

# **Technical Supplementary Report 1: Composite index for quality of care in Australian residential aged care facilities**

## **APPENDICES**



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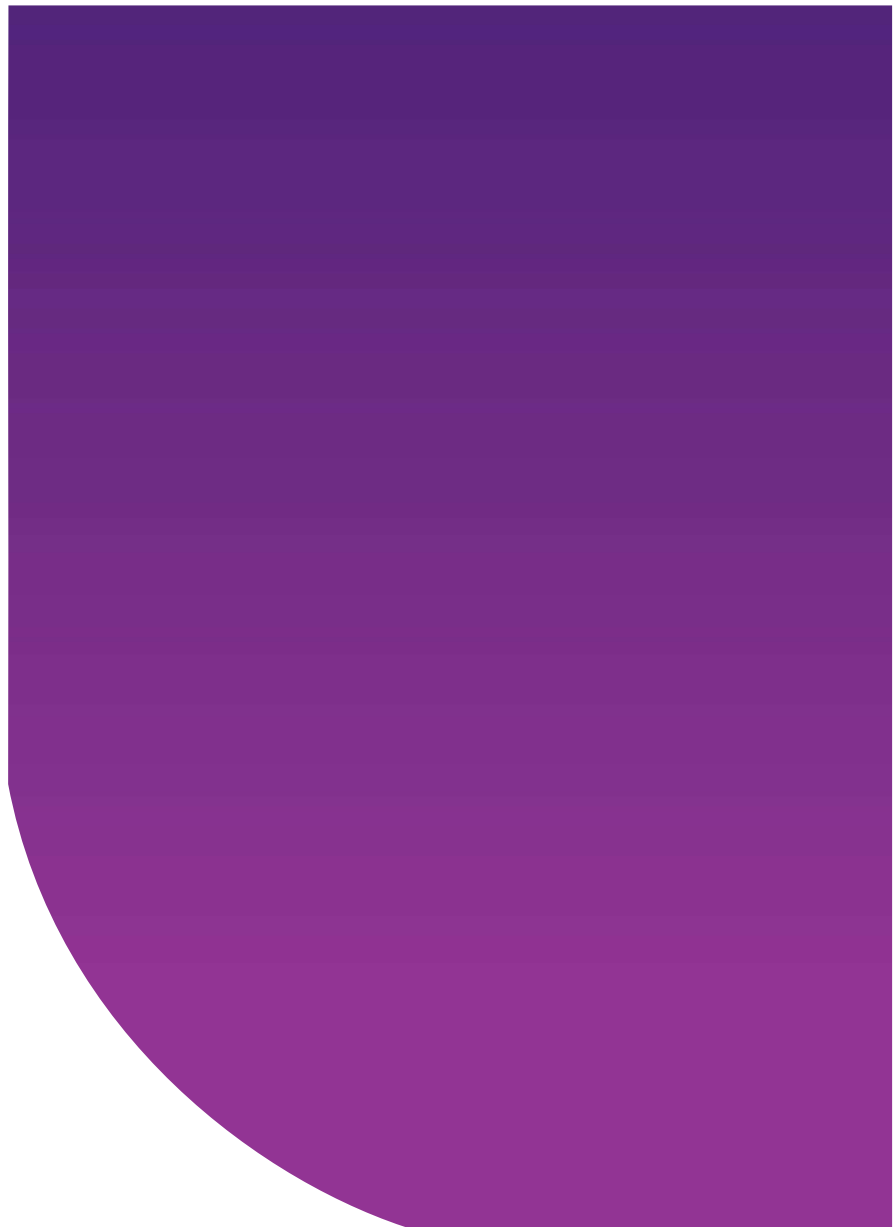
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# Appendix A

## Literature review on quality in residential aged care facilities



## A-1 Background

Australians expect older adults to have access to safe and high quality aged care services.<sup>1</sup> The Australian aged care system should uphold the highest standards in terms of quality and safety to ensure that older Australians receive the high-quality care that they deserve and can live their last years of life with respect and dignity.<sup>1</sup> The Charter of Aged Care Rights supports this view, stating that older Australians have the right to receive high-quality care and services and to always be treated with respect and dignity.<sup>2</sup>

Improving the quality of aged care is considered a priority and key policy issue for governments in many countries.<sup>3</sup> Over the past three decades, the Australian government has implemented policies and legislation focussed on improving the quality and efficiency of aged care.<sup>4</sup> Despite the policy changes and legislative reforms, the aged care sector continues to have problems.<sup>5</sup> The quality of care is highly variable across the aged care system with providers delivering care ranging from high- to low-quality, and even substandard, care with cases of abuse and neglect.<sup>1,6</sup> The Australian aged care sector and the quality of care delivered in Australia's residential aged care facilities have been the focus of numerous major inquiries and reviews.<sup>7</sup> The Royal Commission into Aged Care Quality and Safety's Interim Report has found that the aged care system has failed to deliver uniformly safe and quality care that meet the needs of older Australians.<sup>1</sup>

Australia's ageing population and increases in life expectancy, coupled with a smaller cohort of potential informal carers, will likely see significant and sustained increases in demand for aged care services and residential aged care places in the future.<sup>8,9</sup> Steady increases in operational costs and higher expectations of quality have meant that residential aged care providers are faced with the increasingly difficult challenge of maintaining services without compromising quality.<sup>10,11</sup> The sustainability of the aged care system relies on improving productivity and efficiency through innovation while maintaining quality.<sup>6,11</sup> When measuring the efficiency of residential aged care facilities, it is critical to account for the differences in quality between facilities in order to accurately reflect their relative performances and to facilitate meaningful improvements.<sup>12</sup>

The University of Queensland was commissioned by the Royal Commission into Aged Care Quality and Safety to conduct an analysis to understand the cost and resources required to provide high-quality residential aged care services, specifically investigating the efficient cost associated with providing care at different levels of quality. The purpose of this appendix is to present a literature review on *how the quality of residential aged care is conceptualised and measured*. This literature review presents the concept of quality of care, theoretical framework and the measurement of quality in residential aged care facilities. Quality indicators used to measure the quality and used in efficiency analyses of residential aged care facilities were examined. This literature review was used as the basis for the development of a composite index of quality (*Technical Supplementary Report 1*), which was used to inform the efficiency estimates in the main efficiency analysis.

## A-2 Theory and measurement of quality in residential aged care facilities

The quality of care in health and social care is a complex and multidimensional concept.<sup>13–16</sup> The literature on the measurement of quality of care in residential aged care facilities dates back over half a century.<sup>17,18</sup> Several quality of care frameworks have been proposed over this time.

The Donabedian model (1966, 1988) remains the dominant theoretical framework for assessing the quality of health care. The model has been widely used over the last 50 years to assess quality in health care and has been extended to measure the quality of aged care.<sup>17,19</sup> In this model, Donabedian suggested a three-dimensional approach to assessing the quality of care, which include structure, process and outcomes.<sup>20</sup> *Structure* refers to the attributes of the setting in which care is provided. It includes material resources (e.g. equipment) and human resources (e.g. number, type and qualifications of staff) associated with the provision of care and organisational characteristics (e.g. facility's policies or administrative system). *Process* refers to the components of care delivery. It includes the activities of the health care staff (e.g. treatment, pain

management, physical restraint reduction, clinical quality targets, or patient education) and care recipients (e.g. choice of treatment). *Outcome* refers to the changes in care recipients that can be attributable to the care. It includes care recipients' changes (positive or negative) in the health status, knowledge, and behaviours, as well as satisfaction with care.

