

Research

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Specialist healthcare services for UK care home residents: a latent class analysis

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Abstract

Aim: To identify discrete approaches to specialist healthcare support for older care home residents in the UK and to estimate their prevalence. **Background:** Internationally, a range of new initiatives are emerging to meet the multiple and complex healthcare needs of care home residents. However, little is known about their relative effectiveness and, given their heterogeneity, a classification scheme is required to enable research staff to explore this. **Method:** A UK survey collected information on the funding, age, coverage, aims, staffing and activities of 64 specialist care home support services. Latent class analysis (LCA) was used to allocate the sample into subgroups with similar characteristics. **Findings:** Three classes were identified. Class 1 (55% of sample) contained services with a high probability of providing scheduled input (regular preplanned visits) and support for all residents and a moderate probability of undertaking medication management, but a low probability of training care home staff ('predominantly direct care'). Class 2 (23% of sample) had a moderate/high probability of providing scheduled input, support for all residents, medication management and training ('direct and indirect care'). Class 3 (22% of sample) had a low probability of providing scheduled input, support for all residents and medication management, but a high probability of providing training for care home staff ('predominantly indirect care'). Consultants were more likely to be members of services in Class 1 than Class 2, and Class 2 than Class 3. **Conclusions:** LCA offers a promising approach to the creation of a taxonomy of specialist care home support services. The skills and knowledge required by healthcare staff vary between classes, raising important issues for service design. The proposed classification can be used to explore the extent to which different organisational forms are associated with better resident, process and service outcomes.

Introduction

Against a background of population ageing, the delivery of healthcare services for long-term care home residents is of increasing clinical and policy interest throughout the developed world (Pickard *et al.*, 2007; Tolson *et al.*, 2011; WHO, 2015). In the UK, estimates suggest that around 430,000 older people live in care homes. This figure is almost three times the bed base of NHS hospitals and is predicted to rise by over 75% in the next two decades (Laing and Buisson, 2010; Wittenberg and Hu, 2015). Most care home residents have complex needs, many of which stem from progressive, chronic conditions including neuro-degenerative, musculoskeletal and cardio-respiratory disease. Visual and hearing deficits are common, the majority of residents have dementia and many live with depression and/or pain (British Geriatrics Society, 2011; Lievesley *et al.*, 2011; Gordon *et al.*, 2014). The average care home resident has six diagnoses (Gordon *et al.*, 2014), and median life expectancy from care home admission to death is just 15 months (NHS England, 2015). Even in the absence of chronic illness, older care home residents require appropriate medical care for acute conditions, and the broad range of preventive care services recommended for home-dwelling older adults is also relevant to this population (Thorpe *et al.*, 2011; Smith *et al.*, 2015).

Although the importance of ready access to specialist mental health services was recognised in England's National Dementia Strategy, which advised commissioning an extension to the role of the existing national network of multidisciplinary community mental health teams to support care homes (Department of Health, 2009a; 2009b; Tucker *et al.*, 2014), there is no equivalent provision for residents' physical healthcare needs. This is of concern, as early research indicated that across the UK, 68% of care home residents did not get a regular planned medical review by their GPs, while 44% had no regular review of their medication (British Geriatrics Society, 2011). Further, subsequent studies have suggested that the healthcare services that care homes receive vary greatly in terms of both the support available and the personnel providing it, variation that

is not explained by resident need or care home type (Carter, 2012; Iliffe *et al.*, 2016; Goodman *et al.*, 2017). Although pockets of excellence exist, more than half of care homes do not have access to all the services they require from the NHS, and it is sometimes difficult for them to access timely and appropriate diagnosis and treatment for their residents (British Geriatrics Society, 2011; Gordon, 2015).

While in the Netherlands, medical input to care homes is provided by dedicated physicians, care home residents in the UK typically rely on GPs in primary health for their medical care and referral to specialists (Donald *et al.*, 2008; Conroy *et al.*, 2009; Government Equalities Office, 2010; Tolson *et al.*, 2011). In homes without on-site nursing, NHS-funded community nurses and specialist nursing support services will also visit. Although some GPs successfully manage this commitment, many are overstretched and lack the skills and training to meet care home residents' needs (British Geriatrics Society, 2011; British Medical Association, 2016), a situation mirrored across much of Europe (Briggs *et al.*, 2012). As such the prevailing model of provision – ad hoc, reactive and GP-led – means many care home residents do not receive the specialist, coordinated support they require, healthcare needs are unrecognised and medication is sub-optimal (Barber *et al.*, 2009; Steves *et al.*, 2009; Davies *et al.*, 2011; British Medical Association, 2016). This in turn contributes to inappropriate and unplanned admissions to hospital, with potentially significant consequences for residents' mental, physical and emotional well-being, as well as healthcare costs (Centers for Medicare and Medicaid Services, 2012; Dwyer *et al.*, 2014; Hanratty *et al.*, 2014; Smith *et al.*, 2015; NHS England, 2016).

