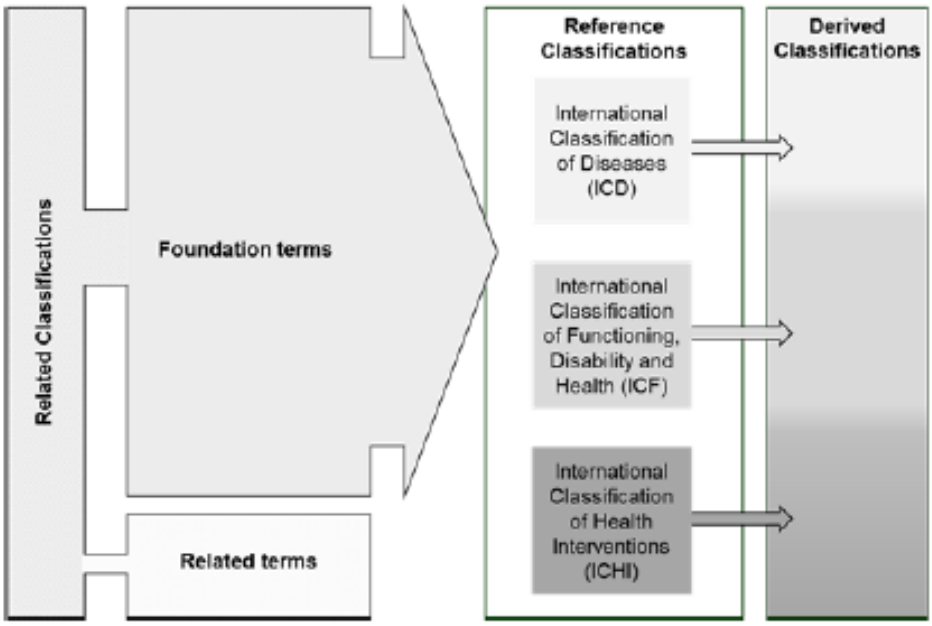

Figure 2 Schematic representation of the WHO-FIC (2018)

Most health classification systems, including the WHO reference classifications, are either typologies or taxonomies. However, the development of health data analytics, health care engineering, modelling and decision support systems demand the introduction of formal ontologies in health care. WHO and other major organisations are committed to transforming the current health classification systems into formal ontologies (Paviot et al, 2011). This process coincides with the semantic mapping of the existing classifications.

1.3 Semantic mapping and interoperability

In order to combine information obtained by two systems for classifying health information, it is important to ensure that the meaning of information can be accurately communicated between the systems. This is a problem of "semantic interoperability" which is:

> "The ability for information shared by systems to be understood at the level of formally defined domain concepts …" (CEN/ ISSS 2005).

The Dublin Core Metadata Initiative has defined a "ladder of interoperability" for increased levels of interoperability (Nilsson et al, 2009). At Level 1, applications use data components with shared

natural language definitions. “Semantic mapping” or “conceptual mapping” refers to the linking of content between different classification schemes. It enables data users to interpret old and new data across the different classifications, link the ways that concepts in the systems relate to each other, and identify areas in which there are gaps or inconsistencies (Almborg, Vikdal and Berg, 2017). At Level 2, data is based on the formal-semantic model of the resource description framework. At Level 3, data is structured as “Description Sets” (records). At Level 4, data content is subject to a shared set of constraints (described in a Description Set Profile).

Conceptual mapping may be done for a variety of purposes (Sun and Sun, 2006; Bramley, 2006; Juve-Udina et al., 2012; Almborg et al., 2017) including:

- comparing information across different systems;
- transferring information from one system to another;
- allowing data collected for one purpose to be reused for another purpose; and
- conducting longitudinal data analysis.

Methods for cross-mapping classification systems have been recently applied for the incremental interoperability of the WHO-FIC (Fig. 2). Recent examples of these initiatives are the mapping of the SNOMED-CT terminology system to the ICD-10 (Brear, 2017), and the mapping of Sweden’s national healthcare intervention classification system onto the ICHI (Almborg et al, 2017).

Aims

The work conducted as part of this project aimed to:

1. provide a detailed analysis of the conceptual framework for the combined use of the NMHSPF and DESDE systems;
2. carry out a semantic mapping and equivalence of service elements/codes: alignment, gaps and overlaps between the NMHSPF and DESDE classification systems;
3. develop mechanisms for supporting the interoperability of the two available models as appropriate, such as a common glossary of terms and definitions of links between terms;
4. complete the Beta version of the Atlas of Mental Health in Western Australia in an urban and a rural catchment area;
5. develop mechanisms for the the first two levels of interoperability to conduct a preliminary gap analysis of bed availability in MH using both approaches (NMHSPF and DESDE) within two Western Australian PHN catchments (urban and rural); and
6. provide recommendations for future application of these systems to mental health planning in WA.

2 Method

2.1 Design

The design of this semantic mapping has been adapted from the mapping approach used by the WHO Family of Classifications (WHO-FIC) network (http://www.who.int/classifications/ network/ en/). Following this approach, the project involved three stages: i) establishing scope and a conceptual framework; ii) conceptual mapping between the two systems; and iii) piloting: DESDE-LTC data in the Western Australian Atlases (Alpha & Beta versions).

There are two major differences between the current project and the on-going mapping work carried out by the WHO-FIC consortium. Mapping in this project is bi-directional, whilst WHO-FIC mapping projects are unidirectional (e.g. mapping of a national classification to the WHO international core classification). We sought to create bi-directional links between the two systems because the current work focused mainly on the external validity of the semantic equivalence, rather than on investigating the reliability with which the same services could be coded by both systems. It aligned the service elements or unit codes used in the two systems to examine whether they could be adequately linked, and incorporated stakeholder and end-user input into the linkage work in order to improve external validity.

Three conceptual mapping equivalences have been produced in this project: 1) the equivalence between NMHSPF types and the DESDE-LTC 2015 codes used in the Atlas of WA Alpha version (preliminary mapping); 2) the equivalence of NMHSPF types and the DESDE-LTC 2018 codes generated for the Atlas of WA Beta version; and 3) the final equivalence between the NMHSPF and DESDE 2018 (semantic or conceptual equivalence).

2.2 Procedure

A core group and a community of practice were put together for this project. The core group was made up of representatives from WAPHA, the DESDE-LTC team and the NMHSPF team, who met on five occasions in a series of three workshops for completing this process. The community of practice was identified by WAPHA. It comprised 14 decision makers from WAPHA, the WA Mental Health Commission, WA Health, and key managers of service provider organisations, as well as academics from a third partner university. The three stages mentioned were completed in seven steps (Fig. 3).

	Canberra 1 19.06.2017	Canberra 2 17-19/07/2017	Brisbane 23-25/01/2018	Perth 1 30/01-02/02/2018	Perth 2 05-07/02/2018	Post-meeting
Introduction						
Framework analysis and comparison (NMHSPF and DESDE 2015)						
Preliminary mapping: Alpha version WA Atlas codes to NMHSPF						
Analysis bed capacity: WA Atlas and NMHSPF						
Completion of WA Atlas Beta version and re-analysis of coding						
Semantic mapping to DESDE 2.0 (2018)						
Reporting						

Figure 3 Gantt Chart of the semantic mapping between the NMHSPF and the DESDE-LTC.

Step 1: Introduction for establishing scope (19 June, 2017 and 17 July to 19 July 2017: Australian National University, Canberra).

Meetings of key participants included members of the NMHSPF and DESDE-LTC teams, and a WAPHA representative. Formal presentations and discussions were used to ensure that participants were familiar with the two systems, and to explore key differences in their purpose, structure, semantics and concepts.

During these meetings, participants also developed editorial principles to guide the mapping process and agreed on a work-plan.

Step 2: Development of the conceptual framework (17 July to 19 July 2017: Australian National University, Canberra).

This work demonstrated a degree of alignment in the domains described for bed-based care used by NMHSPF and the DESDE-LTC codes for residential care. However, there were some areas of difference and it was agreed that further analysis would be required to:

- compare coding for other types of care;
- generate translation rules for data linkage; and
- bridge any differences between the underlying assumptions within the two systems. For example, there were differences in methods for calculating FTEs and in categorising staff across workforce types.

A joint proposal was submitted to WAPHA for additional work with the following aims:

a) detailed analysis of the equivalence of service elements/codes, identifying alignment, gaps and overlaps between the NMHSPF and DESDE systems;
b) development of mechanisms for supporting the mapping/interoperability of available systems as appropriate, such as a common glossary of terms and definitions of links between terms; and
c) application of the two systems and any developed mechanisms for interoperability to the analysis of two WA PHN catchments (urban and rural).

Step 3: Preliminary mapping of the NMHSPF to the WA Atlas Alpha version, application to a sample of DESDE-LTC data from the Western Australian Atlas, and development of initial linkage rules (23, 24 and 25 January, 2018 – The University of Queensland School of Public Health, Brisbane).

As noted previously, the private consultant ConNetica had developed the Alpha version of the Atlas of WA (Figure 1). A preliminary analysis of North Perth PHN data from the Alpha version of the WA Atlas was conducted. The team could then revise codes as needed while they were being mapped against the NMHSPF classifications and perform this task over all the categories listed in the NMHSPF "Service Element and Activity Descriptions" (The University of Queensland, 2016). Through discussion, NMHSPF service elements were assigned provisional DESDE-LTC codes, and any variations between the mapping approaches of the two models were noted, including the service types and the data elements used to define such services. Links were established between the two models for beds, state services, primary mental health services, and community support sector services. As the work proceeded, areas of agreement, disagreement, and overlap were noted, and some linking rules were developed.

Step 4: Analysis of bed capacity identified at the WA Atlas Alpha version and the bed capacity recommended by the NMHSPF (30 and 31 January, 1 and 2 February, 2018 – WAPHA, Perth).

The previous work demonstrated a degree of alignment in the domains described for bed-based care used by NMHSPF, and the DESDE-LTC codes for residential care. Once the preliminary mapping was completed, an analysis of the actual bed capacity (DESDE-LTC 2015, WA Atlas Alpha version) and the ideal capacity (NMHSPF) was conducted in the Perth North PHN. This analysis was carried out in Perth, and the results were checked by the stakeholders, who could provide feedback to the ANU and UQ teams. Participants in the Perth meetings included members of the Western Australian Mental Health Commission, service representatives, and health systems researchers, in addition to the members of the NMHSPF, DESDE and WAPHA teams who had participated in earlier meetings.

A preliminary gap analysis was completed for beds data during the second phase of this project. This work was informed by the theoretical mapping completed previously, and tested the practical application of the linkages. To conduct the gap analysis, a NMHSPF report was generated for Perth

North PHN in order to suggest the number of beds required for each service element. As the Atlas was reviewed, reported beds corresponding to each service element were tallied, allowing comparison between the number of reported Atlas beds and the number of projected NMHSPF beds.

Preliminary analysis of data from rural Western Australia in the Kimberley region was hampered by the lack of an operational reference model of rural MH care to support the interpretation of results. Therefore the data on bed availability and occupancy in the Kimberley region was not included in this analysis.

Step 5: Completion of WA Atlas Beta version and re-analysis of coding (30 and 31 January, 1 and 2 February, 2018 – WAPHA, Perth).

In this stage of work, the group applied the linked codes to Atlas data pertaining to the North Perth PHN and the Kimberley region of the Country WA PHN, and incorporated service feedback and review coding in the Atlas for Perth North PHN.

During this phase of testing, some changes were made to the coding and linkages developed in the previous phase of conceptual mapping. The changes include:

- incorporation of feedback about the nature of services mapped in the Atlas. This feedback was provided by service planners, commissioners and providers during the Perth meetings and in subsequent follow-up work;
- revision of DESDE-LTC codes based on changes to service information and minor changes to codes contained in the most recent iteration of the DESDE system; and
- revision of DESDE-NMHSPF linkages as the teams enhanced their understanding of the systems.

Feedback from the stakeholders was also incorporated during the sessions held on 30-31 January 2018. Members of the ANU team worked further with WAPHA and other stakeholders to incorporate feedback on the North Perth PHN Atlas, finalised the data to complete the Beta version of the Atlas, and provided this as an attachment to the main Atlas. This additional work occurred in Perth from 1-2 February 2018, through email and teleconference communications, and at a meeting in Canberra on 27-28 February 2018.

The team also revised and checked the Kimberley Atlas data. It was agreed that the mapping exercise was not feasible in the rural catchment area until an appropriate model of rural mental care was available. The development of such a model is a separate task that will be carried out by the NMHSPF team in the near future. Until such a model is available in Australia, the use of either system for the analysis and planning of rural mental health services should proceed with caution.

Step 6: Semantic Mapping of DESDE-LTC to NMHSPF (February-March, 2018 – Brisbane, Canberra).

The analysis conducted in Step 4 and 5 contributed to the refinement of the conceptual mapping of the categories in the two classification systems. The UQ group completed a draft report of the semantic mapping in February 2018. This version was revised by the ANU group in March 2018. In addition to the practical mapping of the DESDE-LTC codes available in the WA Atlas Alpha version (Hopkins et al, 2017i; Hopkins et al, 2017ii), and in the Beta version finalised after completing Steps 4 and 5, the ANU group provided the final semantic mapping of the DESDE 2018 codes to the NMHSPF, taking into account the differences between the systems identified in Step 1 (framework and characteristics of the two systems). When the NMHSPF types referred to units of analysis not coded by NMHSPF (e.g. a care intervention coded by the International Classification of Health Interventions - ICHI), a code from this third classification system was provided.

Step 7: Final report (April, 2018 – Brisbane, Canberra).

This step included the final revision of linkages and rules, production and revision of the report.

3 Results

3.1 Conceptual framework for the comparison of DESDE-LTC and NMHSPF

The framework for the comparison of the systems was developed during the first meeting in Canberra, and refined and agreed at the meeting in Brisbane (Fig. 3). This framework involves: a) a description of the two systems that were critically appraised by the working group; and b) identification of the key differences between both systems in regard to their system structure, aims, and context.

3.1.1 Overview and description of the two classification systems

a) The NMHSPF

The NMHSPF was developed under the Fourth National Mental Health Plan to provide a consistent national approach to mental health planning and service delivery. An initial version of the NMHSPF and Planning Support Tool (PST) was completed in 2013, but was not widely released at the time, due to concerns regarding its fragility and potential for misapplication. In 2015, the National Mental Health Commission called for the framework to be released to inform the work of PHNs, who had been charged with responsibility for the development of collaborative regional mental health plans. A second stage review and refinement of the framework was therefore conducted in 2016, to refine aspects of the PST including the appropriateness of the primary care component of the reports and associated documentation. A formal process of training of PHN staff and release of the framework to PHNs commenced in 2017, to support its application to collaborative regional planning.

The NMHSPF provides a population based model of the optimal spectrum of mental health services required to meet the needs of the Australian population. It combines the best available evidence and expert opinion on the prevalence of mental illness and need for mental health services; the types and levels of mental health care required for different needs groups; and efficient standards of mental health service operation. The Planning Support Tool enables calculation of the resources required to deliver this range of mental health services to a selected population region for a chosen year.

The NMHSPF builds a comprehensive model of optimal services from the following components:

- analysis of mental health epidemiology within the Australian population, providing 12-month prevalence of mental illness by age group and level of severity. Varying rates of demand for services are modelled across severity levels, and specific needs groups within the population are identified. Evidence based universal mental health promotion and

indicated mental illness prevention services are also described. A total of 155 different needs groups are identified across all age and severity levels, for which service requirements are modelled;

- definition of a typology of evidence based services and interventions to meet population needs, listing the range of specific service categories, service elements and service activities sufficiently supported by evidence to be considered appropriate for delivery in an optimal mental health service system. The typology is defined across five levels (groups, streams, categories, elements and activities), with the selection of components to be included based on published evidence and expert consensus where insufficient evidence was available. Detailed definitions are provided of relevant service categories, elements and activities, allowing precise definition of the clusters of services required to meet the needs of particular population subgroups. Overall, the elements included were considered to be consistent with national mental health policy and appropriate for delivery within the Australian service system;
- definition of Service Profiles for each of the 155 needs groups using the service elements and activities defined within the typology. These describe the type and quantity of care required to provide an adequate standard of care for the specific populations within the need group. Each care profile models the average care required for that needs group over a 12-month period;
- modelling of staffing profiles, efficiency parameters and resource requirements for each service element, based on efficient operational rates using averaged national staffing profiles and salary levels; and
- generation of PST planning estimates for optimal service levels and resource requirements based on the modelled service demand, interventions and service profiles, for a selected population and year, across a range of output variables.