Donabedian suggested that these three dimensions are interlinked. That is, the structure influences the process, which influences the outcomes.<sup>13,14,20</sup> However, some have argued that his progression from structure to process to outcome is too linear.<sup>21</sup> A comprehensive assessment of the quality of care should be assessed based on a combination of all three dimensions, rather than relying on a single dimension.<sup>20</sup>

Supporting older adults to age well is essential, particularly as life expectancy rises. *Healthy ageing* is a core concept in health policy globally and is defined as the process of developing and maintaining the functional ability that enables wellbeing in older age.<sup>9,22</sup> From a healthy ageing perspective, it represents a holistic approach with a shift towards positive outcomes in ageing (e.g. ability to adapt, to be, and to do what they value), rather than solely focussing on negative outcomes (e.g. mortality, absence of disease, disability or functional impairment).<sup>9,23–26</sup> In residential aged care facilities, both the quality of care and quality of life are considered important aspects of quality. Quality of care refers to the structure, process of care and clinical outcomes, whereas quality of life is a broader measure that refers to outcomes contributing to a care recipient's wellbeing and/or overall health. Both of which have been incorporated into national reporting systems in a number of OECD countries.<sup>17</sup>

Several elements have been proposed as important to the success of quality assessments.<sup>27</sup> Effective quality assessments should include as many indicators as necessary that encompass *all areas* relevant to quality care in the setting (i.e. residential aged care).<sup>28</sup> Quality measurement should be considered carefully to ensure that measures are able to provide adequate information on quality but are not too long, complex or burdensome to complete and collect.<sup>28–30</sup> As such, quality measures should be integrated into routine clinical practice where possible.<sup>30</sup> This has been successfully achieved in the United States with the introduction of a quality assessment system in nursing homes, known as the Resident Assessment Instrument-Minimum Data Set (RAI-MDS).<sup>27</sup>

## A-3 Quality indicators for residential aged care

Quality of care is difficult to define and measure,<sup>31–34</sup> especially within the residential aged care setting.<sup>27</sup> Quality indicators are not considered to be direct and absolute measures of quality but rather can be used to facilitate quality improvement by highlighting areas of care that require further examination.<sup>35–39</sup> As no single measure of quality exists,<sup>31–34</sup> various quality indicators have been described in the literature and implemented in the health and aged care sectors across the world.

### A-3-1 Commonly used quality indicators

In many countries, quality assessment in the health care sector is more advanced than in the aged care sector.<sup>3</sup> The majority (approximately 80%) of OECD<sup>A</sup> countries have structure-based quality measures (e.g. *number of health professionals, staff ratios, number of single rooms*) in residential aged care. However, only a small number of countries routinely collect process- or outcome-based quality measures in residential aged care, including European countries (Germany, Netherlands, Norway, Finland, Portugal), Iceland, Korea, United States and some provinces in Canada.<sup>3</sup> Even fewer countries collect measures for quality of life or experiences of the aged care residents.<sup>3</sup>

Clinical outcome measures can help to identify adverse events and problems in the provision of care.<sup>3</sup> The six most commonly used clinical indicators in residential aged care in these countries include *pressure ulcers*,<sup>B</sup> *falls and fall-related fractures, use of physical restraints, over medication and medication errors, unplanned*

<sup>A</sup> Organisation for Economic Co-operation and Development

<sup>B</sup> Also known as pressure injuries or bedsores.

*weight loss and depression. Examples of other clinical indicators considered for assessment of quality in care include delirium/behaviour, dependency in activities of daily living, pain, continence or continence-related problems, cognitive function, and infection.*

Measures that capture patient-centredness care (e.g. consumer experience) and quality of life are increasingly considered important in the measurement of quality in residential aged care.<sup>40</sup> These measures are commonly collected through interview-based surveys. Unlike the quality of care measures which can be more accurately and easily collected, measures of consumer experience and quality of life are considered more subjective and more challenging to collect.<sup>41</sup>

The focus of quality measurement in aged care is different among countries depending on their conceptualisation of residential aged care.<sup>3</sup> That is, countries that conceptualise nursing care as central to residential aged care tended to initially focus on clinical aspects of care, whilst countries that conceptualise it as social care have focussed on social outcomes, consumer experiences and quality of life.<sup>3</sup> Quality frameworks used in Australia and other countries<sup>A</sup> recognise both clinical and consumer-experience outcomes in the quality measurement of residential aged care.<sup>3</sup>

### A-3-2 Quality indicators – Selected case studies

Many countries have not reached a national consensus regarding the set of quality indicators for the measurement of quality in residential aged care.<sup>3</sup> Most countries do not have a systematic data collection and reporting system in place, largely due to challenges with definitions, methodology and implementation.<sup>3</sup> However, a few countries have introduced mandatory systems of assessment aimed at monitoring quality within residential aged care.

#### Australia

In Australia, the National Aged Care Quality Indicator Program has been introduced to measure the quality of care and services provided by residential aged care facilities. From 1 July 2019, Australian Government-subsidised aged care facilities are mandated to collect and report on three quality indicators: *pressure injuries, use of physical restraint, and unplanned weight loss*.<sup>42</sup> More quality indicators will be introduced in the future, including two new quality indicators related to *falls and fractures, and medication management*.<sup>43</sup>

A registry, known as the Registry of Senior Australians (ROSA),<sup>B</sup> monitors the health, service utilisation, high-risk medicine use, mortality, and other outcomes of people receiving aged care services in Australia. It comprises a *prospective state-wide registry* which enrolls older South Australians who have undertaken an aged care eligibility assessment from April 2018 onwards, and a *historical nation-wide registry* which contains linked de-identified data including national aged care data and death records (1997–2014), Medicare Benefits Schedule (MBS) and Pharmaceutical Benefits Scheme (PBS) records (2002–17).<sup>C</sup> The ROSA Outcome Monitoring indicators include 12 clinical outcome measures: *high sedative load, antipsychotic use, chronic opioid use, antibiotic use, premature mortality, falls, fractures, medication-related adverse events, malnutrition or weight loss, delirium and/or dementia, emergency department presentations, and pressure injuries*.

Harmful polypharmacy and potentially inappropriate medicine use (i.e. medications that should generally be avoided among older adults) is very common in older residents living in residential aged care facilities and have been linked to medication-related adverse outcomes.<sup>44,45</sup> To help address this problem, the Australian Productivity Commission 2011 identified the need for validated indicators that address medication-related quality of care in the aged care setting. Based on high-level evidence and recommendations by established Australian or international reporting programs and initiatives, the ROSA Outcome Monitoring System includes these four indicators that assess high-risk medicine use (high sedative load, antipsychotic use, chronic opioid

<sup>A</sup> Canada (Ontario), England, Finland, the Netherlands, and the United States

<sup>B</sup> Formerly known as the Registry of Older South Australians

<sup>C</sup> For the South Australian sub-set of this national cohort, de-identified hospitalisation and emergency department data from South Australia Health has also been linked, with equivalent datasets from New South Wales to be linked in 2020.

use, and antibiotic use). Some level of high-risk medicine use is, of course, appropriate for some residents living in residential aged care.

Hospitalisations of residential aged care residents are common. As many of these hospitalisations are deemed to be inappropriate or avoidable, hospitalisations may reflect the level and quality of personal and clinical care provided in residential aged care facilities. *Hospital bed days*, defined as the total number of days residents spent in hospital over a given period, was collected by the residential aged care facilities and available for use in this project.