In recent years, multiple policy initiatives have sought to address these concerns (Department of Health, 2007, 2008; NHS England, 2014), and there is now a good understanding of the key elements care home medicine should provide, starting with the comprehensive, multidisciplinary assessment of new residents on admission. Regular (six-monthly or more) structured multidimensional reviews (including medication reviews) are also advocated, while other important facets of care home support services include the prevention of falls and the identification and management of incontinence. A need for the prompt recognition and appropriate management of care home residents who require end-of-life care (including the creation of advanced care plans) is also recognised, as is the importance of training/upskilling care home staff (Nolan *et al.*, 2008; Burns and Nair, 2014; NHS England, 2015; 2016; British Geriatrics Society, 2016).

Against this background, a number of different models of care home support have emerged. These include specialist (mono or multidisciplinary) care home support services with expertise in the generic or particular healthcare needs of care home residents (e.g. falls prevention and palliative care); enhanced payment schemes for GPs who undertake additional work in care homes (e.g. regular scheduled visits on the same day each week to discuss the care of any care home resident the care home staff are concerned about and/or perform routine reviews, sometimes with the support of a geriatrician); and pharmacist-led services focusing on medication reviews (Donald *et al.*, 2008; Hays *et al.*, 2012; Burns and Nair, 2014; British Geriatrics Society, 2016; Iliffe *et al.*, 2016). However, little is known about the effectiveness of these different approaches (Goodman *et al.*, 2015; British Geriatrics Society, 2016; Iliffe *et al.*, 2016), and there have been calls for a classification scheme that will enable research staff to study their relationship with resident outcomes, including quality of life, admission to hospital and locus of death (Goodman *et al.*, 2015; Iliffe *et al.*, 2016).

The exploratory work described in this article sought to derive such a schema via a new application of latent class analysis (LCA), a statistical approach for identifying subgroups of related cases from multivariate categorical data (Goodman, 1974; Magidson and Vermunt, 2002). While LCA has previously been used to identify groups of healthcare services based on their common service features (eg, Mauro *et al.*, 2016; Rodríguez-Benavente *et al.*, 2017), to the best of our knowledge no previous studies have used this approach to categorise specialist healthcare support services for care homes.

Aim

The study sought to identify discrete classes of specialist healthcare support services for older care home residents in the UK and to estimate their prevalence. For the purposes of this article, these are defined as services whereby visiting healthcare professionals, with time dedicated to this role, provide specialist clinical support to identify and address care home residents' healthcare needs.

Method

Study design

LCA was used to identify discrete classes of specialist healthcare support services for older care home residents using data from a UK survey.

Questionnaire development

A self-administered questionnaire was developed to capture information on the organisation, responsibilities and activities of specialist healthcare support services for older care home residents in the UK. The tool was designed by the researchers and was informed by a systematic literature review of specialist care home support services undertaken by the research team (Clarkson *et al.*, 2018) and guidance on effective survey design (Dillman, 2007; Fowler, 2009).

The questionnaire was devised for both postal and electronic distribution (as a form in Microsoft Word), and contained a mix of (predominantly) pre-coded multiple-option and open-ended questions, facilitating the collection of systematic information about different service characteristics while enabling respondents to provide more detail about particular aspects of their work. There were four sections:

- Background (funding, age, coverage, aims);
- Staffing (size, composition, allocation of medical responsibility);
- Activities (assessments, medication reviews, hands-on care and training); and
- Service evaluation (resident outcomes and costs).

The final draft was piloted with two consultant geriatricians who had experience of delivering specialist care home support services and revised prior to dissemination.

Approach to sampling

Data collection took place between 2011 and 2012. In the absence of an existing sampling frame, a multipronged approach was undertaken to identify the population of interest, that is, specialist healthcare support services for care homes in the UK.