The output estimates generated by the PST provide a national average description of optimal service requirements across the spectrum of services, from primary mental health care to intensive treatment and support for those with severe and complex disorders. As an optimal system requires balanced resources across this spectrum, successful application of the framework requires that individual outputs are not considered in isolation. Although based on a national average model most readily applicable to large population sizes, the NMHSPF outputs also provide benchmarks to inform mental health service planning at a small region level.

Analysis of the gap between NMHSPF estimates of required service activity and resource levels for a specific catchment, and currently available services, provides indications of priority areas for service planning. A range of data sources can be used to provide relevant information about current services, including funding, staffing, infrastructure, and service utilisation with comparisons in proportional gaps across service components and subregions, identifying areas of relative under- or over- investment and priorities for future service development. Application of the NMHSPF PST estimates to collaborative regional mental health planning has been successfully trialled in the Central Queensland Wide Bay Sunshine Coast PHN. This process highlighted areas of service deficit,

and the impact of these on the broader service system, providing opportunities for joint service development between the PHN and relevant state mental health services.

The NMHSPF is a dynamic tool which relies on ongoing updating and adjustment to accommodate developments in mental health service knowledge. A further stage of development is planned which will address a number of the limitations of the current tool, and increase its utility for PHNs. PHN users of the PST have been identified as an important stakeholder group to be included in the next phase of development.

The NMHSPF provides a model of the ideal service system required to meet the needs of a given population across all settings and provider types. It uses the most recent available epidemiological data from Australia and international sources to provide estimates of the average 12-month prevalence of mental illness within a standard population of 100,000 people. These estimates are broken down by age groups (0-4 years, 5-11 years, 12-17 years, 18-64 years and 65 years and over) and level of severity (early intervention, mild, moderate, severe, severe and complex, and relapse prevention). Treatment rates, based on current best practice recommendations and expert opinion, are applied to the prevalence estimates for each group to determine the number of individuals with a mental disorder or mental health problem expected to require services within a 12-month period.

The NMHSPF then describes the ideal range and level of interventions or services required for each age and severity group in a set of 155 different care profiles. The recommended bed numbers and other service activity data outlined in care profiles are combined with staffing profiles and cost data to model full-time equivalent (FTE) staff and funding requirements for delivering mental health services to a given population over 12 months. The NMHSPF can generate outputs at the national, state, PHN,Local Health Network (LHN) and Local Government Authority (LGA) level. However, it is important to acknowledge that the NMHSPF is based on national averages, and does not currently consider population characteristics other than age.

The NMHSPF is endorsed by the Australian Department of Health, and is currently being used by trained state, PHN and LHN representatives across Australia to inform mental health planning. The Australian Department of Health is supporting the dissemination of the NMHSPF by providing support for training in its use and for further development of the Framework.

b) The DESDE-LTC (Description and Evaluation of Services and DirectoriEs for Long-Term Care)

The DESDE-LTC is an international classification system of care services based on the European Mapping Service Schedule (ESMS) for coding adult mental health care (Johnson et al., 2000) which was extended to incorporate other care sectors such as child and adolescent mental health, drug and alcohol, ageing, disabilities, long-term care, and social care. It includes an international, standardised tool for describing care teams within health services, and compiles information on inputs and processes of care at the meso-level (e.g. health/social catchment areas) and micro-level (e.g. individual services) (Tansella & Thornicroft, 1998).

The DESDE-LTC can be used to describe health services over 4 main domains:

- **A: definition of catchments, target populations and units of analysis for services**. Services are analysed as "Care Teams" or "Basic Stable Inputs of Care". A BSIC is a combined and co-ordinated set of inputs (including structure, staff and organisation) that deliver care at a micro-organisation level, and have temporal and organisational stability. Catchments, target populations and services can be aggregated to provide higher-level analysis of health systems – for example at a regional, state or national level. Care Clusters that do not meet the stability criteria are classified as (Non-continuous) "Care Programs". They can be mapped using DESDE-LTC as a separate layer of information;

- **B: availability of care:** activities performed by the Care Teams (and Care Programs) are coded**.** Each team or program is coded according to the Main Types of Care (MTCs) it provides. The MTC codes the principal activity of the service according to the DESDE hierarchical tree taxonomy. This activity can be different to the activity mentioned in the name of the service. There are six main MTC mapping branches, as well as optional qualifiers that can be used to develop a more granular description of services as required;

- **C: care utilisation**: DESDE-LTC provides instructions for collection of standardised counts of service use. As with other sections, various levels of granularity can be obtained as required by the specific project; and

- **D: service checklist:** DESDE-LTC provides more detailed, standardised analysis of local care teams, including information about governance, funding sources, characteristics of the services and staffing.

The DESDE-LTC provides multiple options for analysis including the following:

- compiling Atlases of care services in particular areas;
- identifying service availability, diversity, placement capacity and workforce capacity of the care teams operating in a catchment area;
- measuring and comparing the levels of provision/ availability and utilisation of services/care teams between different catchment areas and provision-based gap analysis;
- comparing the structure and organization of services/care teams across catchment areas; and
- recording changes through time in services/care teams available within a catchment area.

The psychometric properties of ESMS and DESDE, including its feasibility, reliability, validity have been extensively tested and published in the scientific literature (Salvador-Carulla et al, 2000; 2006;

2013). DESDE-LTC includes the classification instrument, plus a set of accompanying material: a glossary of terms; technical report on metrics, standardisation and usability; on-line training; and a case book. It has been used in combination with other instruments for health planning, and this usage has been tested in Europe (Salvador-Carulla et al., 2015). All material is open access and available at www.edesdeproject.eu/ and http://www.edesdeproject.eu/ refinement/remast.php.

Like other classification systems, the ESMS/DESDE system is routinely revised to adapt it to general changes in the care system, and to maintain its usability for international comparison of service provision and its analysis. These versions and updates of the ESMS/DESDE system have taken different names: ESMS (Johnson et al., 2000; Salvador-Carulla et al., 2000), DESDE (Salvador-Carulla et al., 2006), DESDE-LTC (Salvador-Carulla et al., 2013), DESDE-LTC/REMAST (Salvador-Carulla et al., 2015), and DESDE 2.0. The latest version will be officially released in October 2018. It has incorporated new codes and qualifiers based on the recent use of the classification for mapping health and social care in Europe (Gutierrez-Colosia et al., 2017), Australia (Fernandez et al., 2016) and Chile (Salinas et al., submitted).

Atlas of Mental Health Care

One of the main functions of the DESDE system is to provide the basic information on service availability and capacity to produce bottom-up atlases of mental health care. The development of an Atlas follows a series of steps:

1) an Alpha version is prepared by the working group based on local surveys and interviews with provider organisations. In this step, care teams are identified in every service available in the defined area. This version requires compiling lists of all the services available in a defined area for a target population including all sectors (health, social, employment, education, housing and justice) (Fig. 4). Once the functional care teams that constitute every service have been identified, they are coded with the DESDE-LTC taxonomy. Additional codes (target group and qualifiers) are provided to complete the full coding of the service. Finally, coded care teams are geolocated in the defined area and geolocated in the area;

2) a Beta version is completed after revision with the public agencies and the key stakeholders;

3) the final version is completed with feedback provided by the local stakeholders and consumer organisations after the launch of the Beta version (version for comments) (Fig. 4).

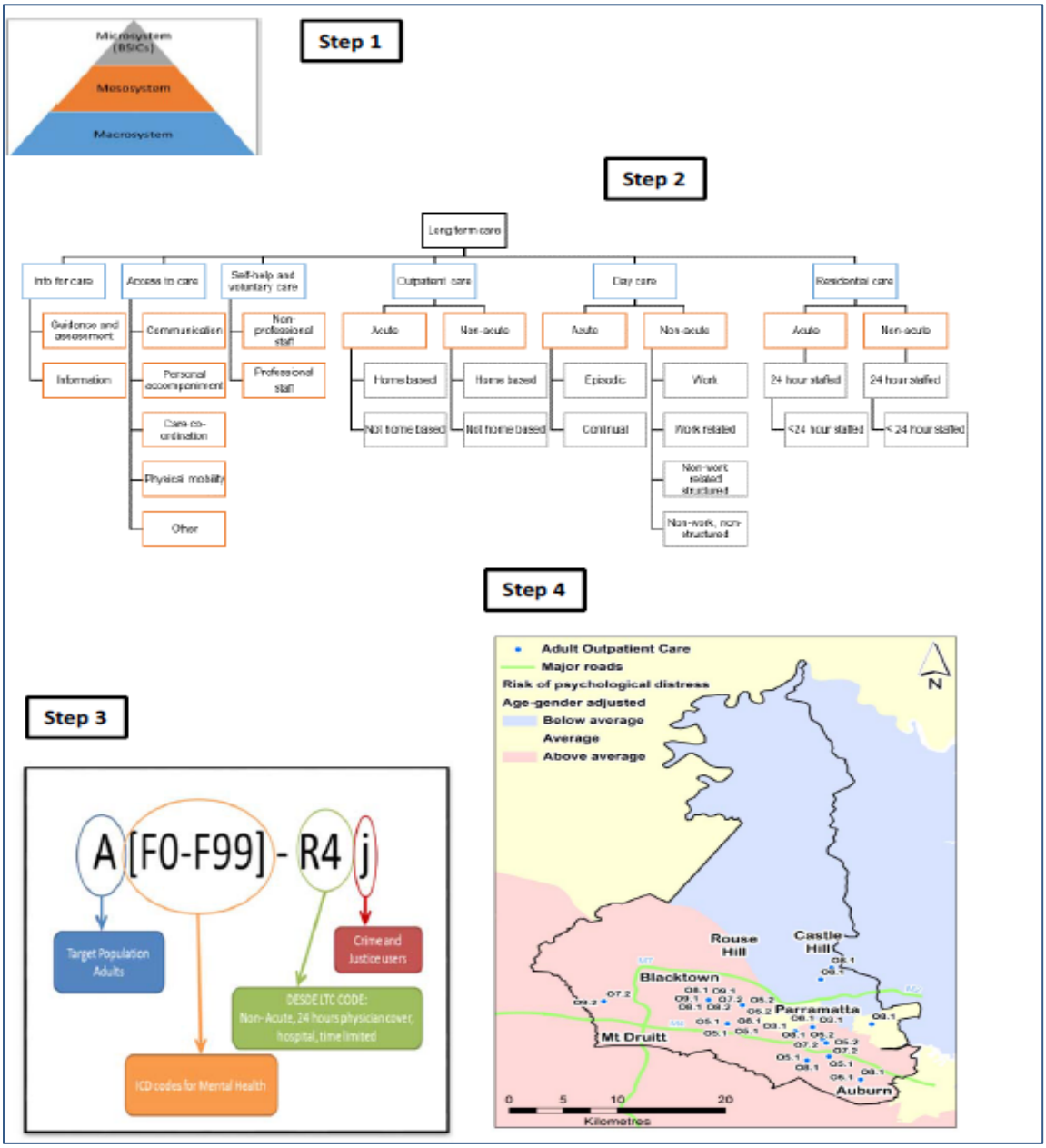

Figure 4 Process of development of the Integrated Atlas of local mental health care

Figure 5 describes the objective, structure, method and results provided by the Integrated Atlases of Mental Health Care. Visual tools are used to display the information on the social and demographic factors, the geolocation of care teams, the balance of care, and the representation of the integral patterns of care provision and capacity in every catchment area.

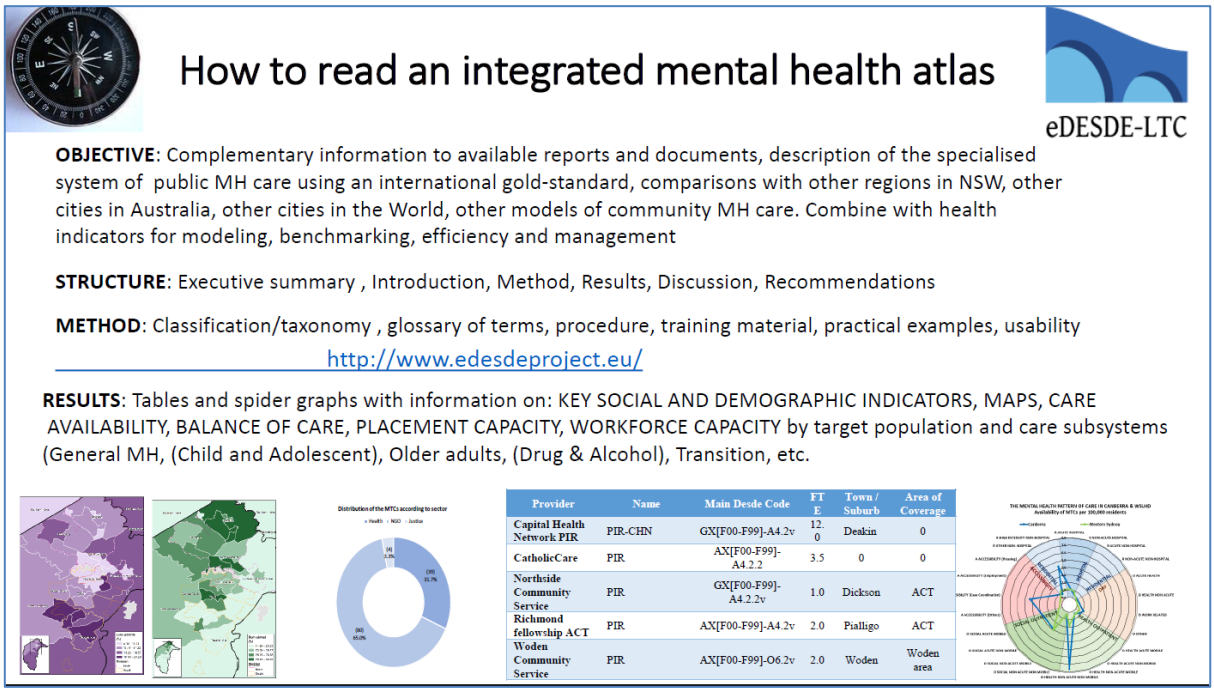

Figure 5 Characteristics of the integrated atlas of mental health care using the DESDE classification of services (care teams) coded by main types of care (MTCs)

The Atlases of Mental Health Care provide service information in separate layers to avoid confusion that may misguide the decision making process. For example, an overestimate of service availability can result when fully private and publicly accessible services are mixed in the same mapping. Therefore a series of layers have been defined:

- **first layer: specific care services** provided for the target group (e.g., mental health services). These services are stable over time, provide universal access and are directly or indirectly paid for by government;

- **second layer: generic care services** provided for the target group (e.g., primary care and general hospital non-psychiatric care);

- **third layer: private services with restricted access.** In the Australian system this would include private practice psychology consultations requiring GP referral and for which fees are paid by service users out-of-pocket without reimbursement, and/or with private insurance reimbursement only;

- **fourth layer: (non-continuous) Care Programs** – which do not meet criteria for temporal and/ or organisational stability.

As these layers use the same coding system, the information can be aggregated to obtain the full description of the mental health provision in a defined area.

The Atlas of Mental Health Care is a useful tool for gaining knowledge about the local mental health system, but it is not a decision support system for policy planning. In order to support policy planning, it should be used in combination with other sources of information, particularly in relation to prevalence, resource utilisation, consumer outcomes, and financing. DESDE-LTC and the related atlalses have been extensively used for mapping health and social care in Europe, Australia and the Americas. This information on service availability and capacity has been endorsed by the departments of health in Catalonia and the Basque Country (Spain) and Finland for national and regional mental health planning, and for informing local planning in New South Wales (NSW) and WA. DESDE-LTC outputs have been used in provision-based gap analysis, analysis of relative technical efficiency and quantitative benchmarking (Torres-Jimenez et al., 2015; Chung et al., 2018).

The development of the ESMS/DESDE system has been funded by European Union research programmes and the European Executive Agency of Health and Consumers. The Atlas projects have been funded mainly by regional and national governments and international co-operation agencies. In Australia, the Mental Health Commission of NSW and individual PHN groups have provided funding to map services in their catchment areas (Primary Health Networks and Local Hospital Networks). In the Western Australian project, DESDE-LTC coding was conducted from a commissioning perspective, used to compile care service Atlases and analyse the first layer of services. The analysis of other layers of care were not in scope for this project.