## England

Quality monitoring systems in long-term aged care in England are less advanced compared to countries such as the United States, as clinical quality indicators predominantly consist of structure- and process-based outcomes which are collected from administrative data sets. However, in an attempt to capture information about social care outcomes and the quality of life of aged care recipients, the Adult Social Care Outcomes Toolkit (ASCOT)<sup>46</sup> was developed. The tool contains items such as *cleanliness and comfort, good nutrition, safety, control over daily life, social participation and involvement, occupation, accommodation and dignity*. It has been used by National Adult Social Care Survey to survey all care recipients in residential aged care nationwide. The ASCOT tool is in use in a number of OECD countries. Waiting times to enter a residential aged care facility from hospital are also collected.<sup>3</sup>

## United States of America (USA)

The United States has developed a five-star rating system which can be used for performance benchmarking. The star ratings of individual residential aged care facilities are available to the public reported and published online, and are intended to assist consumers, caregivers, and their families in comparing nursing homes more easily and to help identify areas about which consumers may want to ask questions. The rating system features an overall five-star quality rating with facilities categorised with one to five stars, where one star indicates poorer quality (quality well below average) and five stars indicates higher quality (quality well above average) compared to other residential aged care facilities.<sup>47</sup>

To reflect the multidimensional nature of quality in residential aged care facilities, the ratings are based on three domains, including health inspections, staffing, and quality measures.<sup>48</sup> *Health inspections* contain information about deficiencies identified during annual health inspections and complaint investigations, weighted by scope and severity, gathered during minimum quality requirements compliance visits. *Staffing* contains information on nursing home staffing levels, including registered nurse and total nurse hours per resident per day, accounting for differences in care needs (high or low care) between facilities. *Quality measures* contain information on the quality of care provided in residential aged care facilities, based on the Minimum Data Set (MDS) and Medicare claims data. It consists of 15 validated and reliable physical and clinical outcome measures that capture a range of functional and health status indicators. The quality measures offer information about how well nursing homes are caring for their residents' physical and clinical needs.

Fifteen quality measures include nine long-stay measures and six short-stay measures, of which some are risk-adjusted.<sup>49</sup> Long-stay measures include the *percent of residents with mobility decline, activities of daily living worsening, at high risk with pressure injuries, catheters, urinary tract infections, falls, antipsychotic medication, number of hospitalisations and emergency visits per 1,000 long-stay resident days*. Short-stay measures include the *percent of short-stay residents with functional improvement and antipsychotic medication, skilled nursing facility residents with pressure injuries, percent of short-stay residents who were re-hospitalised and had an emergency department visit, and rate of discharge to home and community from a skilled nursing facility*.



A star rating for each of these domains and an overall star rating is calculated for each facility.<sup>48</sup> The star rating system assists stakeholders to interpret the complex and multidimensional concept of quality. However, some have argued that this may be unfair for facilities whose scores are around the margins of each category.<sup>50</sup>

### International Resident Assessment Instrument (interRAI instrument)

The interRAI Suite is a fully-integrated, standardised, multidimensional assessment system comprising over 20 clinical assessment instruments across different care settings.<sup>51</sup> The interRAI Suite is an evidence-based best-practice approach developed based on a core set of standard assessment items and can be linked enabling comparison across care settings.<sup>3</sup> The instruments used for aged care facilities are the interRAI long-term care facility instrument (interRAI LTCF) and the interRAI quality of life in long-term care facility (interRAI QOL LTCF). The instruments are collected as part of routine clinical practice and have many applications, including the evaluation of the quality of facilities.<sup>51</sup> They cover the multidimensionality of quality and include the perspective of care recipients in residential aged care facilities.<sup>3</sup> Together, these instruments assess domains including *clinical (e.g. function, mobility, communication ability, behaviour and physical restraint use), mental and physical health, social support, service use, and quality of life*. The assessments, using the interRAI LTCF, allow for casemix and comparisons of facilities within and between countries.<sup>52</sup>

The interRAI LTCF is currently used (to varying degrees) in Canada, Europe, Asia, Australia (CareTrack Aged study) and New Zealand, which was the first country to mandate interRAI assessments in residential and community aged care.<sup>53,54</sup> This serves to demonstrate the potential for international benchmarking of performance of residential age care.<sup>3</sup> Implementing an integrated standardised assessment system, such as the interRAI assessments, on a national scale has been shown to be feasible, as countries including Canada, Europe, USA and New Zealand have introduced interRAI assessments in some form.<sup>3</sup> The Resident Assessment Instruments (RAI) assessments for aged care facilities are used to populate the Minimum Data Set in the USA.

### A-3-3 Quality assurance

From a quality assurance perspective, many countries have set minimum acceptable standards, including compliance and enforcement of such, to provide assurance of the quality of residential aged care. In fact, certification or accreditation of aged care facilities is either mandatory, a condition for reimbursement, or common practice in up to two-thirds of OECD countries. This quality assurance approach is assumed to drive quality improvements in residential aged care. Although such regulations are designed to provide assurance that the most vulnerable and frail residents are protected in residential care, some argue that regulations do not consistently provide the assurance of quality that the community need and expects.<sup>55</sup>

### Accreditation Standards

In Australia, residential aged care providers are required to comply with national accreditation standards.<sup>56,57</sup> The Aged Care Quality and Safety Commission expects aged care service providers in Australia to comply with the Quality Standards at all times. Prior to 1 July 2019, there are four Accreditation Standards<sup>A</sup> with 44 expected outcomes. If the residential aged care facility is assessed as failing to comply with an expected outcome, then the expected outcome is considered to be not met. The number of expected outcomes that were not met by a facility during a given financial year was available for use in the current project. From 1 July 2019, the new Aged Care Quality Standards (Standards) will take effect consisting of eight individual standards.<sup>B</sup>

<sup>A</sup> Management systems, staffing and organisational development; Health and personal care; Care recipient lifestyle; and Physical environment and safe systems.

<sup>B</sup> Consumer dignity and choice, Ongoing assessment and planning with consumers, Personal care and clinical care, Services and supports for daily living, Organisation's service environment, Feedback and complaints, Human resources, and Organisational governance.

## Sanctions

The Department of Health imposes sanctions on aged care facilities if there is an immediate and severe risk to the safety, health or wellbeing of someone receiving aged care services, if the provider does not have the appropriate systems in place, or if a notice of non-compliance has not addressed the issues within an agreed time period. The number of sanctions imposed on residential aged care facilities was available from Aged Care Quality and Safety Commission for use in the current project.

## Complaints and issues

Concerns about the quality of care provided to a resident in a residential aged care facility can be brought to the attention of the provider by the resident, family members, staff or others. If they do not feel comfortable talking to the provider (or they have tried but it did not work) complaints can be made to the Aged Care Quality and Safety Commission. The number of complaints and issues lodged with the Aged Care Quality and Safety Commission about residential aged care facilities in Australia was available for use in the current project.

## Consumer experience

Prior to 9 December 2019, the experiences of the quality of care and services of residents living in residential aged care facilities were surveyed through a set of consumer experience questions as part of site audits.<sup>A</sup> The consumer experience questions consist of ten questions. The consumer experience data was available from the Aged Care Quality and Safety Commission for use in this project.