First, the questionnaire was sent to all consultant physicians on the British Geriatric Society (BGS) mailing list who worked in geriatric medicine or elderly care ($n = 1250$) on the basis that consultant physicians were likely to be involved in many specialist healthcare support services and to be aware of others. This version of the questionnaire thus contained an initial screen to identify clinicians who were part of such services, and a subsequent section for respondents to provide the contact details of any other services they knew of, which were then also sent questionnaires.

Second, key staff in healthcare organisations responsible for service delivery and commissioning in the UK at the time of the survey ($51 \times$ NHS clusters in England, $6 \times$ local health boards in Wales, $7 \times$ NHS boards in Scotland and $5 \times$ health and social care trusts and their associated local commissioning groups in Northern Ireland) were asked to provide contact details of any specialist healthcare support services for care homes in their area. All identified services were then sent questionnaires.

Third, questionnaires were sent to a further 27 service contacts identified by a systematic literature review of specialist care home support services for care homes (Clarkson *et al.*, 2018) or other sources (mainly a small number of individuals who approached the researchers directly nominating their service for inclusion in the study).

Irrespective of mode of identification, non-respondents were followed up at six and twelve weeks post initial contact and data collection closed in the summer of 2012.

Data analysis

Questionnaires were checked prior to entry into Stata (Release 12) and services that specifically addressed the needs of short-term care home residents (ie, dedicated intermediate care services) or that were solely concerned with residents' mental health were excluded. As the unit of analysis was the discrete service, where more than one response was received about the same initiative, a set of predetermined rules were used to combine the responses on a question-by-question basis, creating a single record for each service. Frequency distributions were run to identify the spread of service characteristics.

LCA, a probabilistic clustering approach for multivariate categorical data (Goodman, 1974; Magidson and Vermunt, 2002), was used to allocate the sample into subgroups of services (classes) with similar characteristics. Although latent class membership is not directly observable, it can be inferred from patterns in core sample components (predictor variables), with each service placed in a class based on the highest probability of membership. The choice of predictor variables in this study was clinically driven and was made by the research team (a multidisciplinary group including a senior consultant geriatrician, a nurse and a social worker) taking into account the findings of a literature review (Clarkson *et al.*, 2018) and professional guidelines (eg, British Geriatrics Society, 2016). Four predictor variables capturing key aspects of the support provided by the different services were employed: 'scheduled input', 'all residents', 'medication management' and 'training'. 'Scheduled input' referred to the availability of the service and indicated that the specialist service staff undertook regular, preplanned visits to the care home (rather than visiting only 'as required'). 'All residents' related to service coverage and signified that all care home residents were eligible to receive the service (as opposed to services that targeted subgroups of residents with specific conditions or solely provided guidance for staff). 'Medication management' pertained to the extent to which

the specialist service staff took responsibility for managing residents' health and signified that they undertook the prescription of medication (rather than advising residents' GPs on this). Finally, 'training' referred to the degree to which services sought to increase care home staff's knowledge and skills, and indicated that the service provided formal, planned training (as opposed to ad hoc resident-specific advice).

Following confirmation, through Chi-square tests, that conditional dependence was absent between these variables (Lazarsfeld and Henry, 1968), LCA was conducted in Latent GOLD (5.1) (Vermunt and Magidson, 2005; 2013). The number of random sets and iterations was set to 50 and 3000, respectively, to control for local maxima (a phenomenon in which the programme trying to find best-fitting values for quantities converges on values that are not best fitting) (Linzer and Lewis, 2011). This allowed estimations to begin several times with different initial parameter values (Vermunt and Magidson, 2005). The performance of two and three latent class models was assessed, and the selection of the best-fitting model was informed by a combination of theoretical considerations and four statistical fit indices: the Akaike information criterion (AIC) (Akaike, 1987); the Bayesian information criterion (BIC) (Nylund *et al.*, 2007); the Bootstrap likelihood-ratio test appropriate for small sample sizes; and the associated *P*-value (Vermunt and Magidson, 2005). SI-CHAID (an add-on package to Latent GOLD) was subsequently used to investigate associations between class membership and other service characteristics (Magidson, 2005).