3.1.2 Key Differences between NMHSPF and DESDE-LTC

a) System structure

The NMHSPF describes the service elements and activities that it models. This system is a typology of mental health care provision in Australia. This typology includes different units of analysis (services, interventions, medications, and culture of care) and it is associated with consensus definitions that are not mutually exclusive. NMHSPF does not use codes for computation, and it uses natural language for the naming and definition of its categories.

The DESDE-LTC is an ontology-based conceptual taxonomy that includes a formal glossary, operational definitions, a standard coding system based on a taxonomy tree that follows rules <is-a> and <part-of> (children categories are mutually exclusive and share common attributes of the parent category), and that includes an alphanumeric system for computation.

b) System aims

The aims of DESDE-LTC and NMHSPF are different, which could explain the system differences described above. The NMHSPF describes the ideal distribution of resources in a given area, based on available evidence, burden of illness (Disability Adjusted Life Years -DALYs), and expert consensus-informed models of population-level optimal mental health care. It indicates what the system should achieve, or where should it go.

The DESDE-LTC analyses the actual distribution of resources per 100,000 inhabitants in a local area using standardised international coding. This approach is used to generate local Atlases of Mental Health Care, including those for Western Australia. DESDE-LTC is designed mainly to facilitate international comparisons of local or regional service availability and capacity across a broad array of care sectors and health conditions; and it can also be used to analyse actual resource utilisation, and the relative technical efficiency of resource usage. Rather than indicating directly what resources should be purchased, it supports commissioning by facilitating comparisons of systems in different areas, identification of care gaps, and by helping planners understand the impact on the broader system of making changes in one particular area. As shown in Figure 6, the DESDE-LTC aggregates micro and meso level data to provide a bottom- up analysis of actual care provision, while the NMHSPF uses macro-level data to provide top-down models for ideal macro and meso-level provision.

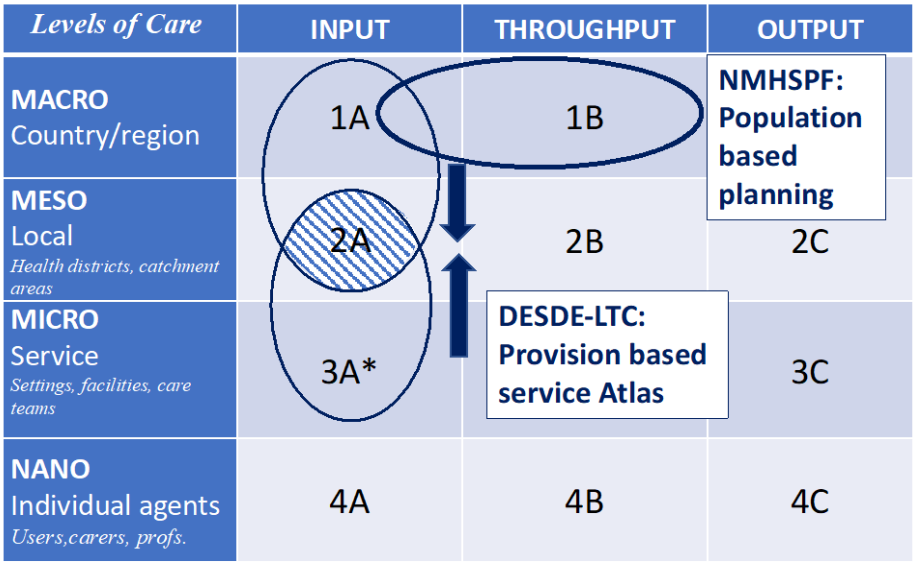

Figure 6 Extended Tansella and Thornicroft Care Matrix. Comparison of NMHSPF and DESDE-LTC

c) System context

The NMHSPF is a top-down self-contained classification system. It is focused at a national level, and is aligned with national systems and datasets in Australia. However, it can also provide estimates at regional and local levels.

The DESDE-LTC is a bottom-up international system for classification and coding of care services. It is designed to work in combination with the international standardised reference classification systems of the WHO Family of Classifications (WHO-FIC) and other United Nations (UN) international classification systems (see Figure 2). It uses the classification codes of the International Classification of Diseases (ICD) and the International Classification of Functioning (ICF) for coding target populations. Its unit of analysis is care teams or "Basic Stable Inputs of Care" (BSICs) coded according to their principal function or "Main Type of Care" (MTC). It only codes service availability and capacity. It does not code interventions, which are coded by the WHO International Classification of Health Interventions (ICHI-Beta version), workforce (coded by the International Standard Classification of Occupations - ISCO), the philosophy or culture of care, team climate, organisational change or care quality. Figure 7 shows how the NMHSPF and the DESDE-LTC relate to each other and to national and international classification systems.

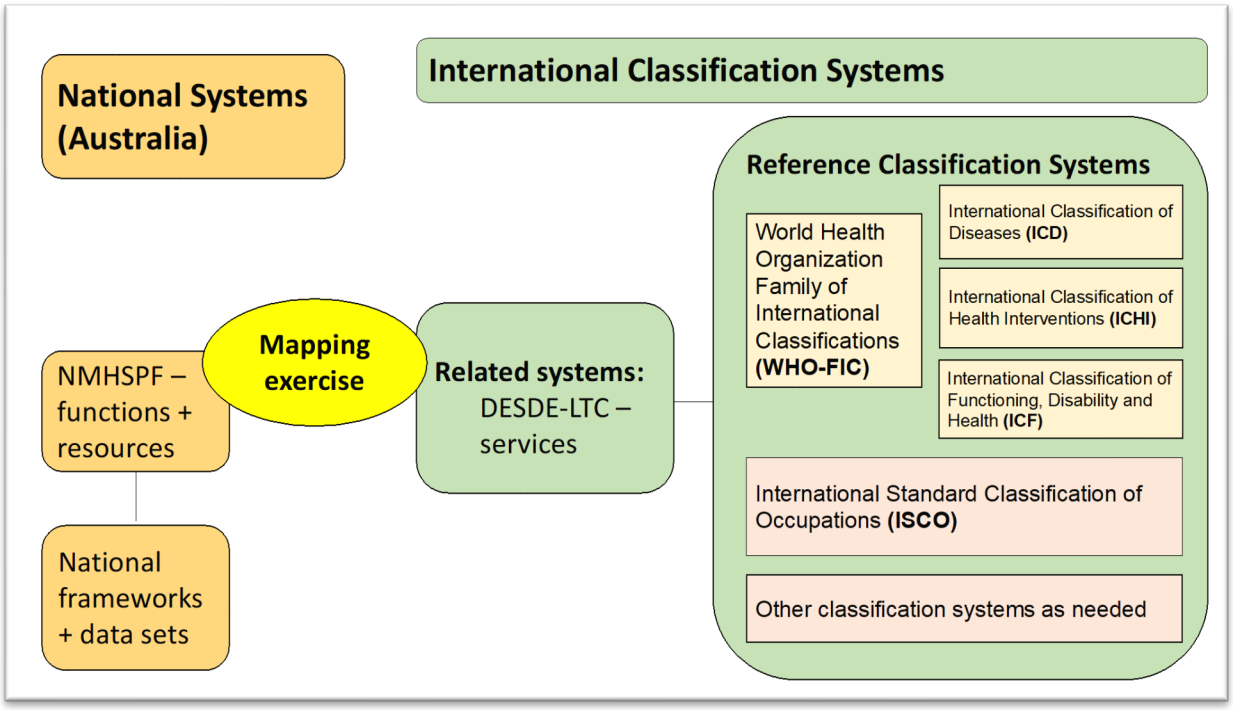

Figure 7 Contextual mapping of the Australian and international classification systems in relation to the NMHSPF and DESDE systems

The different aims, contexts and characteristics of the DESDE-LTC and NMHSPF explain their structural differences.

NMHPF provides standards for efficient mental health service operation. Its Planning Support Tool enables calculation of the resources required to deliver this range of mental health services to a selected population. Therefore NMHSPF is a decision support system (DSS) in itself. Given the disparity of sources of information and units of analysis to produce the information required for producing a DSS (including services, interventions and activities such as prescriptions), the NMHSPF classification cannot be structured into a conceptual taxonomy. A typology defines ideal types and allows combining different units of analysis to get estimates of service provision and costs at different geographical levels. On the contrary, the DESDE-LTC is a hierarchical taxonomy that allows classification of services by care teams. It is designed to be used in combination with other classification systems and provides basic information on local service availability and capacity. In order to be used for planning, DESDE-LTC should be used in combination with other sources of information on the local resource utilisation, outcomes, and costs to generate a decision support system (Chung et al., 2018).

In spite of their different characteristics, these two classification systems can be effectively linked, as the areas of care provision covered by the two systems are highly complementary. This complementarity is shown in Figure 4, demonstrating the Tansella and Thornicroft matrix of the process of mental health care in relation to different levels of the health ecosystem.

3.2 Conceptual mapping of DESDE codes to NMHSPF classification

The semantic mapping conducted in this project has two different practical objectives: 1) its application for improving the knowledge base on service provision in Western Australia using the already available information in the Alpha version of the Atlas of Mental Health Care in WA; and 2) the actual conceptual mapping between DESDE-LTC and NMHSPF. This mapping was carried out for an urban and a country catchment (Perth North PHN and the Kimberley region of the WA Country PHN). Even though mapping was completed in the Kimberley region across the sample of services reported in the Atlas, only the data from PNPHN has been updated and used for this exercise. This was due to problems in the interpretation of the information in rural areas caused by the absence of a valid framework of rural mental health care, both in the DESDE and in the NMHSPF. In the Alpha version of the WA Atlas, services were coded using the 2015 version of the DESDE (Hopkins et al., 2017i; Hopkins et al., 2017ii). Therefore, the updated version of the coding system (DESDE 2.0) could not be applied retrospectively, and assumptions on the equivalence of the 2015 to the NMHSPF system had to be made for this practical exercise. During this process, a series of formal rules for linking the NMHSPF types and the DESDE codes were defined to facilitate the mapping of the two classification systems. The rules for linking “Bed-based” services are shown in Annex 3. The formal rules for mapping “Outpatient and community” services have been described in Annex 4.

For practical purposes, the preliminary mapping with the WA Atlas data (1) and the final semantic mapping of the two systems using the DESDE 2.0 version (2) are shown in Tables 1 to 6.

Inpatient services ("Bed-based mental health services") (Tables 1 to 3).

Table 1 Semantic mapping of NMHSPF to DESDE coding: Acute Inpatient Services

NMHSPF Service Stream: 2.3 Bed Based Care	DESDE-LTC (2015) WA Atlas - Alpha	DESDE 2.0 (2018) Protype MTC code in bold *ICHI Interventions codes in italics*	Comments about practical mapping of WA Atlas	Comments about future applications of the conceptual mapping
2.3.1 ACUTE INPATIENT				
2.3.1.1 Perinatal/Infant (Hospital)				
0-4	None identified in catchment	**CC-[F0-F9] [Z62]-R2s**	Beds for mothers with perinatal mental health problems are assigned the ICD code F53 (puerperal psychosis). In some areas of Australia, cots for their babies are also counted - in these cases, the ICD code Z62 (problems with upbringing) may be used as shown. Cots were not counted in WA, so a prototype code is provided. DESDE qualifier "s" describes care teams designed for a specific subgroup within the target population.	
18-64	AX[F53]-R2	**GXF-[F0-F9] [F53]-R2s**		
2.3.1.2 Child/ Youth (Hospital)				
5-11	None identified in catchment	**CC-[F0-F9]-R2**		
12-17	TA[F0-F99]-R2c CX[F0-F99]-R2	**CA-[F0-F9]-R2**		
2.3.1.3 Adult (Hospital)				
18-64	AX-[F0-F99]-R2	**AX-[F0-F9]-R2**		
2.3.1.4 Older Adult (65+ BPSD) & 2.3.1.5 Older Adult (Hospital)				
65+	OX-[F0-F99]-R2c	**OX-[F0-F9]-R2**	DESDE qualifier "c" denotes closed beds	
65+ BPSD	Not listed separately	**OX-[F03.91]-R2s** OX-[F03.91]-R1s OX-[F03.91]-R2qs	DESDE qualifier "c" denotes closed beds; "q" indicates that the main attribute of the team (e.g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC; "s" describes care teams designed for a specific subgroup within the target population	R2q and R1 are closely related codes. The DESDE R1 code is intensive care as the one provided in ICU. ICD Code [F03.91] "Dementia with behavioural disturbance" has been used for the equivalence with BPSD
2.3.1.6 Eating Dis. Adult				
18-64	AX-[F50]-R2s	**AX-[F50]-R2s**		ICD "Eating Disorders" code [F50]
2.3.1.7 Intensive Care Unit (Hospital)				
12-17	None identified in catchment	**CA-[F0-F9]-R2q** CA-[F0-F9]-R1	The DESDE qualifier "q" indicates that the main attribute of the team (e g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC	The DESDE R1 code is intensive care as the one provided in ICU. Therefore the category R1 (intensive care) could be more intensive than the NMHSPF "High Intensity" category. Some services will be coded at the highest level of intensity in NMHSPF but at the second highest level of intensity "R2" in DESDE.
18-64	AX-[F0-F9]-R1 AX-[F0-F9]-R2c	**AX-[F0-F9]-R2q** AX-[F0-F9]-R1	Some facilities had closed and open beds, but were not sufficiently intensive to be coded R1. When a facility had closed R2c and open R2 beds, the locked unit was regarded as High Intensity in NMHSPF.	
65+	OX-[F0-F99]-R1c	**OX-[F0-F9]-R2q** OX-[F0-F9]-R1	The DESDE qualifier "c" denotes closed beds, but is not required for R1 (intensive care); "q" indicates that the main attribute of the team is significantly higher/greater than for other teams coded in the same MTC; "s" describes care teams designed for a specific subgroup within the target population	
65+ BPSD	Not listed separately	**OX-[F03.91]-R2qs** OX-[F03.91]-R1s		ICD Code [F03.91] "Dementia with behavioural disturbance" is used as equivalent to BPSD

2.3.1.8 PEC (Hospital)				
18-64	AX-[F0-F9]-R2	**AX-[F0-F9]-R2b**	DESDE qualifier "b" is short term episode-related care	
2.3.1.9 Same day admission for ECT				
18-64	AX-[F0-F9]-D0s	***AAA SC BP (ICHI)*** **(AX-[FO-F9]-D0s)**	DESDE code specifies the type of service and the "s" qualifier indicates that the care is specialised.	The intervention ECT is specified by the ICHI code **AAA SC BP.** This intervention is typically provided at AX-[FO-F9]-D0s
Early Psychosis - Acute				
12-17	CY-[F2-F3]-R2s	**CA-[F29]-R2s**		ICD and ICHI do not code the course of illness, so "early" isn't coded. ICD [F29] is used as a proxy code for "psychosis".