### A-3-4 Composite quality index described in the literature

A set of quality indicators can be used to group residential aged care facilities into categories of differing levels of quality. This classification system, known as a composite index, can be developed to measure the quality of residential aged care facilities for multiple purposes, including for benchmarking aged care facilities. An example of a practical (real-life) quality classification system is the star rating system in the USA (described above). In the research literature, there have been several attempts to create a composite index to measure quality; however, these applications have yet to be taken up and implemented into policy.

One study by Castle and Engberg (2007)<sup>58</sup> developed a composite quality index to examine the influence of staffing levels, turnover, worker stability, and agency staff on the quality of care in residential aged care facilities. Fourteen quality indicators of clinical outcomes were combined to construct the composite quality index, using an exploratory factor analysis (EFA). These included 11 long-stay and three short-stay quality indicators. The 11 long-stay quality indicators included the percentages of *residents with activities of daily living assistance increased, moderate to severe pain, high risk and low risk of pressure injuries, physical restraint, depression/anxiety, low risk of loss bladder/bowel control, catheter, most time in bed/chair, locomotion worsen, and urinary tract infection*. Three short-stay quality indicators included percentages of *residents with delirium, moderate to severe pain, and pressure injuries*. These valid and reliable quality measures were derived from Resident Assessment Instruments (RAI) assessment used in aged care facilities contained in the Minimum Data Set.<sup>58,59</sup> The exploratory factor analysis was used to investigate the number of constructs (factors) underlying the quality variables.<sup>B</sup> The results suggested that a single composite index was the most robust and could be developed to reflect all 14 quality measures. The final composite index score was calculated with a linear equation that incorporated a weighted contribution of each of the indicators, which are relative to the amount of variance in common with the other indicators.

<sup>A</sup> From 9 December 2019, consumer experience interviews will be undertaken in compliance monitoring assessment contacts at residential services.

<sup>B</sup> Prior to analysis, all variables were normalised. Principal factors were estimated for the variables to investigate the magnitude (size) of the correlations between each factor and each quality variable (known as factor loadings). It is a statistical procedure to identify the common variance amongst a set of observed variables and creates an index (i.e., factor) comprised of that common variance. They remain the indices (i.e., factors) with eigenvalue higher than one. The eigenvalue is to measure how much of the variance of the observed variables an index explains. Any index with an eigenvalue greater than one explains more variance than a single observed variable.

One study by Chen and Shea (2004)<sup>60</sup> derived seven quality indicators/indices, rather than a single composite index, to inform an efficiency analysis of nursing homes in the United States. Data from the Online Survey Certification and Reporting System (OSCAR) database was used to construct the quality indicators/indices, using a principal component analysis.<sup>A</sup> These seven quality indicators measured nursing home quality using all three domains of the Donabedian's framework (structural, process, and outcome). The seven constructed indicators/indices included two *structural* indicators (*per resident ratios of full-time equivalent personnel who influence the quality of care and quality of life*), four *process* indicators (*prevalence rates of catheterisation, physical restraints, and drug administration error; group organisation for its residents and their families*), and one *outcome* indicator (*the number of regulatory deficiencies*).<sup>B</sup> The seven quality indicators which represented the quality of nursing home outputs were used as explanatory variables in a hybrid cost function.

One study by Boakye-Dankwa and colleagues<sup>61</sup> investigated the underlying factors that contributed to the variation among nursing homes in the United States. A cluster analysis identified two clusters (subgroups) of nursing homes: better-performing and poorer-performing nursing homes. Ten standardised continuous measures were averaged and then used in the cluster analysis. The ten measures cover employees, residents and survey ratings. These included *sick hours; employee foundation; employee satisfaction; certified nursing assistants retention; staff ratio; rate of pressure ulcers; rate of falls; rate of unexplained weight loss; resident, family, or friend satisfaction; and survey rating*. The results showed that the better-performing facilities achieved better performance across domains. This study provides an example of a method for classifying nursing homes into subgroup for the purpose of evaluating nursing home quality.

An alternative method for constructing a composite index representing quality in residential aged care facilities, suggested by Castle and Engberg, is the latent variable method.<sup>58</sup> The latent variable method is based on the idea that there is an unobserved latent measure of quality at each facility and that facilities can be divided into subgroups based on this construct. The latent variable (quality) is comprised of subgroups (latent classes). This method has been used in the estimation of hospital quality.<sup>62</sup> For example, Shwartz and colleagues (2008) used a Bayesian latent variable model to estimate an underlying construct of process quality, which was derived from 15 care process quality measures obtained from the Centers for Medicare and Medicaid Services in the United States.<sup>62</sup> To our knowledge, there are no published studies in the literature that used the latent class analyses approach to derive a composite quality index in the residential aged care setting.

## A-4 Quality indicators used in efficiency analysis of residential aged care facilities

In the literature on efficiency analysis of residential aged care facilities, adjustment for quality of care is considered a key component. A recent systematic review of efficiency measurement in residential aged care facilities by Tran and colleagues<sup>63</sup> found that there was a broad range of indicators used to measure (or use as a proxy) for the quality of residential aged care facilities across 39 studies. The indicators used in these 39 efficiency studies are summarised in Table A-1 below.

The most frequently used indicators in these studies measuring the efficiency of aged care facilities are clinical outcomes, including *pressure injuries, physical restraints, catheterisation, activities of daily living related (decline or severity), urinary tract infection, falls, depression, pain, and antipsychotic use*. The most frequent structure-based indicators were *care staffing ratio, rating for health inspection (deficiencies), and national nursing home rating*. The reasons for selecting the different indicators varied across studies, with some chosen based on an underlying theoretical justification, while others selected based on a pragmatic approach in the context of data availability or a lack of good-quality measures. In fact, most studies used readily

<sup>A</sup> The detailed results of the factor analysis are not available on the published study.

<sup>B</sup> The personnel who influence quality of life (e.g. activity professionals and staff) and group organisation for its residents and their families are two indicators that are not well-validated nor widely-used measures of nursing home quality.

assessable and available data. However, a series of studies by Laine and colleagues used quality measures from the interRAI suite for their efficiency analysis of long-term aged care in Finland.<sup>64–66</sup> Studies by Dulai used the five-star ratings for their efficiency analysis in the United States.<sup>67,68</sup>

None of the 39 reviewed studies independently created a composite quality index to use for efficiency analyses. However, there were studies that used a national or state-based rating system. Two studies measuring the efficiency of aged care facilities in the United States used the five-star quality rating system which is considered the most well-validated and reliable rating system in residential aged care in that country.<sup>67,68</sup> Examples of the other systems used in efficiency analysis studies are the quality reporting system used in Texas nursing facilities,<sup>69,70</sup> deficiencies rating methods developed by Gannett News Services and Florida Agency for Health Care Administration,<sup>71</sup> or the Taiwan nursing home rating system using accreditation reports.<sup>72</sup>

All other studies incorporated individual quality indicators into the efficiency analysis in several ways:

- Quality variables included as *outputs* and included them directly into the frontier estimation, either using data envelopment analysis (DEA) or stochastic frontier analysis (SFA).<sup>68,71,73–79</sup>
- Quality variables included as the *determinants* of the shape and position of the frontiers, often in studies using SFA.<sup>67,69,70,80–84</sup>
- Quality variables included as the *explanatory variables* of inefficiencies. There are two approaches to this: (i) directly in the error term in the SFA<sup>67,85</sup> or (ii) in a second-stage regression analysis, that follows the first stage where inefficiencies were estimated using either DEA or SFA.<sup>64,65,68,72,76,86–88</sup>

Table A-1. Quality indicators identified in the efficiency literature, categorised by the Donabedian (structure, process, outcome) framework<sup>14</sup>