Results

Response rate

Responses were received from 438 of the 1250 consultant physicians on the BGS mailing list (35%); 2 further geriatricians who had been alerted to the survey by their colleagues; 49 of the 77 healthcare organisations approached (64%: 57% in England, 86% in Wales, 71% in Scotland and 80% in Northern Ireland); and 5 other service contacts, that is, 494 individuals in total. Together these provided information on 64 specialist healthcare support services: consultant physicians provided information about 24 discrete specialist care home support services; other contacts provided data on 40 further services.

Specialist support service characteristics

The majority of services provided support to care homes with and without nursing with a view to reducing hospital admissions, enhancing end-of-life care and/or identifying unmet needs, and had been operational for between one and four years (see Table 1). Services typically employed fewer than 10 staff. Nurses were the most frequently reported discipline, followed by consultant physicians (typically part-time). However, medical responsibility for care home residents was commonly retained by residents' GPs outside the specialist service. More than half of the participating services (56%) contained at least two disciplines.

Care arrangements

Just over three quarters of specialist care home services provided input for all care home residents, and approximately four-fifths undertook regular, preplanned visits (Table 2). Most undertook assessments of care home residents and reviewed their medication. However, only around half prescribed medication for residents,

Table 1. Service characteristics

Characteristic	%	(n)
Funder		
Primary care organisation	78.7	48
Acute trust	6.6	4
Other	14.8	9
Service coverage (type of care home)		
Care homes with and without nursing	63.2	36
Care homes with nursing only	36.8	21
Service aims ^a		
Avoid hospitalisation	83.6	51
Enhance end-of-life care	67.2	41
Identify unmet needs	45.9	28
Time service has been in operation		
<2 years	23.3	14
2–4 years	50.0	30
5 years plus	26.7	16
Staff numbers		
1	25.9	14
2–4	25.9	14
5–10	24.1	13
More than 10	24.1	13
Personnel		
Medical consultants	39.7	25
GP	28.6	18
Other doctors	30.2	19
Nurses	63.5	40
Pharmacists	27.0	17
Therapists	17.5	11
Others	15.9	10
Medical responsibility		
GPs (outside of specialist care home service)	63.5	40
Others	36.5	23

^aThree most common aims only.

and still less provided hands-on care (eg, dressing pressure ulcers or setting up syringe drivers). Just over half delivered formal training to care home staff.

Latent class results

Sixty services provided sufficient data for inclusion in the LCA. To identify the appropriate number of subgroups, the model fit indices of the two and three class models were compared. Both the AIC and BIC values were lower for the two than the three class model, suggesting that the two class model was a better fit and the bootstrap likelihood-ratio test and associated *P*-value also favoured this. However, it is important that the final latent class model includes classes that are qualitatively distinct (Petscher *et al.*, 2013), and

Table 2. Care arrangements

Characteristic	%	(n)
All residents ^a	76.2	48
Scheduled input ^a	80.3	49
Assessment	89.1	57
Medication review	82.3	51
Medication management (prescribing) ^a	51.6	33
Hands-on care	44.3	27
Formal training ^a	54.0	34

^aThe four predictor variables used in the latent class analysis.

based on theoretical justification and interpretability, the three class model was deemed the most appropriate solution.

The three class model (see Figure 1):

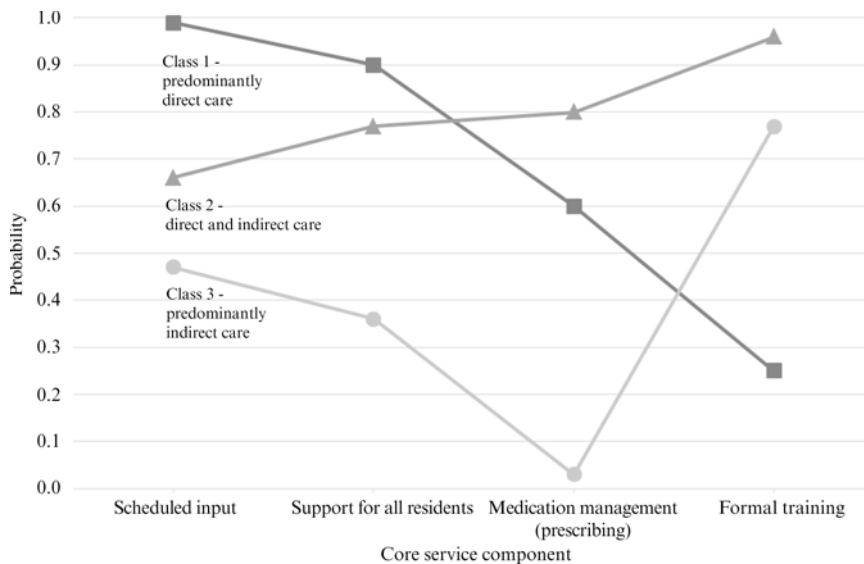
- Class 1 was the largest group and contained 55% (*n* = 33) of the sample. Members of this group had a high probability of providing scheduled input (0.99) and support for all residents (0.90), and a moderate probability of undertaking medication management (0.60). However, the probability that they would deliver formal training was low (0.25). As such they were deemed to provide ‘predominantly direct care’ for care home residents.
- Class 2 comprised 23% (*n* = 14) of the sample. Like Class 1, members of Class 2 had a moderate to high probability of providing scheduled input (0.66), offering support for all residents (0.77) and undertaking medication management (0.80), but in contrast to Class 1, they also had a high probability of delivering formal training for care home staff (0.96). They were thus characterised as providing both ‘direct and indirect care’.
- Class 3 contained 22% (*n* = 13) of the sample. Members of Class 3 had the lowest probability of providing scheduled input (0.47) and offering support for all residents (0.36), and a particularly low probability of undertaking medication management (0.03). On the other hand, the probability of their delivering formal training was high (0.77). They thus provided ‘predominantly indirect care’.