Table 2 Semantic mapping of NMHSPF to DESDE coding: Sub-acute Inpatient Services

NMHSPF Service Stream: Bed Based Care 2.3.2 SUB-ACUTE	DESDE-LTC (2015) Alpha Atlas of WA	DESDE 2.0 (2018) Protype MTC code in bold	Comments about practical mapping of WA Atlas	Comments about future applications of the conceptual mapping
2.3.2.1 Step Up/ Step Down - Youth (Residential) 12-17yrs	None identified in catchment	**CA-[F0-F9]-R8.1b**	DESDE qualifier "b" is short term episode-related care	
2.3.2.2 Step Up/Step Down – Adult (Residential) 18-64 yrs	AX-[F0-F99]-R8.1	**AX-[F0-F9]-R8.1b**	DESDE qualifier "b" is short term episode-related care	
2.3.2.3 Rehabilitation – Adult and Older Adult				
18-64	AX-[F0-F99]-R7 AX-[F0-F99]-R4c	**AX-[F0-F9]-R8.2b**	DESDE qualifier "b" is short term episode-related care; "c" denotes closed beds	Typical length of stay is 120 days with an expected maximum of 180 days. The DESDE code is R8 "shorter stay"
65+	None identified in catchment	**OX-[F0-F9]-R8.2b**	DESDE qualifier "b" is short term episode-related care	
2.3.2.4 Older Adult (Hospital)				
65+	OX-[F0-F99]-R4c	**OX-[F0-F99]-R4**	DESDE qualifier "c" denotes closed beds	
65+ (BPSD)	Not listed separately	**OX-[F03.91]-R4s**	The DESDE qualifier "s" describes care teams designed for a specific subgroup within the target population	ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.3.2.5 Intensive Care (Hospital)				
18-64	AX-[F0-F99]-R4c	**AX-[F0-F9]-R4bq**	DESDE qualifier "b" is short term episode-related care; "c" denotes closed beds; "q" shows that the main attribute of the team (e.g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC.	
65+	OX[F0-F19]-R2c OX[F0-F99]-R4c OX[F0-F99]-R2c	**OX-[F0-F9]-R4bq**		

Table 3 Semantic mapping of NMHSPF to DESDE coding: Non-acute Inpatient Services

NMHSPF Service Stream Bed Based Care	DESDE-LTC (2015) Alpha Atlas of WA	DESDE 2.0 (2018) Protype MTC code in bold	Comments about practical mapping of WA Atlas	Comments about future applications of the conceptual mapping
2.3.3 NON-ACUTE				
2.3.3.3 Adult + Older Adult (24 hr support)				
18-64	AX-[F0-F9]-R7	AX-[F0-F9]-R7 **AX-[F0-F9]-R11**		
65+	None identified in catchment	**OX-[F0-F9]-R11**		
2.3.3.4 Older Adult (Hospital/Nursing Home)				
65+	None identified in catchment	OX-[F0-F9]-R8.1 OX-[F0-F9]-R4		

65+ BPSD	None identified in catchment	OX-[F03.91]-R8.1s OX-[F03.91]-R4s	DESDE qualifier "s" describes care teams for a specific subgroup within the target population.	ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.3.3.1 Intensive Care (Hospital)				
18-64	AX-[F0-F99]-R4c	**AX-[F0>F9]-R4q**	DESDE qualifier "c" denotes closed beds; "q" indicates that the main attribute of the team (e.g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC	
65+ BPSD	None identified in catchment	**OX-[F03.91]-R6q**		ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.3.3.2 Intensive Care – Older Adult (65+) (Hospital-based)				
65+	None identified in catchment	**OX-[F0>F9]-R6q**	DESDE qualifier "c" denotes closed beds; "q" indicates that the main attribute of the team (e.g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC; "s" describes care teams for a specific subgroup within the target population.	
65+ BPSD	None identified in catchment	**OX-[F03.91]-R6sq**		ICD Code [F03.91] means "Dementia with behavioural disturbance"

In general, the semantic equivalence of NMHSPF and DESDE for inpatient services was good. We were able to identify equivalent codes in the DESDE system for all the acute and sub-acute service types in the NMHSPF classification. Five service types were not identified in the Atlas of PNPHN region, and three types were not listed separately. One service (2.3.2.3: Rehabilitation - Adult and Older Adult) received a completely different code in the Atlas than the one finally selected as a prototype code for this service type. Another service (2.3.1.9: Same day admission for ECT) was identified as a health intervention and coded with ICHI. The prototype service providing this type of intervention is provided in Table 1.

The semantic mapping of non-acute inpatient services showed a somewhat lower equivalence than other in-patient services. Five out of eight service types could be fully matched to a prototype DESDE code. Three services required more than one MTC to be described, using the DESDE system. Only two service types were identified in the Atlas of the NPPHN region. Six NMHSPF service types were not available in the catchment area.

Statewide services

The semantic mapping of the Statewide services, between the NMHSPF with DESDE-LTC 2015 and the DESDE 2018, including primary and specialised clinical ambulatory mental health care, is provided in Table 4.

Table 4 Semantic mapping of NMHSPF to DESDE coding: Statewide programs

NMHSPF Service Stream 2.1 Primary & Specialised Clinical Ambulatory MH Care Services	DESDE-LTC (2015) Alpha Atlas of WA	DESDE 2.0 (2018) Protype MTC code in bold	Comments about practical mapping of WA Atlas	Comments about future applications of the conceptual mapping
EARLY INTERVENTION:				This is not a NMHSPF category. These services were in the WA Atlas.
COPMI				
0-17 years	CX[e310][F0-F9]-I2.1.1u CX[e310][F0-F99]-O10.2g	**CX[e310][F0>F99]-O10.2**	Two services were mapped – an information/ guidance service and a non-mobile non-acute program for COPMI and parents.	COPMI is a target group for whom there can be various services. Service are shown as DESDE codes, with an ICHI code [e310] to denote "family"
CBCL				

0-17 years	CX[F0-F9]. I1.1le	**CX-[F0-F9]-I1.1**	CBCL does not appear in the Atlas or NMHSPF. This code could relate to ART= Acute Response Team – information / guidance / triage for Child and Adolescents 24/7. The DESDE qualifier "l" denotes liaison care; "e" denotes not face-to-face such as telephone service	
Child and youth				
0-17 years	CX-[F0-F99]-O9.1 TA-[F0-F99]-O9.1 CX-[F64 2]-O9.1h	CX-[F0-F9]-O8.1 CX-[F0-F9]-O9.1 CX-[F0-F9]-O10.1 CX-[F0-F9]-D4.1	This could correspond to non-acute, continuing care for young people - includes outpatient and day programs	
ADULT CONTINUING CARE AND MITT				This is not a NMHSPF category but appears in other categories (e.g., 2.1.3 Acute care; 2.1.4 Consultation Liaison; 2.1.5 Clinical Community treatment; 2.1.6 Day Programs)
Standard 18-64 years	AX-[F0-F99]-O2.1 AX-[F0-F99]-O5.1.1 AXIN-[F0-F99]-O5.1.1 AX-[F0-F99][F10-F19]-O5.1 AX-[F0-F99]-O6.1 AX-[F0-F99]-O7.1u AXF-[F0-F99]-O9.1 AX[F0-F99]-[e95]-O9.1 GXIN[F0-F99]-O10.1u GX-[e310][F0-F99]-R10.1	**AX-[F0-F9]- O6.1** AX-[F0-F9]- O5.1		These services are coded in DESDE as Adult/ non- acute/ mobile care /health related Includes ICD codes for suicide [T14.91], family [e310] and substance use [F10-F19]
Eating disorders				
0-17 years	CX[F50] - O10 2g	**CX[F50] - O10.2**	DESDE qualifier "g" denotes group care; "l" denotes liaison care; "s" describes care teams designed for a specific subgroup within the target population (e g., for Eating Disorders within the "Mental Disorder" group).	
18-64 years	AX[F][F50] - O10.2g AX[F50] -D8.1h AX[e310][F50] - O1.1g	**AX-[F50]-D4.1s**		AX[e310][F50] - O1.1g denotes the parents and partner program
PIMH (perinatal)				
0-17 years	None identified in catchment	None identified in catchment		
18-64 years	AXF-[F30-F39]-O2.1 AXF-[F0-F99]-O4.1l AXF-[F0-F99]-O10.1 AXF[F53]-O9.2 AXF[F53]-O10.2g AXF[F0-F19]-O9.1	AX-[F][F0-F9]-[F53]-D4.1s AX-[F][F0-F9]-[F53]-O2.1lh	DESDE qualifier "h" describes care provided in hospital, "l" denotes liaison care, "s" refers to specific subgroup	
Older persons				
65+ years (including BPSD)	OX-[F0-F99]-O6.1	**OX-[F0-F9]-O9.1** OX-[F0-F9]-O8.1 OX-[F0-F9]-O10.1	Services speficially for people with Dementia and Behavioural Problems would be coded [F03.91]	ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.1.4 CONSULTATION LIAISON				
Paediatric				Not coded separately in the NMHSPF
0-17 years	CX-[F0-F99]-O3.1l	**CX-[ICD]-[F0-F9]-O4.1hl**	DESDE qualifier "h" describes care provided in hospital, "l" denotes liaison care.	In addition to the ICD codes for mental illness [F0-F9], the code [ICD] is used because Consultation Liaison includes any diagnosis (incl. physical illness)
2.1.4.1 General (Hospital)				

0-17 years	CX-[F0-F99]-O3.1l	**CX-[ICD]-[F0-F9]-O4.1hl**	Difference between "Paediatric" and "General 0-17 years" not clear, DESDE qualifier "h" describes care provided in hospital, "l" denotes liaison care.	
18-64 years	GX-[ICD][F0-F99]-O3.1lh AX-[F0-F99]-O4.1l AX-[ICD][F0-F99]-O4.1l	**AX-[ICD]-[F0-F9]-O4.1hl**		
65+ years (including BPSD)	OX-[F0-F99]-O3.1l	**OX-[ICD]-[F0-F9]-O4.1hl**		Separate BPSD services would be coded as OX-[ICD]-[F03.91]-04.1hl ICD Code [F03.91] means "Dementia with behavioural disturbance
2.1.4.2 Emergency Department (Hospital)				
0-17 years	None identified in catchment	**CX-[F0-F9]-O3.1hl**	DESDE qualifier "h" describes care provided in hospital, "l" denotes liaison care.	
18-64 years	GX-[ICD][F0-F99]-O3.1lh	**AX-[F0-F9]-O3.1hl**		Separate BPSD services would be coded as OX-[ICD]-[F03.91]-03.1hl
65+ years (including BPSD)	None identified in catchment	**OX-[F0-F9]-O3.1hl**		
2.1.3 ACUTE CARE SERVICES				
2.1.3.1 Acute care incl Crisis				
0-17 years	CX-[F0-F99]-O4.1 CY-[F0-F9]-05.1m	**CX-[F0-F9]-O2.1**	The first code relates to the ACIT – Acute intervention team The second code seems to relate to the YouthLink program in the Atlas but the inclusion of this service was in error, as it was classified in the Atlas as a Non-Acute service.	
18-64 years	AX-[F0-F99]-O2.1	AX-[F0-F9]-O2.1 AX-[F0-F9]-O1.1		
65+ years (including BPSD)	OX[F0-F99]-O2.1d	**OX-[F0-F9]-O1.1**	The Atlas listed a Hospital in the Home service. Final 2018 codes for this were generated for the broader NMHSPF category.	Separate BPSD services would be coded as OX-[ICD]-[F03.91]-01.1
2.1.3.1 Acute care incl (high intensity, home-based)				
0-17 years	None identified in catchment	**CX-[F0-F9]-O2.1dq**	These include Hospital in The Home (HiTH) services. DESDE qualifier "d" describes care provided entirely at the home of the user; "q" indicates that the main attribute of the team (e.g., mobility, intensity) is significantly higher/greater than for other teams coded in the same MTC.	
18-64 years	AX-[F0-F99]-O2.1d	**AX-[F0-F9]-O2.1dq**		
65+ years (including BPSD)	OX-[F0-F99]-O2.1d	**OX-[F0-F9]-O2.1dq**		Separate BPSD services would be coded as OX-[ICD]-[F03.91]-02.1dq
2.1.3.1 Acute care includes Triage				
0-65+ years	AX-[F0-F99]-I1.1	**GX-[F0-F9]-I1.1**	DESDE qualifier "I" denotes liaison care	
Early Psychosis - Specialist community teams (mobile)				
0-17 years	CY-[F29]-O5.1.1	**CX-[F29]-O6.1s** CX-[F29]-O5.1	ICD code [F29] is used for psychosis DESDE qualifier "e" indicates the team uses ICT to deliver service; "I" denotes liaison care, "s" refers to specific subgroup [F98.9] is used for generic behavioral or emotional disturbance with onset in childhood	Early psychosis is not coded separately in the NMHSPF The course of disease "early" is not coded in DESDE, ICD or the ICHI
18-64 years	AX-[F0-F99]-O9.1	**AX-[F29]-O6.1s** AX-[F29]-O5.1		

The equivalence of Statewide services and DESDE codes was somewhat lower than the equivalence found for inpatient services. Twenty one NMHSPF types could be matched to a DESDE MTC prototype. MTCs describing the service type 2.1.3.1 ("Acute care incl. Crisis, adult") were also very close in the hierarchical tree. Three service types were associated to two or more DESDE codes from distant branches in the tree (e.g. Day care and Outpatient Care). The characteristics of some service

types in the catchment area were different to those identified in the prototype MTC code (e.g. 2.1.4.1 : "Consultation liaison general -hospital- for children and adolescents"; 2.1.3.1 "Acute care incl Crisis"). Five service types were coded with at least three different MTCs in the catchment area. One (Adult Continuing Care and MITT) had 10 different MTCs assigned to its type in the catchment area. Three service types were not available in the area at the time the Atlas of NPPHN was completed.

Community Support Sector Services

The semantic mapping of Community Support services including rehabilitation, peer support, and carer and respite services, is shown in Table 5.

Table 5 Semantic mapping of NMHSPF to DESDE coding: Community Support Sector Services

NMHSPF Service Stream: Community Support Services	DESDE-LTC (2015) Alpha Atlas of WA	DESDE 2.0 (2018) Protype MTC code in bold	Comments about practical mapping of WA Atlas	Other comments and future applications
2.2.2.1 Individual support and rehabilitation				
0-17	CA-[F00-F99]-O6.2 CX-[F0-F99][E95]-O9.2u CY-[F10-F99]-O9 2d TA-[F0-F99]-O9.2d	**CX-[F0-F9]-[ICF]-O6.2** CX-[F0-F9]-[ICF]-O5.2 CX-[F0-F9]-[ICF]-O7.2	DESDE qualifier "d" denotes Domiciliary care provided entirely at the home of the user; "u" describes teams where care is typically delivered by a single health care professional. The ICD-9 code [E95] (suicide attempt) used in the 2015 version has been replaced by the ICD-10 CM code [T14.91]	The code [ICF] is used because the target of the service is focused on functional aspects rather than on clinical aspects.
18-64	AX-[F00-F99]-O5.2 AX-[e310]-[F00-F99]-O5 2 GXIN-[F0-F99]-O6.2 AX-[F0-F99]-O6 2 AX-[T14.91][F0-F99]-O6.2ul AX-[F0-F99]-O9 2s GXIN-[F0-F99]-O9.2 AX-[F0-F99]-O8 2 AX-[F0-F99]-O9 2du AX-[F0-F99]-O9 2u AXF-[F53]-O9.2 AX-[F0-F99]-O10.2 AX-[F0-F99]-A5 AX-[F0-F99]-I2.1.2eu AX-[F0-F99]-A5.4u AX-[F0.F99]-A5.1 AX-[F0-F99]-A5.4 AX-[F0-F99]-A5.5 GX-[F0-F99][F10-F19]-O7.2	**AX-[F0-F9]-[ICF]-O6.2** AX-[F0-F9]-[ICF]-O5.2 AX-[F0-F9]-[ICF]-O7.2	DESDE qualifier "d" denotes care provided at home; "e" refers to service delivery by information and communication technologies (ICT)s; "l" denotes liaison care; "u" describes teams where care is typically delivered by a single health care professional; "s" describes care teams designed for a specific subgroup within the target population.	ICD Code [T14 91] means "Suicide attempt" ICD Code [F53] means "Puerperal psychosis" and is used as a general code for perinatal mental health problems
65+ (incl BPSD)	OX[F0.F99] . O6.1	**OX-[F0-F9]-[ICF]-O6.2** OX-[F0-F9]-[ICF]-O5.2 OX-[F0-F9]-[ICF]-O7.2		ICD Code [F03.91] means "Dementia with behavioural disturbance" and is used if services are specifically for this group.
2.2.2.2 Individual Peer Work				
0-17	None identified in catchment	**CX-[F0-F9]-[ICF]-O7.2k**	DESDE qualifier "k" indicates (paid) peer work	
18-64	GX-[F0-F99]-S1.1	**AX-[F0-F9]-[ICF]-O7.2k**		
65+ (incl BPSD)	None identified in catchment	**OX-[F0-F9]-[ICF]-O7.2k**		ICD Code [F03.91] means "Dementia with behavioural disturbance" and is used if services are specifically for this group.