	Structure (19/39)	Process (1/39)	Outcome (20/39)
Inputs (1/39)			1. % Non-ambulatory (n=1) <sup>a</sup> 2. % resident not self-feeding (n=1) <sup>a</sup>
Outputs (13/39)	1. Rating for health inspection (deficiencies) (n=4) 2. FTEs contributing to QOC (e.g., RN) per resident (n=1) 3. FTEs contributing to QOL (e.g., activity professionals and staff) per resident (used as QOL measure) (n=1) 4. Administrative service performance (n=1) 5. Life care performance (n=1) 6. Health care performance (n=1) 7. Extra nursing hours (n=1)	1. Degree of involvement in the provision of organised groups for its residents and their families QOL (used as QOL index) (n=1)	1. % ADL decline (n=3) 2. % pressure injuries (n=8) 3. % restraints (n=7) 4. % UTI (n=3) 5. % depression without treatment (n=1) 6. % pain (n=3) 7. % (no) falls (n=4) 8. Catheterisation (n=6) 9. % drug error (n=1) 10. Accident rate (or emergencies) (n=2) 11. Out-of-pocket charges (as residential satisfaction—Willing to pay) (n=1)
Control variables (20/39)	1. Staffing (RN/total nursing hours per resident day) (n=3) 2. Nursing staff ratio <sup>b</sup> (n=4) 3. High quality facility (Care person per resident) (n=3) 4. Nursing home rating (n=3) 5. Qualification of medical staff (n=2) 6. % RNs (n=1) 7. % rooms with own toilet (n=1) 8. % single rooms (n=1) 9. Average assistance time (n=1)		1. ADL severity level (n=5) 2. Acuity index (n=1) 3. Pressure sores (n=4) 4. Catheterisations (n=3) 5. Restraints (n=4) 6. Bedfast (n=2) 7. Unplanned weight change (n=2) 8. Depression (n=3) 9. Antipsychotic, anti-anxiety/hypnotic use (n=3) 10. Behavioural symptoms (n=1) 11. Cognitive impairment (n=1) 12. % use ≥ 9 medications (n=1) 13. Bowel incontinence (n=1) 14. Bladder incontinence (n=1) 15. % UTI (n=1) 16. % injury, fall, fracture (n=1) 17. Pneumococcal vaccination (n=1) 18. Influenza vaccination (n=1) 19. On pain management (n=1) 20. Adjusted mortality rate (n=1)

Source: Adapted from Tran and colleagues (2009)<sup>63</sup>

FTE: full-time equivalent; QOC: quality of care; QOL: quality of life; RN: registered nurse; ADL: activity of daily living; UTI: urinary tract infection

<sup>a</sup> These patient conditions as quality measures incorporated as inputs in the study by Duffy and colleagues<sup>74</sup> to reflect the opportunity for patient co-production.

<sup>b</sup> Nurses employed / nurses that should be employed according to the guidelines

## A-5 Quality indicators available for use in this project

From the literature review above, it can be seen that to capture the quality of residential aged care facilities for the purpose of either benchmarking or incorporating quality into efficiency measurement, the set of quality measures should cover the multidimensionality of quality. Based on the Donabedian framework, measures should cover all the three domains (structure, process, and outcomes), and should include both the quality of care and quality of life, and quality assurance (i.e. minimum standards).

Ideally, quality measures should be collected during a routine clinical practice. Fully integrated, standardised

assessment systems, such as the interRAI suite,<sup>A</sup> allow the information captured across different care settings, including aged care, to be linked using the core set of assessment items. Besides the clinical assessment instruments, which is the combination of the clinical, physical, cognitive and social functional measures, the interRAI suite also includes quality of life instruments completed by the person or their proxy.

In regards to constructing a complex composite index for benchmarking and incorporating into an efficiency measurement of residential aged care facilities, the five-star rating system in the United States may be a good example. This is because the star rating system covers all the dimensions of the quality, uses validated methods, and comprises well-validated and reliable quality measures. The data used is derived from national routine sources, including the Minimum Data Set (derived from RAI<sup>B</sup>), state health inspection, staffing quarterly reports, and Medicare. The overall five-star rating is the outcome based on three domains (health inspection, staffing, and quality measures). Australian residential aged care staffing levels has been researched and compared with this US five-star system for benchmarking elsewhere.<sup>89</sup>

The Australian database for residential aged care facilities, provided by the Royal Commission in the current project on the *Cost of Residential Aged Care*, includes both quality indicators and quality assurance measures. The available clinical quality indicators are the ROSA Outcome Monitoring indicators administered by the Registry of Senior Australians and hospital bed days. The available quality assurance measures include complaints and issues, sanctions, accreditation standards (expected outcomes not met), and consumer experience. The database covers the multidimensionality of quality covering structure, process and outcome measures. The measures are suitable for use to investigate the cost of care in residential aged care in the current project.

Quality of aged care cannot be improved if reliable measurement is not possible. Data collection to measure the quality of residential aged care facilities in Australia is a subject of improvement. We advocate that a carefully selected and well-tested set of standardised, fully integrated quality indicators be collected nationally as part of routine practices. The collection of such a set of indicators will require a standardised process and regular evaluation. This will ensure the reliability and coverage of the data. This allows for a robust understanding of the quality level and trend of the industry.

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<sup>A</sup> [www.interRAI.org](http://www.interRAI.org)

<sup>B</sup> RAI is similar to the interRAI instrument for long-term care facilities

# Appendix B

## **Latent class analysis to construct the quality index at the provider level**





## B-1 Introduction

At the facility level, a latent class analysis model was used to develop the composite quality index for residential aged care facilities. This is presented in *Section 5.1 of the Technical Supplementary Report 1*. At the provider level, the best-fit latent class analysis model described above was replicated to create the composite quality index for each residential aged care provider. The method and results of the latent class model at the provider level are presented in this Appendix.

## B-2 Provider-level data exploration

Data exploration of the provider-level data is described in detail in *Appendix C of The Cost of Residential Aged Care* report. All provider-level data for latent class analysis was provided in a similar format as the facility-level data, except for the Registry of Senior Australians (ROSA) indicators. That is, the ROSA indicators at the facility level were provided as proportions/rates risk-adjusted for age, gender, and the number of co-morbidities of the cohorts; however, the ROSA indicators at the provider level were provided as crude proportions/rates. Therefore, instead of using adjusted rates/proportions of ROSA indicators as in the facility-level analysis, the latent class analysis at the provider level used the crude rate of antibiotic use and crude proportions of high sedative load, antipsychotic use, and chronic opioid use.

In the provider-level data, the expected outcomes not met indicator has one outlier with 461 expected outcomes not met in comparison to other providers ranging from 0 to 106. This extreme outlier is not suitable for latent class analysis. To preserve the form of the variable as a count variable used in the latent class analysis at the facility level, the expected outcomes not met variable was right truncated at 150 and 50. The right truncation at 150 had a range of 0 to 150 expected outcomes not met, i.e. the provider with the extreme outlier of 461 expected outcomes not met was replaced with a value of 150. The right truncation at 50 had a narrower range of 0 to 50, with 10 of the 1,197 providers with over 50 expected outcomes not met replaced with a value of 50.

The sample size for the provider-level analysis is 1,197 unique providers, which represents the whole sector.<sup>A</sup> Similar to the facility-level analysis, the data of different financial years were combined to produce one set of quality variables for each provider for the whole period.