2.2.4.5 Individual Carer Support Services				
0-17	None identified in catchment	CX-[e310]-[F0-F9] - O7.2 CX-[e310]-[F0-F9]- O8.2 CX-[e310]-[F0-F9]- O9.2 CX-[e310]-[F0-F9]- O10.2		These services are typically low-intensity, for any person related to the consumer and may be mobile or non-mobile. By convention the ICF codes e310 are used to specify services for families and e340 for services for other carers. These services are provided for carers whether or not they themselves have a mental health condition. ICD codes [F0-F9] are used because the person being cared for could have any mental diagnosis Services that are specifically for carers of consumers with dementia and behavioural disorders use the ICD code [FO3.91]
18-64	AX-[e310]-[F00-F99]-O8 2 GX-[F0-F99]-O10.2 GX-[F0-F99]-S1.1	AX-[e310]-[F0-F9] - O7.2 AX-[e310]-[F0-F9]- O8.2 AX-[e310]-[F0-F9]- O9.2 AX-[e310]-[F0-F9]- O10.2		
65+ (incl BPSD)	Not listed separately	OX-[e310]-[F0-F9] - O7.2 OX-[e310]-[F0-F9]- O8.2 OX-[e310]-[F0-F9]- O9.2 OX-[e310]-[F0-F9]- O10.2		
2.2.1.1 Group Support & Rehabilitation				
0-17	CX-[F50]-O10.2g	**CX-[F0-F9]-[ICF]- O10.2g**	DESDE qualifier "g" refers to outpatient services where care is provided through group activities (typically over 80%).	ICD Code [F50] means "Eating Disorders"
18-64	AX-[F0-F99]-O7 2g GX-[F0-F99]-O9.2g AX-[F0-F99]-O10.2g AX-[F0-F99]-O10.2gu AXF-[F0-F99]-10 2g AXF-[F53]-O10.2g AXF-[F50]-O10.2g AXIN-[F0-F99]-O10.2g GX-[F0-F99]-O10.2g AXIN-[F0-F99]-O11g AX-[F0-F99]-I2.1.1g	**AX-[F0-F9]-[ICF]- O7.2g**		
65+ (incl BPSD)	None identified in catchment	**OX-[F0-F9]-[ICF]- O7.2g**		OX Services specifically for people 65+ yrs with BPSD) would be assigned the ICD Code "Dementia with behavioural disturbance" [F03.91]
2.2.1.2 Group Based Peer Work				
0-17	None identified in catchment	**CX-[F0-F9]-[ICF]- O7.2gk**	DESDE qualifier "DESDE qualifier "g" means mainly group based care; "k" refers to paid peer work;	
18-64	AXF-[F50]-O10.2g AX-[F31]-O10.2g GX-[F0-F99]-S1.3g GX-[F0-F99]-S1.4g GX[F0-F99]-O9.2g GX[F0-F99]-O10.2gu	**AX-[F0-F9]-[ICF]- O7.2 gk**		ICD Code "Bipolar disorder" [F31] ICD Code "Eating Disorders" [F50]
65+ (incl BPSD)	None identified in catchment	**OX-[F0-F9]-[ICF]- O7.2 gk**	DESDE qualifier "g" – mainly group based care; "k" refers to paid peer work;	ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.2.4.4 Group Carer Support Services				
0-17	CX[e310][F0-F99]- O10.2g	**CX-[e310][F0-F99]- O10.2g**	DESDE qualifier "g" --group based care	In the mapping exercise, COPMI services were compared within the State-wide services group.
18-64	GX-[F0-F99]-O10.2gu	**AX-[F0-F99]- O10.2gk**	DESDE qualifier "g" – mainly group based care; "k" refers to paid peer work; "u" refers to care provided by a single worker.	

65+(incl BPSD)	None identified in catchment	OX-[F0-F99]-O10.2gk		ICD Code [F03.91] means "Dementia with behavioural disturbance"
2.2.4.3 Family Support Services				
0-17	CX-[e310]-[F00-F99]-O6.2 CA-[e310]-[F00-F99]-O6.2 TA-[e13x]-[F10-19]-O9 2 CX-[e310]-[F0-F99]-O10.2g	CX-[e310]-[F0-F99]-06.2 CX-[e310]-[F0-F99]-09.2	DESDE qualifier "g" – mainly group based care;	These services could be mobile and non-mobile
18-64	GX-[e310]-[F0-F99]-O9.2 AXIN-[e310] [F50]-O11g AX[e310][F00-F99]-O8.2 GX-[e310][F0-F99]-O10.2 GX-[F0-F99]-A4.2 2	AX-[e310]-[F0-F99]-06.2 AX-[e310]-[F0-F99]-09.2	DESDE qualifier "g" – mainly group based care;	
65+ (incl BPSD)	None identified in catchment	OX-[e310]-[F0-F99]-06.2 OX-[e310]-[F0-F99]-09.2		
2.2.4.2 Day Respite (centre-based)			Prototype DESDE codes in brackets	The definition provided at NMHSPF for this service type is too broad to provide an equivalent DESDE code. "Respite" is the general aim of the service more than its actual function.
0-17	Services not listed separately	(GX- [F0-F9]-D4s) (GX- [F0-F9]-D8s)		CX- [F0-F9]-D4s and -D8s should refer to respite services only for children and adolescents. In any other case they should be coded for any age "GX"
18-64	GX[e310][F0-F99]-O9.2u GXIN[e310][F0-F99]-O10.2 GX[e310][F0-F99]-O10 2 GX[e310][F0-F99]-R10.1	(GX- [F0-F9]-D4s) (GX- [F0-F9]-D8s)	The 4 codes corresponding to this NMHSPF type appear in the Atlas as Adult non-acute non-mobile outpatient care group DESDE qualifier "u" refers to care provided by a single worker.	Note that services under "adult" are coded here "GX" . "Respite" services for the individual target and for his or her family should be coded separately
65+ (including BPSD)	Services not listed separately but note that services under "adult" are coeded GX	(GX- [F0-F9]-D4s) (GX- [F0-F9]-D8s)		OX- [F0-F9]-D4s and -D8s should refer to respite services for older adults
2.2.4.1 Flexible Respite (home-based)				The definition provided at NMHSPF for this service type is too broad to provide a DESDE code. All these services should be coded with a 'd' qualifier (home)
0-17	Not listed separately but note adults coded GX	CX-[e310][F0-F99]-O7.2d		
18-64	GX-[e310][F0-F99]O9.2 GXIN-[e310][F0-F99]-O10.2 GX-[e310][F0-F99]-O10.2	AX-[e310] [F03.91]-O7.2d		
65+ (including BPSD)	Not listed separately but note adults coded GX	OX-[e310] [F0-F9]-O7.2d		ICD Code "Dementia with behavioural disturbance" [F03.91] The BPSD type will be OX–[e310] [F03.91]-O7.2d
2.2.3.1 Residential Crisis & Respite Services				
0-17	None identified in catchment	CX-[F0-F9]-R8.1b	The DESDE qualifier "b" refers to bundled care - episode-related care provision, usually provided for non-acute patients within a time limited plan	
18-64	None identified in catchment	AX-[F0-F9]-R8.1b		
65+ (including BPSD)	None identified in catchment	OX-[F0-F9]-R8.1b		ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.12 Other Evidence Based Physical Therapies				

Exercise for older adults 65+ (including BPSD)	None identified in catchment	VEB.TI.ZZ VEB.PN.ZZ VEB.PP.ZZ (OX-[F0-F9][Z72.3]-O10.2)	A DESDE code could be generated to describe a service that provided this intervention. However many services can provide it. This includes a package of interventions in ICHI: VEB.TI ZZ:Prescription for physical activity behaviours VEB.PN ZZ: Advising about physical activity behaviours VEB.PP ZZ: Counseling about physical activity behaviours	The specific example used for this category was exercise interventions for older people. The ICHI code AS1 PG ZZ (Assisting and leading exercise for mental functions) denote interventions of cognitive rehabilitation
2.1.6.2 Day Program				
0-17	None identified in catchment	CX-[F0-F9]-D4 CX-[F0-F9]-D5 CX-[F0-F9]-D6 CX-[F0-F9]-D7 CX-[F0-F9]-D8		
18-64	AX-[F0-F99]-D9	AX-[F0-F9]-D4 AX-[F0-F9]-D5 AX-[F0-F9]-D6 AX-[F0-F9]-D7 AX-[F0-F9]-D8		
65+	OX[F0.F99] . D1.2 (6)	OX-[F0-F9]-D4 OX-[F0-F9]-D5 OX-[F0-F9]-D6 OX-[F0-F9]-D7 OX-[F0-F9]-D8		

The mapping of Community Support services at NMHSPF with DESDE showed a greater disparity than the streams of services described above {In-patient and Statewide services). Eighteen service types of this group could be matched to an MTC prototype in DESDE 2.0, but there were more MTC codes per every service type than in the previous service streams. Sixteen service types could not be matched to a single MTC prototype code. In some cases where at least two MTC codes were required to describe the NMHSPF service type, the distance between these codes was small (the codes pertained to the same branch in the same level of the tree hierarchy) (eg 2.1.6.2: "Day program"). In other cases, the codes pertained to distant branches in the same level of the tree hierarchy (e.g. 2.2.4.5: "Individual Carer Support Services, adult").

Thirteen service types were not available in the catchment area, and five were not listed separately. Nine of the NMHSPF types with services identified in the local area required more than two MTC codes to be described in the Atlas. In one case (2.2.2.1: "Individual support and rehabilitation"), 19 MTC were required to describe the services corresponding to this service type in the local area. One service type (2.2.4.2 :"Day Respite -centre-based") included MTCs from different main branches in the DESDE, system which may indicate problems in the operational definition of this service type. Some of these services may require a more precise definition in the NMHSPF Service Element and Activity Descriptions (The University of Queensland, 2016). A standard glossary of terms that includes operational definitions of service types may be particularly relevant in the case of the day and the flexible respite services, the family support services, and the individual carer support services.

The service type 2.1.12:" Other Evidence Based Physical Therapies" constitutes a special case within this group. This type includes a broad scope of health interventions, and it may probably fit better

the services/interventions grouped as "Commonwealth services" in Table 6, and coded with ICHI. The specific intervention listed under this heading ("Exercise for older adults 65+ -including BPSD") is actually a package of three different interventions listed in the ICHI classification. A tentative MTC providing this intervention has been provided (see Table 5 for comments).

Commonwealth services

Table 6 provides the mapping of the NMHSPF Commonwealth services to DESDE. This grouping follows a different approach, as many of these NMHSPF care types are actually health interventions, which should be compared to an international classification system of interventions, rather than an international classification of services (DESDE). Here, the correspondence of the Commonwealth services to the codes of the International Classification of Health Interventions {ICHI Beta version) has been provided (Alborg et al, 20127). In addition, we have listed the service "prototypes" that typically provide every type of intervention (service prototypes) using the DESDE coding.

Table 6 Semantic mapping of NMHSPF to DESDE coding: Commonwealth services (ICHI codes are provided for interventions and DESDE codes for prototype services providing these interventions)

NMHSPF Service Stream: Commonwealth services	**ICHI Beta version (2017)** ***(Codes for interventions)***	**DESDE 2.0 (2018)** ***(Codes for prototype services providing this intervention)***	**Comments**
2.1 .2 NMHSPF SERVICE CATEGORY – ASSESSMENT: A mental health assessment is a determination of a person's mental health status and need for mental health services, ... based on the collection and evaluation of data obtained through interview and observation, of a person's mental history and presenting problem(s). Provided by a suitably trained mental health professional or mental health team (may consist of a psychiatrist, psychologist, mental health nurse +/or allied health professional)			
2.1.2.1 Brief Mental Health Assessment Duration: up to 30 min, average 15 min	AS1 AA ZZ (Assessment of mental functions)	***Brief MH Assessment*** 0-17 years *CX-[F0-F9]-I1.1u* 18-64 years *AX-[F0-F9]- I1.1u* 65+ years (incl BPSD) *OX-[F0-F9]- I1.1u*	This element can be provided in diverse settings, so DESDE codes the service type. The DESDE "u" qualifier indicates that the service is provided mainly by a single professional.
2.1.2.2 Comprehensive Mental Health Assessment Duration: average 45 mins	AS1 AA ZZ (Assessment of mental functions)	***Comprehensive*** 0-17 years *CX-[F0-F9]- I1.1qu* 18-64 years *AX-[F0-F9]- I1.1qu* 65+ years (incl BPSD) *OX-[F0-F9]- I1.1qu*	Duration is not coded in ICHI or DESDE, but the DESDE "q" qualifier indicates that the comprehensive assessment is more intensive than the Brief assessment. OX Services for people 65+ yrs with incl BPSD have ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.7 SERVICE CATEGORY – MONITORING AND ONGOING MANAGEMENT: Provided by specialist trained mental health professionals (psychiatrists, psychologists, mental health nurses, allied health professionals)			
2.1.7.1 Centre Based Monitoring and Ongoing Management Includes: *mental health status monitoring; *Risk assessment; Risk management plan; *Family, friends, support people and	AS1 AA ZZ (Assessment of mental functions) VBA AA ZZ (Assessment of self-harm behaviours) VBA TD ZZ (Collaborating or building partnerships in relation to self-harm behaviours)	***Centre-based*** 0-17 years *CX-[F0-F9]-O8.1u* *CX-[F0-F9]-O9.1u* *CX-[F0-F9]-O10.1u* 18-64 years *AX-[F0-F9]-O8.1u* *AX-[F0-F9]-O9.1u* *AX-[F0-F9] -O10.1u* 65+ years (incl BPSD) *OX-[F0-F9]-O8.1u* *OX-[F0-F9]-O9.1u* *OX-[F0-F9]- O10.1u*	This element involves multiple interventions, most of which can be coded in ICHI. DESDE codes indicate the service type and the setting in which the service takes place. The DESDE qualifier "d" denotes home-based services. ICHI does not classify interventions by the setting in which they are provided, so the ICHI codes are the same for centre-based and home-based services.

carers needs assessment; *Social and environmental assessment; *Individualised Care Plan and Review; *Physical health review;	SX1 AA ZZ (Assessment of engagement in community, social and civic life) PZB TB ZZ (Individualised planning)	***Home-based*** 18-64 years *AX-[F0-F9]-O6d*	
		65+ years (incl BPSD) *OX-[F0-F9]-O6d*	OX Services for people 65+ yrs with incl BPSD) have ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.8 SERVICE CATEGORY: CARE COORDINATION AND LIAISON: Includes working in partnership and liaison with primary care providers, acute health and emergency services, rehabilitation and support services, family, friends, support people and carers and other agencies that occur outside of the clinical encounter. Provided by Clinical and non-clinical service providers and teams.			
2.1.8.1 Care Coordination and Liaison	PZB TC ZZ (Navigating the service system) VEL TD ZZ (Collaborating or building partnerships in relation to behaviours related to psychological health and wellbeing)	0-17 years *CX-[F0-F9]-A4*	This element may involve multiple interventions, most of which can be coded in ICHI. DESDE codes indicate the service type and setting.
		18-64 years *AX-[F0-F9]-A4*	
		65+ years (incl BPSD) *OX-[F0-F9]-A4*	OX Services for people 65+ yrs with incl BPSD) have ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.9 Structured Psychological Therapies (SPT): Structured interaction between a participant and a qualified mental health professional(s) using a recognised, psychological method, (e.g., cognitive behavioural techniques, family therapy or psycho education counselling).			
2.1.9.1 SPT Low Intensity Intervention – Individual Structured brief intervention between the consumer and a vocationally qualified professional	AS1 PP ZZ (Counselling and coaching)	0-17 years *CX-[F0-F9]-O8.2bu* *CX-[F0-F9]-O9.2bu* *CX-[F0-F9]-O10.2bu*	These interventions can be provided in diverse services types, as indicated by the DESDE codes. The DESDE qualifier "b" refers to bundled care - episode-related care provision, usually provided for non-acute patients within a time limited plan; "u" indicates that care is provided mainly by a single professional.
		18-64 years *AX-[F0-F9]-O8.2bu* *AX-[F0-F9]-O9.2bu* *AX-[F0-F9]-O10.2bu*	
		65+ years (incl BPSD) *OX-[F0-F9]-O8.2bu* *OX-[F0-F9]-O9.2bu* *OX-[F0-F9]-O10.2bu*	OX Services for people 65+ yrs with incl BPSD) have ICD Code "Dementia with behavioural disturbance" [F03.91]]
2.1.9.4 SPT Extended Intervention - Individual Structured interaction, lasting 45 minutes, between the person and a qualified mental health professional using a recognised, psychological method	AS1 PQ ZZ (Psychotherapy) AS1 PP ZZ (Counselling and coaching) AS1 PM ZZ (Education)	0-17 years *CX-[F0-F9]-O8.1qu* *CX-[F0-F9]-O9.1qu* *CX-[F0-F9- O10.1qu*	SPT Extended interventions can be provided in different service settings – see DESDE codes DESDE "q" qualifier means that the extended intervention is more intensive than other SPT elements; "u" means that care is mainly provided by a single professional. SPT includes various interventions that are coded separately in ICHI. The duration is specified in NMHSPF but not in DESDE and ICHI.
		18-64 years *AX-[F0-F9]-O8.1qu* *AX-[F0-F9]-O9.1qu* *AX-[F0-F9] -O10.1qu*	
		65+ years (incl BPSD) *OX-[F0-F9]-O8.1qu* *OX-[F0-F9]-O9.1qu* *OX-[F0-F9]- O10.1qu*	OX Services specifically for people 65+ years incl BPSD) would be assigned the ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.9.5 SPT Extended Intervention - Family Structured interaction, lasting 45 minutes, between the person's family and a qualified mental health professional using a recognised, psychological method	SSJ PQ ZZ (Psychotherapy - family relationships) SSJ PP ZZ (Family counselling) SSJ PM ZZ (Family education)	0-17 years *CX-[F0-F9]-[e310]-O8.1qu* *CX-[F0-F9]-[e310]-O9.1qu* *CX-[F0-F9]-[e310]-O10.1qu*	By convention the ICF code e310 is used when referring to family interventions.
		AX-[F0-F9]-[e310]-O8.1qu *AX-[F0-F9]-[e310]-O9.1qu* *AX-[F0-F9]-[e310]- O10.1qu*	
		65+ years (incl BPSD) *OX-[F0-F9]-[e310]-O8.1qu* *OX-[F0-F9]-[e310]-O9.1qu* *OX-[F0-F9]-[e310]-O10.1qu*	OX Services specifically for people 65+ years incl BPSD) would be assigned the ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.9.6 SPT Extended Intervention - Group A structured interaction, lasting 60 minutes, between people (on average 8) in a group	AS1 PQ ZZ (Psychotherapy)	0-17 years *CX-[F0-F9]-O8.1gu* *CX-[F0-F9]-O9.1gu* *CX-[F0-F9] -O10.1gu*	The group format is denoted by the DESDE qualifier "g"
		18-64 years *AX-[F0-F9]-O8.1gu* *AX-[F0-F9]-O9.1gu*	

setting (other than of a multiple-family group) facilitated by mental health clinicians (2) using a recognised, psychological method - e.g., CBT or psycho-education		*AX-[F0-F9]-O10.1gu* 65+ years (incl BPSD) *OX-[F0-F9]-O8.1gu* *OX-[F0-F9]-O9.1gu* *OX-[F0-F9]-O10.1gu*	
2.1.10 SERVICE CATEGORY: CLINICIAN LED WEB-BASED PSYCHOLOGICAL INTERVENTIONS: includes clinician moderated web based psychological interventions and may be offered as an alternative to or as a component of face to face care			
2.1.10.1 Clinician Led Web-based Psychological Interventions	AS1 PP ZZ (Counselling and coaching)	0-17 years *CX-[F0-F9]-O8.1ue* *CX-[F0-F9]-O9.1ue* *CX-[F0-F9]-10.1ue* 18-64 years *AX-[F0-F9]-O8.1ue* *AX-[F0-F9]-O9.1ue* *AX-[F0-F9]-O10.1ue*	The DESDE qualifier "e" indicates that the service is delivered electronically.
		65+ years (incl BPSD) *OX-[F0-F9]-O8.1ue* *OX-[F0-F9]-O9.1ue* *OX-[F0-F9]-O10.1ue*	Services specifically for people 65+ years incl BPSD) would be assigned the ICD Code "Dementia with behavioural disturbance" [F03.91]
2.1.13 SERVICE CATEGORY– PHARMACOTHERAPY: Provided by Medical practitioners			
2.1.13.1 Pharmacotherapy Prescription and 2.1.13.2 Pharmacotherapy Review	PZX TI ZZ (Pharmacotherapy Prescription)	N/A	There is not a prototype service for this intervention. Pharmacotherapy prescription can take place in many services and it has only been coded with ICHI.

All the care types listed under the Commonwealth services category are actually health interventions which can be provided in a diversity of care services. Even though a tentative MTC DESDE code has been provided in Table 6, these types should be coded using the International Classification of Health Interventions, as recommended by the DESDE manual. ICHI does not code the type of professional, the type of psychotherapy provided (eg Cognitive Behavioural Therapy (CBT)), the time frame of the intervention (eg brief psychotherapy), or the duration of every consultation. In spite of these difficulties, it has been possible to assign at least an ICHI code to every service type of this NMHSPF grouping. Due to the restrictions of ICHI mentioned above, the codes of ICHI are less granular than the intervention types described in NMHSPF, while service types in DESDE are usually more granular than in NMHSPF.

One NMHSPF type listed in "Inpatient care services" (Same day admission ECT) and another listed as "Other Evidence Based Physical Therapies" would better fit a category of interventions together with the care types described in Table 6.

3.3. Practical application of the NMHSPF to WA Atlas data

The Beta version of the Atlas of Mental Health Care of the Perth North PHN region is provided in Annex 5. In the PNPHN we were able to map services corresponding to three different service streams within the NMHSPF: bed-based services, state-wide programs, and community support sector services (Tables 1 to 5). In practice, the Atlas data could be adequately classified by both systems. Differences include separate codes for acuity, intensity, bed status (closed), and stay length

in DESDE, whereas the NMHSPF combines some of these elements to form categories: for example, bed status and intensity.

Most NMHSPF service streams linked during the theoretical mapping phase were able to be applied to the Atlas, with the exception of Primary Care services, because this was not in scope for the Western Australian Atlas Alpha version. Mapping Primary Care services in Western Australia would be a separate task . Similarly, psychologists in private practice could be mapped using DESDE-LTC if required, although these should be considered as a separate layer of information when comparing across areas.

3.4. Preliminary gap analysis for beds in PNPHN (projected versus actual availability of bed-based care)

[redacted]

Table 7 Bed based care types showing ideal bed capacity and actual bed availability per in-patient care team in the PNPHN catchment

NMHSPF Service Stream 2.3 Bed Based Care	NMHSPF projected beds	PNPHN Atlas reported beds (WA Atlas, Alpha version)	Statewide beds	DESDE-TC (2015) codes for PNPHN beds (WA Atlas, Alpha version)
2.3.1 ACUTE: Total Beds	[redacted]			
2.3.1.1 Perinatal/Infant (Hospital)				
0-4				Not listed
18-64				AX-[53]-R2
2.3.1.2 Child and Youth (0-17 yrs) (Hospital)				
5-11				Not listed

12-17				CX-[F0-F9]-R2
2.3.1.3 Adult 18-64 yrs (Hospital)				
18-64				AX-[F0-F9]-R2
2.3.1.4 Older Adult (65 +BPSD) (Hospital) & 2.3.1.5 Older Adult				
65 +				OX-[F0-F9]-R2c
65 +BPSD				Not listed separately
2.3.1.6 Eating Disorders - Acute Adult				
18-64				AX-[F50]-R2s
2.3.1.7 Intensive Care Unit (Hospital)				
12-17				Not listed
18-64				AX-[F0-F9]-R1; AX-[F0-F9]-R2c
65 +				OX-[F0-F9]-R1c
65 +BPSD				Not listed separately
2.3.1.8 PEC (Hospital)				
18-64				AX-[F0-F9]-R2
2.3.1.9 Same day admission for ECT				
18-64				AX-[F0-F9]-D0s
Early Psychosis - Acute				
12-17				CY-[F2-F3]-R2s
2.3.2 SUB-ACUTE: Total Beds				
2.3.2.1 Step Up/ Step Down - Youth (Residential)				
12-17				Not listed
2.3.2.2 Step Up/Step Down – Adult (Residential)				
18-64				AX-[F0-F9]-R8.1
2.3.2.3 Rehabilitation – Adult and Older Adult				
18-64				AX-[F0-F99]-R7; AX-[F0-F99]-R4c
65 +				Not listed
2.3.2.4 Older Adult (Hospital)				
65+				OX-[F0-F9]-R4
65+ BPSD				Not listed separately
2.3.2.5 Intensive Care (Hospital)				
18-64				AX-[F0-F9]-R4c
65 +				OX-[F0-F9]-R4c
2.3.3 NON-ACUTE: Total Beds				
2.3.3.1 Intensive Care (Hospital)				
18-64				AX-[F0-F9]-R4c
65 +BPSD				Not listed separately
2.3.3.2 Intensive Care – Older Adult (65 +) (Hospital-based)				
65 +				Noty listed
65+ BPSD				Not listed
2.3.3.3 Adult + Older Adult (24 hr support Residential)				
18-64				AX-[F0-F9]- R7/R11
65 +				Not listed
2.3.3.4 Older Adult (Hospital/Nursing Home)				
65+				Not listed
65+ BPSD				Not listed
ALL BEDS Grand total				
Additional non-acute non-mental health	**NMHSPF projected beds**	**PNPHN Atlas reported beds (WA Atlas Alpha version)**	**Statewide beds**	**DESDE-TC (2015) codes for PNPHN beds (WA Atlas, Alpha version)**
Adult 18-64				AX[F0-F99]-R11: AXM[F0-F99]-R11;

3.5. Practicality of the combined use of NMHSPF and DESDE

This mapping exercise demonstrated that It was feasible to conceptually link the NMHSPF service types to DESDE codes. Fifty two NMHSPF services types have been matched to a single MTC prototype code from the DESDE system. The majority of service types listed in the NMHSPF had equivalent codes in the DESDE system, with the possible exception of some community support services, such as day services and flexible respite services, family support services, and individual carer support services. The categorisation of these services may require detailed operational definitions that are mutually exclusive. Eventually the "z" qualifier of DESDE 2.0 can be used in Australia to designate respite services to provide full semantic interoperability. The full mapping of NMHSPF to the international classification of health care requires the addition of ICHI to code the interventions listed in the NMHSPF system.

The combined use of DESDE 2.0 and ICHI (Beta version), as suggested in Figure 2, provides nearly full equivalence with NMHSPF, with some constraints. For example, it was not possible to obtain a full match between the two systems at the same level of granularity.

The definitions of the NMHSPF service elements did not fully match BSICs because these two systems differ in their linearisation, their definitions are provided at quite different levels of analysis, and the units of analysis of the two systems do not coincide. The main units of analysis in the NMHSPF are "service elements" that can be composed of particular interventions as well as types of services. This is different to the DESDE approach, where the main units of analysis are types of care teams or BSICs. This unit of analysis identifies a group of professionals who provide standard care for a defined target population group on a routine basis. This international definition of care teams is similar to the definition of "clinical microsystems" developed by the Institute of Medicine and used in the United States for health quality assessment (Likosky, 2014).

The DESDE-LTC does not code interventions or intervention packages which are coded by another international classification system (ICHI) (Alborg et al., 2017) (Figure 6). In ICHI, interventions are defined as an "action" for an specific "target" using defined "means". Actions take place in the service, but these actions are not the service itself. Where a NMHSPF service element is an intervention or intervention package, the DESDE would not directly code the intervention and therefore the ICHI code has been provided for the mapping exercise .

There was a set of services mapped in the Atlas which did not align to the other reported service streams, or are not modelled in the NMHSPF. DESDE allows the coding of care services across different sectors including health, social, education, employment, housing and justice. Funding and management are registered at section D of the DESDE-LTC instrument, but they are not coded in

the MTC. In addition "Justice" services are signified by a "j" qualifier in DESDE (Annex 2); and services for other target groups are registered in the target pre-coding (see Annex 1). As an example, Alcohol and Other Drugs (AOD) services are identified with the ICD code [F10-F19] to indicate AOD as a target.

On the other hand, some service types of the NMHSPF did not match any category in the DESDE system. DESDE does not directly code general health conditions such as pregnancy or ageing. Similarly it does not code "metasyndromes" such as "psychosis", course of illness , or the time of onset of the mental problem. Therefore, there is no direct translation of the NMHSPF service element of "Early Intervention" in the DESDE system. As an example, "Early psychosis" services cannot be coded with ICD or ICF because these classifications do not have a code for illness course "early" or for "psychosis". As a matter of convention however, psychosis can be coded using a proxy code: the ICD code F29 (unspecified psychosis not due to a substance or known physiological condition). Other convention codes added to DESDE for describing specific target groups such as "dementia with problem behaviours" are listed in Annex 2.

In spite of this lack of full equivalence, information about the services can still be coded using DESDE, as shown in Tables 1-5, in combination with ICHI (Table 6). A series of rules have also been provided for coding interventions:

a) if the element is a type of service and an intervention, information about the service itself can be coded in DESDE – for example the NMHSPF element of Same Day ECT is coded as a specialist Day service (DESDE) and as a specific type of intervention (ICHI);

b) if the element cannot be described as an actual service, ICHI codes can be used if needed. For example, the ICHI code for Psychotherapy: "AT2 PQ ZZ" could be used for the NMHSPF Service element of "Structured Psychological Treatment" intervention; and

c) where a service is designed to provide ONLY one type of intervention, the service could be coded directly using DESDE. This was the case for some community support sector service types shown in Table 6.

Other discontinuities between the systems were resolved through the use of additional DESDE qualifier codes in the 2018 updated version of this classification (DESDE 2.0). For example, in the Sub-Acute category, step up-step down residential care can be coded using the DESDE 'b' "bundled" qualifier, which describes episode-related care provision, usually provided for non-acute patients within a short time limited plan (e.g. three months of brief psychotherapy). The 'b' qualifier is only assigned when at least 80% of the care provided in the facility is short- time limited and episode-related.

During the discussion process, the team also identified geographical variations that may affect particular data sets. For example, in some parts of Australia, perinatal inpatient beds are counted

only as the mothers' beds, but in others, the infants' beds are also counted. DESDE codes for each type were identified: child beds (CC-[F0-F9][Z62]-R2s) and mother (GX-[F][F53]-R2s). It will be important to clarify that both systems are using the relevant type of counting and coding for these beds in future analyses of datasets.

Some cells in Tables 1 to 6 show a relatively large number of Atlas codes for each NMHSPF Category, and fewer revised DESDE-LTC codes in the Atlas preliminary mapping. This is because the Atlas codes refer to numerous individual services and the granularity of the DESDE-LTC coding used in the Atlas means that relatively minor variations are coded with this system. This is illustrated by the use of lower case qualifiers at the end of some DESDE-LTC codes, which can code very specific aspects of services coded in the Atlas. For example, the qualifier "c" refers to beds that are closed. The qualifier "q" refers to services providing a high intensity type within the same DESDE category (see Annex 2). On the contrary some NMHSPF Commonwealth interventions show higher granularity than ICHI and therefore these different NMHSPF interventions are coded with the same ICHI code.

In the future development of the semantic interoperability of these systems, it may be important to consider the level of granularity in the data, and to account for this when constructing linkages. For example, linkages between the main NMHSPF categories and the main branches of the DESDE-LTC taxonomy are likely to be the most stable across data sets.

Table 8 shows service elements modelled by the NMHSPF but not included in the current work. These elements were not in scope for the WA Atlas so no data were available. These care types could be coded by DESDE-LTC in future data sets if required, so should not prevent semantic matches between the two systems.

Finally, the development of semantic equivalence between the two systems is difficult in some highly specific services associated with particular mental health problems/ interventions/ target populations. This may required additional discussion, but it was possible to develop adequate linkages (Table 9) .