## B-3 Latent class analysis model

This model contained seven quality variables. There were: four ROSA clinical outcome variables representing high-risk medicine use as continuous variables, count of expected outcomes not met, number of issues, and consumer experience report score.

Similar to the facility-level analysis, before applying the latent class, providers that had zeros on all four ROSA high-risk medicine use variables, zero issues (complaints), no sanctions and no expected outcomes not met were assigned as the highest quality providers according to the available quality variables. These providers were then excluded from the latent class analysis and later added into the quality classification as representing the highest quality.

The latent class analysis was conducted with expected outcomes not met right truncated at 150 and then repeated with expected outcomes not met right truncated at 50.

<sup>A</sup> The sample of providers reflects the whole sector of residential care providers, including sanctioned facilities, as well as some providers of flexible care (transition care, short-term restorative care and multi-purpose care).



## B-4 Latent class analysis with expected outcomes not met right truncated at 150

The model was tested from 2 to 5 classes to determine the best fit for the underlying latent class. While the model fit (AIC, BIC) was slightly better for five classes than four classes (Table B-1), on inspection, the extra class was derived from further splitting the lowest quality class that only contained around 4% of observations into two more classes with 2-3% and 1% of observations, respectively. This did not add any value to the analysis and it was therefore decided to use the four-class model. The final model consisted of four classes. The latent class marginal means are given in Table B-2.

Table B-1. Model fit for two-class, three-class, four-class, and five-class models

Model	N	LL (model)	df	AIC	BIC
2 class	1,107	-5805.985	20	11651.97	11752.16
3 class	1,107	-4405.288	28	8866.576	9006.84
4 class	1,107	-4276.346	36	8624.692	8805.031
5 class	1,107	-4026.781	44	8141.563	8361.977

AIC = Akaike Information criteria; BIC = Bayes Information criteria; df = degree of freedom; LL = log likelihood; N = number of observations. Note: BIC uses N = number of observations.

Table B-2. Latent class analysis marginal means with expected outcomes not met right truncated at 150

	Margin	Std. Err.	z	P> z	95% CI
<i>Class 1 (lower quality)</i>					
N. of expected outcomes not met	17.712	0.535	33.100	0.000	(16.664, 18.761)
Issues (percentile)	1.445	0.117	12.360	0.000	(1.216, 1.674)
ROSA Antibiotic use (adjusted rate)	1.014	0.013	75.110	0.000	(0.987, 1.04)
ROSA Antipsychotic use (adjusted proportion)	1.045	0.035	30.050	0.000	(0.976, 1.113)
ROSA Chronic opioid use (adjusted proportion)	0.983	0.030	33.190	0.000	(0.925, 1.041)
ROSA High sedative load (adjusted proportion)	0.954	0.020	48.310	0.000	(0.915, 0.992)
CER summary score	34.721	0.129	270.130	0.000	(34.469, 34.973)
<i>Class 2 (lower quality)</i>					
N. of expected outcomes not met	150.000	3.873	38.730	0.000	142.409, 157.591
Issues (percentile)	1.889	0.458	4.120	0.000	(0.991, 2.787)
ROSA Antibiotic use (adjusted rate)	0.999	0.046	21.860	0.000	(0.909, 1.088)
ROSA Antipsychotic use (adjusted proportion)	1.213	0.118	10.250	0.000	(0.981, 1.445)
ROSA Chronic opioid use (adjusted proportion)	0.990	0.100	9.930	0.000	(0.794, 1.185)
ROSA High sedative load (adjusted proportion)	1.012	0.067	15.200	0.000	(0.882, 1.143)
CER summary score	33.993	0.457	74.390	0.000	(33.098, 34.889)
<i>Class 3 (medium quality)</i>					
N. of expected outcomes not met	0.479	0.035	13.730	0.000	(0.411, 0.547)
Issues (percentile)	1.071	0.041	26.210	0.000	(0.991, 1.151)
ROSA Antibiotic use (adjusted rate)	1.024	0.005	192.160	0.000	(1.013, 1.034)
ROSA Antipsychotic use (adjusted proportion)	1.047	0.014	72.240	0.000	(1.018, 1.075)
ROSA Chronic opioid use (adjusted proportion)	1.081	0.014	78.180	0.000	(1.054, 1.108)
ROSA High sedative load (adjusted proportion)	1.080	0.011	94.660	0.000	(1.058, 1.102)
CER summary score	34.957	0.061	570.540	0.000	(34.837, 35.077)
<i>Class 4 (medium quality)</i>					
N. of expected outcomes not met	0.223	0.082	2.740	0.006	(0.064, 0.383)

	Margin	Std. Err.	z	P> z	95% CI
Issues (percentile)	1.037	0.111	9.370	0.000	(0.821, 1.254)
ROSA Antibiotic use (adjusted rate)	0.924	0.022	42.090	0.000	(0.881, 0.967)
ROSA Antipsychotic use (adjusted proportion)	0.814	0.038	21.190	0.000	(0.739, 0.889)
ROSA Chronic opioid use (adjusted proportion)	0.659	0.045	14.660	0.000	(0.571, 0.748)
ROSA High sedative load (adjusted proportion)	0.678	0.031	21.670	0.000	(0.616, 0.739)
CER summary score	35.860	0.208	172.240	0.000	(35.452, 36.268)

CER: Consumer Experience Report; CI: confidence interval; N.: Number of; ROSA: Registry of Senior Australians. Std. Err.: standard error. Note: Number of observations is 1,107 (providers).

In Table B-2 above, it is clear that two classes (Class 1 and 2) are identified as having lower quality according to expected outcomes not met. Classes 1 and 2 have average expected outcomes not met of 17.7 and 150, respectively. These classes also have higher than average issues and slightly lower consumer experience. The other two classes have very low expected outcomes not met, with most providers in these two classes having either 0 or 1 not met expected outcome. Class 4 has low value for four ROSA high-risk medicine use variables averaging under the mean value of 1 including the confidence intervals.

The difference between the four classes is summarised in Table B-3 below. The four classes can be evaluated using the margins plots in Figure B-1 below, using the class descriptions to guide interpretation.

*Table B-3. Latent class analysis level interpretation for the model with expected outcomes not met right truncated at 150*

Level	LCA class	Quality	Description of quality levels
Level 1	N/A (pre-selected before LCA analysis)	Highest quality	Four ROSA high-risk medicine use variables = 0 Number of issues = 0 Expected outcomes not met = 0 Sanctions = 0 CER score = 35.84 (standard deviation 1.33)
Level 2	Class 4 <sup>a</sup>		Four ROSA high-risk medicine use = lower Expected outcomes not met = lower Number of issues = lower CER score = comparable to CER score of Level 1
Level 3	Class 3 <sup>a</sup>		Expected outcomes not met = lower Number of issues = lower CER score = moderately high
Level 4	Class 1 <sup>a</sup>		Expected outcomes not met = average Number of issues = high CER score = lower
Level 5	Class 2 <sup>a</sup>	Lowest quality	Expected outcomes not met = high Number of issues = high CER score = lower

CER: Consumer Experience Report; LCA: latent class analysis; N/A: not applicable; ROSA: Registry of Senior Australians.

<sup>a</sup> Not in comparison with 'perfect quality' group (level 1)

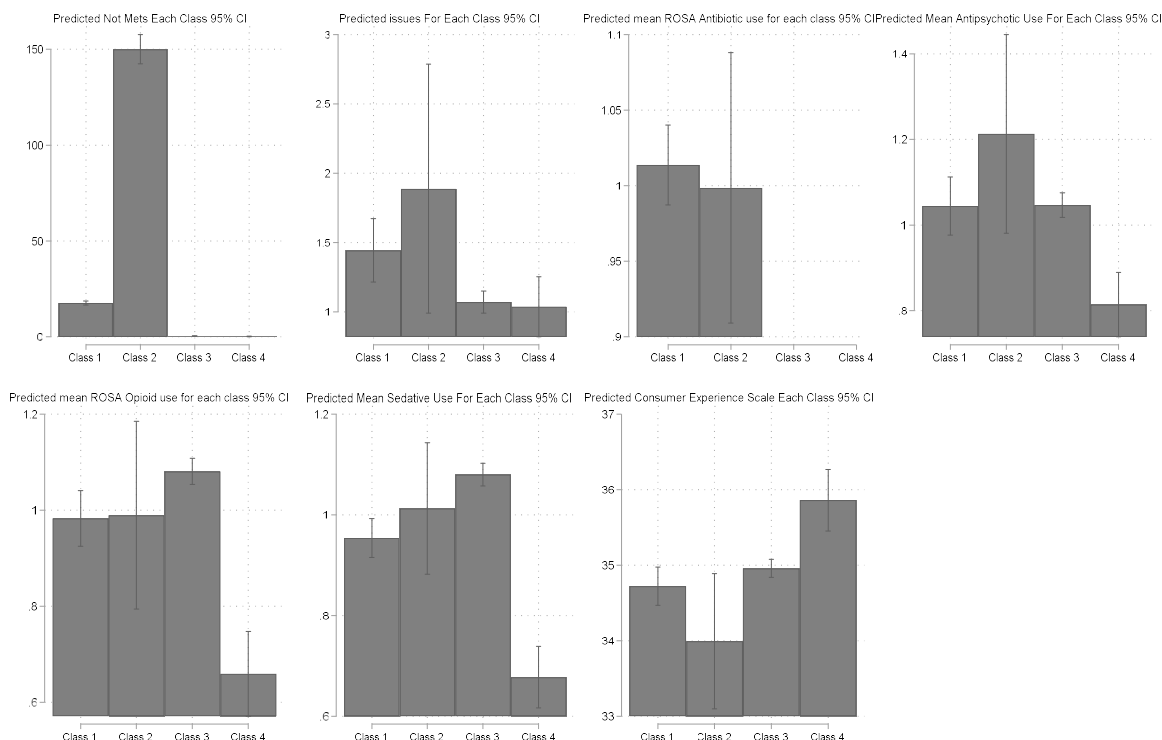


Figure B-1. Margin plots of the latent class analysis, four-class model with expected outcomes not met right truncated at 150

Table B-4 presents the model categories with the expected outcomes not met right truncated at 150. Level one represents providers chosen *a priori* as high quality as they did not score on any of the count quality variables. This model does not adequately capture the providers in the lowest quality group (Level 5) with only 0.8% of providers.

Table B-4. Categories of the model with expected outcomes not met right truncated at 150

Level	LCA level	Frequency	Percentage
1	N/A	90	7.5%
2	4	118	9.9%
3	3	874	73.0%
4	1	105	8.8%
5	2	10	0.8%
<b>Total</b>		<b>2,197</b>	<b>100%</b>

N/A: not applicable.

### B-5 Latent class analysis with expected outcomes not met right truncated at 50

The model was tested from 2 to 5 classes to determine the best fit for the underlying latent class. While the model fit (AIC, BIC) was slightly better for five classes than four classes (Table B-5), on inspection, the extra class was derived from further splitting the lowest quality class that only contained around 4% of observations into two more classes with 2-3% and 1% of observations, respectively. This did not add any value to the analysis and it was therefore decided to use the four-class model.

Table B-5. Model fit for two-class, three-class, four-class, and five-class models

Model	N	LL (model)	df	AIC	BIC
2 class	1,107	-4,531.92	20.00	9,103.84	9,204.03
3 class	1,107	-4,211.65	28.00	8,479.29	8,619.56
4 class	1,107	-4,077.47	36.00	8,226.94	8,407.28
5 class	1,107	-3,965.24	44.00	8,018.48	8,238.89

AIC = Akaike Information criteria; BIC = Bayes Information criteria; df = degree of freedom; LL = log likelihood; N = number of observations. Note: BIC uses N = number of observations.

The final model consisted of four classes. The latent class marginal means are given in Table B-6.

Table B-6. Latent class analysis marginal means with expected outcomes not met right truncated at 50

	Margin	Std. Err.	z	P> z	95% CI
<i>Class 1 (lower quality)</i>					
N. of expected outcomes not met	29.853	1.062	28.110	0.000	(27.771, 31.934)
Issues (percentile)	1.593	0.163	9.770	0.000	(1.274, 1.913)
ROSA Antibiotic use (adjusted rate)	0.994	0.018	55.140	0.000	(0.959, 1.03)
ROSA Antipsychotic use (adjusted proportion)	1.090	0.046	23.460	0.000	(0.999, 1.181)
ROSA Chronic opioid use (adjusted proportion)	0.935	0.040	23.100	0.000	(0.855, 1.014)
ROSA High sedative load (adjusted proportion)	0.917	0.026	35.160	0.000	(0.866, 0.968)
CER summary score	34.649	0.180	192.580	0.000	(34.297, 35.002)
<i>Class 2 (lower quality)</i>					
N. of expected outcomes not met	6.557	0.555	11.820	0.000	(5.47, 7.644)
Issues (percentile)	1.265	0.106	11.900	0.000	(1.057, 1.474)
ROSA Antibiotic use (adjusted rate)	1.018	0.013	76.770	0.000	(0.992, 1.044)
ROSA Antipsychotic use (adjusted proportion)	0.994	0.035	28.720	0.000	(0.926, 1.062)
ROSA Chronic opioid use (adjusted proportion)	1.031	0.029	35.420	0.000	(0.974, 1.088)
ROSA High sedative load (adjusted proportion)	0.997	0.019	51.850	0.000	(0.96, 1.035)
CER summary score	34.697	0.132	262.520	0.000	(34.438, 34.956)
<i>Class 3 (medium quality)</i>					
N. of expected outcomes not met	0.219	0.025	8.850	0.000	(0.17, 0.267)
Issues (percentile)	1.053	0.043	24.600	0.000	(0.969, 1.137)
ROSA Antibiotic use (adjusted rate)	1.025	0.006	183.430	0.000	(1.015, 1.036)
ROSA Antipsychotic use (adjusted proportion)	1.058	0.015	70.590	0.000	(1.028, 1.087)
ROSA Chronic opioid use (adjusted proportion)	1.087	0.014	77.790	0.000	(1.06, 1.114)
ROSA High sedative load (adjusted proportion)	1.093	0.011	99.230	0.000	(1.071, 1.114)
CER summary score	34.986	0.065	541.510	0.000	(34.86, 35.113)
<i>Class 4 (medium quality)</i>					
N. of expected outcomes not met	0.298	0.065	4.560	0.000	(0.17, 0.426)
Issues (percentile)	1.070	0.108	9.920	0.000	(0.859, 1.281)
ROSA Antibiotic use (adjusted rate)	0.928	0.018	50.270	0.000	(0.892, 0.964)
ROSA Antipsychotic use (adjusted proportion)	0.807	0.036	22.480	0.000	(0.737, 0.878)
ROSA Chronic opioid use (adjusted proportion)	0.676	0.038	17.620	0.000	(0.601, 0.751)
ROSA High sedative load (adjusted proportion)	0.675	0.027	24.810	0.000	(0.622, 0.729)
CER summary score	35.804	0.194	185.020	0.000	(35.425, 36.183)

CER: Consumer Experience Report; CI: confidence interval; N.: Number of; ROSA: Registry of Senior Australians. Std. Err.: standard error. Note: Number of observations is 1,107 (providers).