Table 8 Examples of Service types modelled in NMHSPF but not included in Alpha version of the Mental Health Atlas of WA

Service types	How care type can be coded in future if needed
Private Hospital Beds - general	DESDE-LTC can code in a separate layer (Layer 3). Particularly important for eating disorders – e.g., admission to pediatric gastroenterology wards.
Primary Care – e.g., Structured Psychological Treatment	DESDE-LTC can code this service type in a separate layer (Layer 2). If needed, can use ICHI to code intervention type and ISCO to code workforce type (Fig. 6)
Respite: Non-residential, flexible forms	DESDE-LTC will explore options for additional qualifiers for this. A n operational definition of these services at NMHSPF will be needed
Peer work	DESDE has assigned the qualifier "k" to (paid) peer work services for MH services
Physical assessments	This type of intervention should be coded with ICHI and not with DESDE.
Advocacy (*)	Advocacy is not coded by DESDE. It is an intervention that can be provided by different services.
Transcranial Magnetic Stimulation 18-64yrs	This is an intervention coded in ICHI: *AA SC BO*. The typical service providing this intervention would be AX[F0-F99]-O6.1h

(*) NMHSPF Advocacy *is to build capacity in a person to advocate on their own behalf or speaking, acting or writing on behalf of a person to improve their welfare.*

Table 9 Examples of specific services linkage rules (text in italics is paraphrased or quoted from the DESDE and NMHSPF guidance material)

	DESDE-LTC	NMHSPF	Mapping adequacy and rules
Psycho-geriatric services	DESDE codes MH services for older people as OX[F0-F9]. To subtype, use additional ICD code for dementia with behavioural problems OX[F03 91]	Distinguishes between - primary MH in an aged person Vs primary dementia with behavioural manifestations that require MH treatment	Adequate: DESDE-LTC adds a proxy ICD code
Early Psychosis Service	CY-[F29]-R2s	2.3.1 Acute inpatient services: EPS are included in this service type	Adequate: DESDE adds a proxy ICD code F29 to denote psychosis but does not code "early"
Day Admission for ECT	Code as day care -- specialized care AX-[F0-F9]-D0s - ICHI code *AAA SC BP* for electrical stimulation of the brain	2.3.1 Acute inpatient services: included in this service type	Adequate using DESDE-LTC codes. Can add ICHI code for ECT if want to specify intervention type
PECU	AX-[F0-F9]-R2b. Psych Emergency Care Units in Emergency Dept (Hospital)	2.3.1.8 Psychiatric emergency care unit	Adequate: WAPHA noted that WA has observation units - not strictly PECUs as not authorized
Perth's Psych. hostels	DESDE-LTC only counts beds that are designated as mental health places	2.3.3.3 Non-acute residential 24 hour support (counts beds as non-MH but the service users as having MH problems).	Adequate – possible to link coding for WA data, although both teams found these hostels difficult to classify
Partners In Recovery and similar services	DESDE-LTC codes as Accessibility to care and should include qualifier "m"		Adequate-careful analysis of individual services is needed as PIR providers often other services including counselling

4 Key findings and recommendations

4.1 Findings

The project demonstrated that it is feasible to align DESDE-LTC codes with NMHSPF service elements and that when tested, the linkages were generally adequate.

It will be noted that single NMHSPF service elements (types) were at times linked to multiple DESDE codes, whereas ICHI interventions were related in some occasions to several NMHSPF service elements (interventions). This not necessarily a problem and simply reflects the different approaches used by the systems.

DESDE analyses service attributes individually, and uses a code to combine these attributes into a description for each individual service. DESDE coders can choose the level of granularity for the analysis and build simpler or more complex codes as needed. This reflects the flexible approach and international scope of the DESDE, which is designed to support the description of complex services across different systems for different purposes.

The approach taken by the NMHSPF reflects its national focus and its aim to focus on service elements in the Australian healthcare system. As there is a discrete pool of service types in Australia, some NMHSPF categories can combine service attributes which in DSEDE would be coded separately. This was evident for example in exploring residential services in terms of their acuity, intensity and bed status.

It is important to note that the results discussed here are not transferable across locations where the DESDE has been used to map services. This explorative work served to determine the potential for compatibility. Further work will be required to establish valid, reliable links between the two models.

Future validation work would benefit from using Atlas data which:

- has been finalised by completing the full Atlas development process;
- covers additional service types such as psychological services delivered by general practitioners and additional data types such as service utilisation. These were not in scope for the Atlas commissioned in Western Australia;
- provides data for all service types to allow more comprehensive gap analysis; and
- is as recent as possible to ensure relevance and currency.

4.2 Recommendations

- Additional work is required to establish the validity and reliability of the linkages developed in this work between the NMHSPF and the DESDE. This work would need to include clarification of issues not fully resolved in the current work and testing practical application on another sample of DESDE data.
- If this further work were to proceed, the required amount of work would have to be scoped

5 Conclusion

The project has demonstrated that despite considerable differences in structure and purpose it is possible to establish provisional linkages between the NMHSPF and DESDE-LTC. Relational coding has been completed, linking rules have been identified and the relevant tables are provided in this report.

The linked codes enabled services coded in the Atlas to be matched to NMHSPF service elements and indicate that service gap analysis using both systems may be feasible.

Linkage rules were developed through conceptual analysis and then refined during testing on data on samples of data extracted from the Western Australian Atlas. Data from the PNPHN was tested in detail and a provisional gap analysis was completed for bed numbers.

Linkages were also tested using a small sample of Country WA services mapped in the Atlas for the Kimberly region and linkages were established between the systems. This work was hampered by the lack of an ideal service model for services in Rural and Remote Australia and the diversity of service types in the Country WA PHN. For example, the definition of hospital care in both classifications did not accommodate small hospitals run by General Practitioners or run by nurses with on-call General Practitioner support.

Because the WA Atlas was only provided as an Alpha version, feedback provided during the linkage work led to revisions being made to DSEDE codes and service data. These revisions are a standard part of the Atlas development process and are typically be completed prior to the release of the Atlas, so making these revisions during the linkage project was not a usual procedure.

Because of the need to combine the linkage work with incorporating feedback into the WA Atlas coding, additional work would need to be undertaken to test the reliability and validity of related DESDE-LTC and NMHSPF codes in another setting.

In summary, a set of provisionally linked DESDE-LTC and NMHSPF codes has been developed and tested in the Western Australian context. The challenges of conceptual and practical linking of

service types have been explored. Further work will need to be undertaken before the findings of this project are considered in any other application.

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Annexes

Annex 1 DESDE 2.0: Updated codes for the target population (2018)

1. Age groups

GX **All age groups**

NX None/undetermined

CX **Child & Adolescents** (e.g. 0-17)

CC Only children (e.g. 0-11)

CA Only adolescent **(**e.g. 12 – 17)

CY Adolescents and young adults (e.g. 12-25)

AX **Adult** (e.g. 18-65)

AY Young adults (e.g. 18-25)

AO Older Adults (e.g. 50- 65)

OX **Older than 65**

TC Transition from child to adolescent (e.g. 8-13)

TA Transition from adolescent to adult (e.g. 16-25)

TO Transition from adult to old (e.g. 55-70)

2. Gender identity and sexual orientation:

M Male

F Female

L Lesbian

G Gay

B Bisexual

T Transgender

I Intersex

3. Health condition (ICD)

Diagnostic target groups can be identified by ICD-10 codes in brackets after the age group code but before DESDE 2.0 code. Diagnostic categories can be downloaded from the following website

http://apps.who.int/classifications/icd10/browse/2010/en#/V. Use the shorter form of coding that better describes the target population. For example, for identifying the target group "mental disorders" in ICD-10 use [F] instead of [F0-F9]. For identifying the target group of "intellectual disability" use [F7] instead of [F70-79].

i. **ICD** When there is not a specific diagnostic group defined by the care team or it covers all types of disorders
ii. **[X]** When the care team includes all types of an ICD section the letter of the section will be coded. For example [F] for mental disorders.
iii. **[Fx]** When there is a general category but the specific diagnosis is not identified:
[F7] Intellectual disability
iv. **[Fxx]** When there is a specific diagnosis described in the care team (e.g. F50 for Anorexia)
v. **[*Fxx*]** When a proxy ICD code has been selected to describe the service because no specific code describes the specific target population. For example the use of [*F29*] to describe services for early psychosis.

4. Functional group (ICF)

The target population of services that provide interventions for functional problems can be described with ICF codes (WHO International Classification of Functioning). ICF also includes the severity level and this allows the description of services exclusively aimed at subgroups of population defined by severity (e.g. mild, moderate and severe groups within the stepped care model in mental health)

5. Special social needs (ICD Z codes)

ICD-10 "Z" codes for describing "Factors influencing health status and contact with health services" have been used to describe target groups with special social needs such as homelessness (Z59.0), extreme poverty (Z59.5), child abuse (Z62.81). ICD-10 CM provides additional codes such as "T" codes for describing the target group of services for victims of domestic violence (T74: Adult and child abuse, neglect and other maltreatment).

6. Extended or related target group (ICF context codes)

Section 'e" of ICF includes codes for referring to the nuclear family (e310) and the extended family (e315). For practical purposes code e310 is used here both for the core and the extended family. Friends, acquaintances, peers colleagues, neighbours and community members are coded as e320, and personal care providers and personal assistants as e340. This ICF codes can be used for coding services aimed at providing care to the social network of the user.

Frequent ICD-10 CM codes for defining the target population of mental health services are:

B20-B24	Human immunodeficiency virus [HIV] disease
F0-F9	All types of Mental disorders
F03.91	"Unspecified dementia with behavioural disturbance" used as a generic code for (services for) any type of dementia with behavioural problems
F1 (F10-F19)	Alcohol and Other Drug disorders
F2 (F20-F29)	Schizophrenia, schizotypal, delusional & other non-mood psychotic disorders
F29	"Unespecified psychosis not due to a substance or known physiological condition" used as a proxy code for "psychosis" (e.g. Early Psychosis).
F50	Eating Disorders
F53	"Puerperal psychosis" used as a proxy code for perinatal mental health problems
F59	Unspecific behavioral syndromes associated with physiological disturbances and physical factors
F63	Impulse Disorders
F64	Gender identity health conditions
F98.9	"Unspecified behavioral or emotional disorders originating in childhood" used as proxy for behavioral disorders with onset in childhood
ICD	All types of health conditions
T14.91	**"**Suicide attempt" used as a proxy code for any service related to suicide
Z04.71/2 abuse	Encounter for examination and observation following alleged physical
Z2	Persons with potential health hazards related to communicable diseases
Z59	Problems related to housing and economic circumstances
Z62	Problems related to upbringing
Z63	Bereavement due to disappearance and death of family member
Z65	Problems related to other psychosocial circumstances
Z69	Encounter for mental health services for victim and perpetrator of abuse
Z70	Counselling related to sexual attitude, behaviour and orientation
Z72	Problems related to lifestyle
Z72.3	Lack of physical exercise

e310	Services for family (includes here the extended family)
e340	Personal care providers and personal assistants
ICF	Services for any disability/ functional problem

Annex 2 DESDE 2.0: Updated additional qualifiers (2018)

The DESDE 2.0 coding can be complemented by optional codes which provide additional information on the care team characteristics.

QUALIFIERS FOR DESCRIBING COMPLEMENTARY CHARACTERISTICS OF MTCs

A series of qualifiers have been incorporated to facilitate a quick appraisal of those characteristics of MTC and their related Structured Care Team (SCT) which may be relevant to local policy or for a specific research. These descriptors are optional. They are related to the general description of the care team provided at Section "D", and therefore they are not part of the hierarchical tree structure of the DESDE 2.0 system. These optional qualifiers are represented as small letters which can be added at the end of the numeral coding to provide additional information about the location where the care team is provided (eg a hospital setting), specific characteristics of the care teams described (e.g., liaison care teams), the means by which the care team is delivered (e.g., eHealth/telecare). A number of these additional qualifiers are related to larger organisations in the local system where the SCT is located (e.g., general hospitals).

"a" Acute care (complementary)

This qualifier describes acute care which is provided for users in a crisis situation within a non-acute, non-residential setting (branches "O" and "D") but which does not fit criteria for a separate MTC. As an example, this may be relevant to differentiate ambulatory facilities with the capacity to provide acute in working hours care as an ordinary activity from those ambulatory centres that do not provide acute care at all.

"b" Bundled care

This qualifier describes episode-related care provision, usually provided for non-acute patients within a short time limited plan (e.g. three months of brief psychotherapy). The 'b' qualifier is only assigned when at least 80% of the care provided in the facility is short- time limited and episode-related. The "b" qualifier in residential care indicates that the length of stay in this particular service is significantly shorter than for other care teams coded with the same MTC in the same area. For example, less than 72 hours in services with stays that are less than one week; less than a week in services limited to four weeks; or less than three months in time limited services (usually called "sub-acute services").

"c" Closed care

This qualifier describes secluded MTCs with high level of security which is provided under locked doors. Usually these units are for crime & justice users, or persons with mental illness with high risk for themselves or others. The availability of a single room for seclusion within an acute ward does not qualify the care team as closed care.

“d” Domiciliary care

This qualifier describes MTCs provided entirely at the home of the user. If a care team provides mobile home care as part of a broader or more general activity it should not be coded as "d".

“e” eCare

This qualifier includes all care services relying on modern information and communication technologies (ICTs) (e.g. telecare/telemedicine, teleconsultation, teleradiology, telemonitoring).

Specialist technical devices for healthcare professionals (robotics and advanced systems for diagnosis and surgery; simulation and modelling devices; healthcare grids, tools for training) are NOT included in this coding.

When an outpatient CT is provided using teleconsultation, the ‘e’ can be added at the end of the DESDE-LTC code to differentiate this care team from face-to face care teams. (e.g. O81.e)

“f” Far-away

This qualifier describes care teams available for a defined population but too distant to be accessed on a routine basis. This additional descriptor does not depend on the distance of the care team from an individual patient but from a target population quarter (e.g. a municipality). The suggested cut-offs for assigning this code are as follows: 1) Residential care teams: 100 kms; 2) Outpatient non-mobile: 70 kms; 3) Day care: 50 kms. This coding is not intended for mobile outpatient care teams or for eHealth. For example the hospital acute ward assigned for a rural area is in a city 130 kms away from the main location in the rural area; or the assigned day care centre for this area is located in a town 70 kms away from the rural area.

“g” Group

This qualifier refers to outpatient services where most of their care is provided through group activities (typically over 80% of their overall care activity).This excludes family therapy.

“h” Hospital (Care provided in a hospital setting)

This qualifier describes non-residential MTCs (“O”, “D”) provided in a meso-organisation registered as a “hospital” but which is different from acute residential care (e.g. an outpatient unit or a day hospital placed in a general hospital setting in order to differentiate these SCTs from similar units placed in the community). Also describes non-acute residential

care normally found in the community (R8-R13), but which in this case is located in a health care campus or cluster and cannot be coded as R4-R6.

This code excludes “Long-Term Institutional Care settings which are coded as “i”.

“i” Institutional care

This qualifier describes large residential facilities characterised which usually have over 100 beds, and which could be described as “Institutional care” particularly in facilites for indefinite stay. This code is relevant for better describing residential care.

This additional code may provide relevant information with regard to the balance of care in specific areas such as mental health, intellectual disabilities or age, where large long-term residential care characterised an “institutional” care model (e.g acute, time-limited and indefinite stay: R2.i, R4.i, R6.i).

“j” Justice care

This qualifier describes facilities whose main aim is to provide care for crime & justice users (security or prison hospitals, surveillance wards for patients under justice custody, physical disability and psychiatric units in prisons and regional security units). These units may also be coded in an independent tree due to the special characteristics of the target population.

“k” Carer

This qualifier describes facilities whose main aim is to provide care by peers, family members or other ‘non-professional’ carers who are paid for their work, and where typically most (over 90%) of the staff is non-professional. Codings are specified in the target group section. This qualifier can also be used to differentiate in the “S1” branch peer led services from those services covered by other non-professional staff.

“l” Liaison care

This qualifier describes liaison MTCs where specific consultation and care is provided for a subgroup of users from a different main target population (e.g., liaison psychiatric care teams for oncology patients) usually located in another area of care (e.g. outpatient consultation on intellectual disabilities to a general medical care team, or consultation on mental disorders to the general medical care teams of a hospital). A liaison care team provided to inpatients from other wards within the same general hospital will be counted as low mobility Outpatient care.

This qualifier excludes activities of care which are part of the other care team (e.g. psychology care provided by a psychologist within the oncology unit) will not be counted as a liaison care team. A special attention should be paid to whether these facilities fulfil criteria for SCT or MTCs, and are not care units or care programmes within a care team.

“m” Management

This qualifier describes SCTs whose main aim is defined as management, planning, coordination or navigation of care, but which also include several forms of clinical care as part of the coordination of their activity (e.g., the care team typically provides therapeutic counselling as part of its case management activities). These care teams cannot be coded as A4 but should be differentiated from other outpatient care teams. These care teams may include intensive case management, assertive outreach, assertive community treatment, disease management, or even personalised care.

A special attention should be paid to whether these facilities fulfil criteria for SCT or MTCs and are not care units or care programmes within a care team.

“n” Novel

This qualifier describes hospital facilities in hospital clusters, precincts, hospital campuses, or community centres which include partial residential care and do not fulfil criteria for typical general or specialised hospitals. For example, a previous psychiatric hospital is transformed in a general hospital complex that includes a psychiatric ward, an open time-limited unit, a residential indefinite stay unit, and a building with individual supported accommodation in the same premises.

‘o’ ‘On call’ Physician

This qualifier describes residential MTCs where a physician is on call. The physician is not formally on duty at the centre part of the day, usually at night. To add this qualifier care teams on call should be used frequently (e.g at least 4 times a week). This qualifier is not used for other clinical staff on call.

‘p’ Primary Care (Specialized Care provided in a primary care centre)

This qualifier describes specialised ambulatory care provided at the “primary care centre” by a qualified specialist either working under agreement with a specialised care centre or general hospital, or working on-site under contract with the primary care centre. When specialised care at the primary care centre is provided by a subset of primary care clinicians this should be coded with the “s” qualifier.

For example: psychiatric care which is provided by a specialist who is entitled to prescribe specialised treatment including psychotropic drugs in the primary care centre on a regular basis, even though the specialist is based at the Community Mental Health Centre (CMH). This care team is not a mere consultation-liaison care team mainly addressed to support physicians from primary care centre. This additional descriptor is added to the MTC provided

by the CMH at the “mental health tree”: AX[F0-F9]-O8.1p; AND to the coding of this MTC at the primary care centre: AX[ICD][F0-F9] O8.1p.

“q” Quite

This qualifier indicates that the main attribute of the MTC (e.g., length of stay, mobility, intensity) is significantly higher/greater than for other care teams coded with the same MTC in the same area. For example, a “q” qualifier in a “low mobility” MTC indicates that the mobility of the care team is at the higher rank within the “low mobility” group (typically between 20 and 49% of the overall activity performed in the centre). A “q” qualifier in the “high mobility” MTC indicates that the mobility of the care team is higher within the “high mobility” group (typically between 80 and 98% of the overall activity performed in the centre). A “q” qualifier in time-limited residential stay indicates that it is typically over two years.

“r” Reference main type care in an area

This qualifier describes the main and/or official referral care team for a MTC provided at the local area, in areas where care has been organised by quarters or “sectors”. This optional descriptor is particularly relevant in mental health to differentiate the reference mental health centre from other outpatient units in the same local area, or the referral acute hospital care team from other acute units which could also be used by the same target group within the local area.

“s” Specialised care

This qualifier describes care teams designed for a specific subgroup within the target population attended by the care system at the local area.

For example, care teams for elderly persons with Alzheimer’s disease within the “E” group, care teams for Eating Disorders within the “Mental Disorder” group, or a primary care subset of professionals providing specialised care for diabetes, mental health or intellectual disabilities.

“t” Tributary

This qualifier describes satellite units of care dependent from a main care team. Typically the team itinerates to different settings where they provide care on a regular basis (e.g. Royal Flying Doctors care team in rural Australia), or part of the team is permanently in the setting but it does not qualify as a SCT due to its dependency from the headquarters (e.g., satellite ambulatory mental health centres in Girona -Spain).

“u” Unitary

This qualifier describes single-handed SCTs where clinical care is typically delivered by a single health care professional (psychiatrist, psychologist, nurse). This descriptor allows differentiating local systems where care is provided mainly by community centres and teams from those where outpatient care is mainly delivered by single professionals in individual practices. “u” should not be used when a service has one Full Time Equivalent but this is covered by several professionals.

“v” Variable

This qualifier is used when the code applied at the time of interview could vary significantly in the following days or weeks (for example from acute Outpatient care to non-acute). This depends on the capacity of the service to provide the type of care described by the code due to fluctuations in the demand or the supply capacity. For example, a crisis accommodation team for homelessness, or a crisis domestic violence refuge, may fluctuate in its capacity to provide acute care within 24 hours, depending on the demand and the availability of places.

This code can be also applied to services under transition due to a health reform, a change in the whole financing system or social care, or the development of a new disability scheme. This variability in the pattern of service provision is independent of the time continuity of the service. For example, a continuous service can have a ‘v’ code due to a health reform while a care program limited to two years may show organizational stability during the period when it is funded.

“w” Whole

This qualifier indicates that the service only provides the extreme level of the activity described by MTC. For example in “low mobility” MTCs a “w” qualifier indicates that there is no mobility of the staff so this care team is entirely “non- mobile”. On the contrary when this code is applied to a “high mobile” MTC it indicates that all the activity of the care team is mobile. For example, the “w” qualifier attached to a low mobile Outpatient service indicates that this service is fully non-mobile (O9), whilst the same qualifier applied to a mobile service (O6) indicates that 100% of its activity is mobile. Likewise a “w” qualifier attached to an “S” code indicates that a self-support service is exclusively run by un-paid peers.

“x” **Target population not clearly defined**

Additional qualifier “x”, could be added to describe services or clinical teams without a clearly defined target population, or services that have two or more separate targets where the main attribute of BSICs and MTCs (care provided by the same professionals to the same

target group) cannot be applied. This is a residual code that should be applied with caution after checking the characteristics of the service with local planners and managers.

"y" **Unused services**

This qualifier describes services/care teams that are physically located in the catchment area but which are not available for or used by the residents in this area.

"z" **Open Qualifier**

Additional qualifier "z", could be added to describe extra information required by a specific research, or requested by the funding agency or organisation for management or governance purposes. For example, this descriptor can be used for describing transportation to the care team or catering care teams if the agency wants to incorporate this type of delivery to the coding and mapping. The addition of other optional qualifiers requires a formal definition of the descriptors added in every specific project.

When needed, other optional codes could be added depending on the specific objectives of the research.

Annex 3 Rules for mapping bed-base care between NMHSPF and DESDE

Bed based care linkage rules (text in italics is paraphrased or quoted from the DESDE and NMHSPF guidance material)

Care type	DESDE LTC (2015)	NMHSPF	Mapping adequacy + linkage rules
Acuity categories	**Acute:** *(i) admitted due to crisis or deterioration (ii) admission usually within 24 hrs (iii) users retain own accommodation. At least 20% of the users in the last 12 months meet the criteria for residential acute care for crisis.*	**2.3.1.2 Acute Hospital** *Short to medium term 24 hour, specialist psychiatric care for people with acute, recent onset of severe symptoms*.	**Adequate** for initial mapping In practice both systems map acute, sub-acute, non-acute care and it was possible to link coding for the WA examples. Will need further testing on alternative data sets.
	Sub-Acute: definitions of "sub-acute" are very diverse internationally so DESDE-LTC does not have a specific category for this, but instead uses its service feature codes and qualifiers to describe services. -Sub-acute hospital services are coded as R4b *(non-acute, 24hr physician, hospital, time-limited)* -Sub-acute residential services are coded as R8.1b and R8.2b *(non-acute, non 24hr physician, time-limited, 24-hours support, less than 4 weeks or over 4 weeks but less than one year)*	**2.3.2 Sub-Acute**- includes *step-up/ step down services, Rehabilitation services and medium term intensive care services*	The DESDE sub-acute category is time-limited. The granularity of the coding system and the addition of qualifiers allows coding different lengths of sub-acute stay and those from longer time-limited stay
	Non-Acute: *Residential facilities that do not satisfy the criteria for acute care. Crisis admissions are sent to other facilities routinely.*	**2.3.3 Non-Acute:** *Main distinguishing feature is that care is provided over longer period – expected stay is in excess of 6 months.*	The DESDE non-acute category is time-limited but in the non-acute category, length of care can be coded as time-limited or indefninite. This means it is possible to code time-limited residential care that is longer than subacute time limits
Intensity categories:	Within Acute care settings, intensity can be very high (R1), high (R2q) or medium (R2)	Intensive care can be provided across all levels of acuity and is usually provided in secure units	**Adequate** for initial mapping and it was possible to link coding for the WA examples.

			This area would benefit from additional testing and clarification with other data-sets. In the DESDE-LTC, the qualifier "q" (quite) is used within a particular care type to indicate that the main attribute of the MTC (e.g., mobility, intensity) is significantly higher/greater than for other care teams coded with the same MTC in the same area - that it is at the higher end of the range for that type of care. In the WA Atlas, it was used within the R2 category to code high intensity acute care that is of high intensity but not sufficient to be coded as R1 (the highest intensity level). The "b" qualifier is used here. In residential care indicates that the length of stay in this particular service is significantly shorter than for other care teams coded with the same MTC in the same area.
	R1 (Very) High: *admission for deterioration of physical or mental status severe enough to require continuous 24 hr surveillance and/or to require special isolation measures. The prototype of R1 is an "Intensive Care Unit"* **R2q High:** *admission for deterioration of physical or mental status that provide the highest intensity level of regular care*	**2.3.1.7 Intensive Care Unit** *Lockable area within an acute mental health unit – short term, safe, low stimulus care* **2.3.2 Sub-Acute residential services**: *safe secure structured environment, usually collocated with general or psychiatric hospital*	
	R2 Medium*: Facilities that provide regular care (medium intensity) of surveillance and/or security for in-patient admission*.	**2.3.1.2 Acute Hospital** *Short to medium term 24 hr, specialist psychiatric care acute, recent onset of severe symptoms* **2.3.1.8 Psychiatric emergency care unit**	
Bed closed status	DESDE codes closed beds as "c " (R1 intensive care does not need additional "c" qualifier) For example, if a facility has some closed and some open acute hospital beds + medium intensity: would code R2c for closed and R2 for the open beds	Bed status is incorporated into categories of Intensive care across different levels of acuity. In this example, closed beds would be coded as High intensity	**Adequate/ resolved** DESDE 2015 "c" = Framework's Intensive care DESDE 2015 "not c" = care types not classified as intensive unit These rules do not apply for the mapping with the DESDE 2018 version as high intensity can occur in locked or unlocked units and *vice versa*
After hours support	Distinguishes physician Vs non-physician cover	Codes if support available for 24 hours, does not distinguish physician/ non-physician cover	

	Hospital care	Hospital care	**Adequate/ resolved:** For hospitals, both require 24 hr physician cover
	Non-hospital: **R7** *(non-acute, indefinite stay, 24hr support - physician cover)* **R11** *(non-acute, indefinite stay, 24 hr support - non-physician cover)*	**2.3.3.3 Non-Acute – 24 hour support**	For non-hospital, DESDE codes could be aggregated and linked to Framework categories as shown
	R5 (*non-acute, time limited stay, 24 hr support – physician cover)* **R8** *(non-acute time-limited, 24 hr support non-physician cover)*	**2.3.3 Sub-Acute**	
	R9 *(non-acute, time limited, daily support, non-physician cover,)* **R10** *(non-acute, time limited, less than daily support, non-physician cover)*	**2.3.3 Non-acute**	

Annex 4 Rules for mapping Outpatient and community care services between NMHSPF and DESDE

Outpatient and community mapping

Some variations were identified but it was possible to resolve most of them – some would benefit from further clarification.

Two main issues were identified:

- NMHSPF modelling of Day Care services is limited in the NMHSPF, whereas this is a major category in the DESDE-LTC;
- service user age groups were not fully aligned.

Code linkages for Outpatient and community care services

	DESDE LTC	**NMHSPF**	**Mapping adequacy + rules**
Day Care / Programs	Codes Day Care as a main branch of the tree taxonomy.	**2.1.6 Day Programs** NMHSPF modelling excludes some target groups (e.g., older people).	**Not resolved:** linkages were possible in this dataset, but further clarification needed before using elsewhere. Different approaches reflect national vs international focus of the systems – NMHSPF consultations found that Day Programs are less common in Australia; the DESDE-LTC team is aware that Day Care services are important in other countries.
Age groups			**Adequate:** age groups do not completely align but mapping was possible and there are some work-arounds.
	Transitional services (adolescent to adult) are coded: CY adolescents + young adults 12-25yrs AY Young adults 18-25yrs	Currently transition services are not distinguished. Funding has been obtained to adapt Framework to have a late teens/ early adults category which would cover transitional	Main impact likely to be on coding transitional services. This may be resolved when NMHSPF adaptation completed, but in the interim, UQ can extract reports for relevant age groups.

		services – work begins 2019.	
Workforce Classification	Does not code workforce in main counting branches, but can use optional Section D Care Team Inventory For further specification can use codes from the International Standard Classification of Occupations (ISCO)	Codes non-medical as "any tertiary qualified" or "vocational qualified" but can extract data on individual professions.	**Not tested** May be possible to link if DESDE Section D and ISCO codes are used and Framework extracts profession.
Workforce: Clinical vs non-clinical staff roles	Classifies service type rather than worker type – but in some codes, analysis of service provider qualification and role may contribute to understanding the service type.	Distinguishes between "clinical" and "non-clinical" staff based on their qualifications. Provides separate reports for clinical and non-clinical.	**Not resolved** Not a barrier for current mapping work but would need further clarification and testing for future applications.
Workforce: Categorisation of social workers and occupational therapists	In more granular analyses, makes a distinction between health-related and other types of care. This is a broad distinction to enable international comparisons. In services providing "health related care" at least 20% of staff have a health related qualification and in services	The Framework distinguishes between "non-clinical" (Peer Workers or Vocationally Qualified) and "clinical" (Tertiary qualified – including social workers and Occupational therapists) workers.	**Adequate:** the systems have a very different focus but this wasn't a problem in the testing with WA Atlas data. In practice, teams can be coded in DESDE as providing health related services even if they include social workers and occupational therapists amongst their staff. This seems unlikely to cause difficulties in practice but may benefit from further clarification and testing.

	providing "social related care", at least 20% of staff are qualified care professionals. Social workers and occupational therapists are listed as examples of qualified care professionals (social related care) but not as examples of qualified health care professionals (health related care services).	In Australia, appropriately accredited social workers and occupational therapists can work as mental health clinicians.	
Vocationally qualified workers	If a service is staffed by vocationally qualified workers, the DSDE service code would be O8.2 "Other care" rather than O8.1 "Health related care" .	The category "non-clinical" would include these Vocationally qualified workers as well as Peer Workers.	**Adequate** for mapping exercise, but as with other points about workforce coding, would benefit from further clarification.
Intervention Classification	Coding interventions is optional – can use DESDE-LTC Section D Care Team Inventory and International Standard Classification of Health Interventions (ICHI).	Some intervention types are coded in Framework.	**Not fully tested** It may be possible to use DESDE Section D. It proved possible to use ICHI codes to link to NMHSPF interventions (e.g., for ECT).
Structured Psychological Treatment provided by General Practitioners	Would be coded as: AX-[F0-F9]-O8.1 Where the GP is seeing MH patients but not delivering SPT, code as AX-[F0-F9]-O8.1-O10.1p.	Intervention would be coded as SPT and worker would be coded as medical - only include where GP has the appropriate mental health/ psychological	**Not tested** as no Atlas data on this service type but it was possible to construct the DESDE-LTC codes. NMHSPF is harmonizing with AIHW dataset - will have 4 types GP MH activities –Brief MH Assessment; Extended MH assessment, SPT (can include families), monitoring and ongoing

		treatment credentials.	management. May need to review linkage and coding if these additional activities are added to NMHSPF classifications.
Respite care	Residential respite can be coded in the main branch.	2.2.4 Family and Carer Support includes Flexible Respite and Day Respite.	**Not resolved:** DESDE team will review NMHSPF definitions after the meeting and consider whether to develop additional coding for flexible and day respite types. Some respite services are distinguished by their focus on the recovery philosophy or culture of care – this is not coded currently in DESDE.
Advocacy	Can currently be coded as **A5.2 Accessibility of care: Other**	UQ provided definition: "Advocacy – is to build capacity in a person to advocate on their own behalf or speaking, acting or writing on behalf of a person to improve their welfare."	**Adequate**: linkage okay for mapping exercise. DESDE team will review UQ definition and consider whether to propose changes to DESDE codes for this.
Group-work			**Not tested:** but discussion indicated both systems appear to restrict "group" to formal therapeutic or rehab groups. Further clarification would be helpful.
Funder types	Differentiates funding types through layers of analysis.	Differentiates by funder types.	**Not tested** but it seems likely that linking will be possible .

Annex 5 The Integrated Atlas of Mental Health Care of the Perth North PHN Region (Beta version)