In Table B-6 above, it is clear that two classes (Class 1 and 2) are identified as having lower quality according to the expected outcomes not met. Classes 1 and 2 have an average expected outcomes not met of 29.8 and 6.6, respectively. These classes also have higher than average issues and slightly lower consumer experience. The other two classes have very low expected outcomes not met, with most providers in these two classes having either 0 or 1 not met expected outcome. Class 4 has low value for all four ROSA high-risk medicine use variables averaging under the mean value of 1 including the confidence intervals.

The difference between the four classes is summarised in Table B-7 below. The four classes can be evaluated using the margins plots in Figure B-2 below, using the class descriptions to guide interpretation.

*Table B-7. Latent class analysis level interpretation for the model with expected outcomes not met right truncated at 50*

<b>Level</b>	<b>LCA class</b>	<b>Quality</b>	<b>Description of quality levels</b>
Level 1	N/A (pre-selected before LCA analysis)	Highest quality	Four ROSA high-risk medicine use variables = 0 Number of issues = 0 Expected outcomes not met = 0 Number of sanctions = 0 CER score = 35.84 (standard deviation 1.33)
Level 2	Class 4 <sup>a</sup>		Four ROSA high-risk medicine use = lowest compared to other Level 3-5 (classes 5-3) Expected outcomes not met = lower Number of issues = lower CER score = comparable to CER score of Level 1
Level 3	Class 3 <sup>a</sup>		Four ROSA high-risk medicine use = higher Expected outcomes not met = lower Number of issues = lower CER score = moderately high
Level 4	Class 2 <sup>a</sup>		Expected outcomes not met = average Number of issues = high CER score = lower
Level 5	Class 1 <sup>a</sup>	Lowest quality	Expected outcomes not met = high Number of issues = high CER score = lower

CER: Consumer Experience Report; LCA: latent class analysis; N/A: not applicable; ROSA: Registry of Senior Australians.

<sup>a</sup> Not in comparison with 'perfect quality' group (level 1)

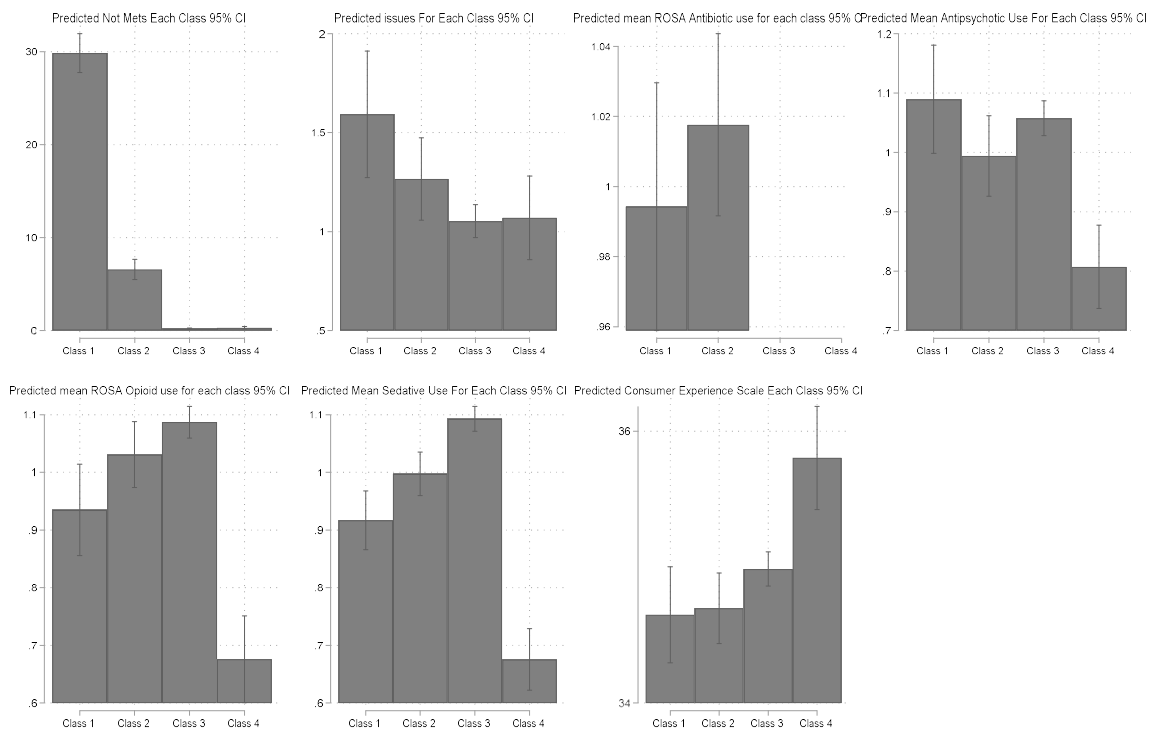


Figure B-2. Margin plots of the latent class analysis, four-class model with expected outcomes not met right truncated at 50

Table B-8 presents the model categories with the expected outcomes not met right truncated at 50. These model categories have a similar interpretation to the model categories with the expected outcomes not met variable right truncated at 150. However, this model captures more providers in the lowest quality group (Level 5) with 5.0% of providers compared to the previous model which capture 0.8% of providers. Therefore, this model with expected outcomes not met right truncated at 50 was considered to be preferable over the previous model with expected outcomes not met right truncated at 150.

Table B-8. Categories of the model with expected outcomes not met right truncated at 50

Level	LCA level	Frequency	Percentage
1	N/A	90	7.5%
2	4	126	10.5%
3	3	808	67.5%
4	2	113	9.4%
5	1	60	5.0%
<b>Total</b>		<b>1,197</b>	<b>100%</b>

N/A: not applicable

## B-6 Conclusion

This appendix summaries the latent class analysis at the provider level used to construct the composite quality index for each residential aged care provider. Despite differences in the format of the ROSA indicators and truncation of the expected outcomes not met, the results of the latent class analysis at the provider level were consistent with the results at the facility level. This was regardless of whether the expected outcomes not met were right truncated at 150 or 50.

The latent class analysis captured three clearly distinguishable groups with different levels of quality (higher, medium and lower). The *lower-quality facilities* had a high number of expected outcomes not met. These facilities also had a relatively higher number of issues (complaints), and lower consumer experience report scores. The *medium-quality facilities* had higher usage of antipsychotics, sedatives and opioids. This aligns with the Australian government's focus on addressing medication-related quality of care in residential aged care facilities. These facilities also had a relatively low number of expected outcomes not met and issues (complaints), and moderate consumer experience report scores. The *higher-quality facilities* had an extremely low number of expected outcomes not met, low number of issues (complaints), low usage of high-risk medicines, and high consumer experience report scores. These results were consistent with the facility-level analysis in *Technical Supplementary Report 1*.

A large number of caveats apply to the construction and use of the composite quality index using the latent class analysis approach. The composite quality index constructed using provider-level data presented in this Appendix is a work in progress due mostly to data completeness. When more complete and better quality data becomes available, results may be different. Further discussion of the limitations are provided in the *Technical Supplementary Report 1*.

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