Associations between classes and other service characteristics/arrangements

No association was found between the three classes and the funder, type of care home served, aims of the service or length of operation. However, there was a significant difference between the classes with regard to the involvement of medical consultants, with those services that provided ‘predominantly direct care’ more likely to contain consultants than services providing ‘direct and indirect care’, which in turn were more likely to contain consultants than services providing ‘predominantly indirect care’ (Table 3). Weak evidence suggested that the prevalence of other doctors ($\chi^2 = 8.98$, *P* = 0.062) and GPs ($\chi^2 = 7.90$, *P* = 0.095) followed the same pattern. In keeping with this, GPs were significantly more likely to hold medical responsibility for residents in care homes where the specialist service provided ‘predominantly indirect care’ than in the other two classes. As expected, significant relationships were also found between the classes and the provision of assessments and medication reviews, with services in the ‘predominantly

Table 3. Comparison of other service characteristics across the three latent classes

Characteristic	Class 1 Predominantly direct care % (n = 33)	Class 2 Direct and indirect care % (n = 14)	Class 3 Predominantly indirect care % (n = 13)	χ^2	P
Medical consultant staff member	56.65	25.29	13.92	10.17	0.038
Medical responsibility provided by GPs (outside the specialist service)	56.70	50.98	92.56	7.67	0.022
Undertake medication review	93.45	94.59	39.10	17.65	<0.001
Undertake assessment	96.88	99.59	55.50	15.07	<0.001

**Figure 1.** The latent profiles of specialist healthcare support services for care homes

direct' and the 'direct and indirect' classes more likely to undertake these activities than those in the 'predominantly indirect' class.

Discussion

Despite a good understanding of the healthcare needs of care home residents, and over a decade of debate about the best way to address these, it is not clear which approaches to service delivery are most effective (Carter, 2012; Burns and Nair, 2014). There is, thus, a need for a classification scheme that will permit researchers to identify the prevalence of different models, and compare their relative costs and benefits (Goodman *et al.*, 2015; Iliffe *et al.*, 2016). To the best of our knowledge, this is the first study to use LCA to develop such a scheme, placing specialist healthcare support services for care home residents into three subgroups on the basis of four key dimensions of service arrangements (Goodman, 1974; Bailey, 1994; Magidson and Vermunt, 2002). The first class (the most prevalent) captured services that focused on the provision of direct care; the second captured services that provided direct and indirect care; and the third (the least common) represented services that focused on the provision of indirect support. The remainder of this article will discuss the potential practice implications of these different arrangements and consider the utility of LCA in creating a taxonomy of specialist healthcare support services for care home residents whose effectiveness can be explored in future research.

Potential practice implications

The identified service models highlight a number of important issues for the design of specialist care home support services of interest to both commissioners and service providers. One of these is the extent to which specialist service staff personally engage in care home residents' management, as opposed to focusing on training care home staff as a means of promoting positive change. At present, the dominant model (Class 1) focuses on the delivery of direct care, with specialist staff (often including consultants) undertaking regular, preplanned visits to care homes where the care and management of any care home resident can be discussed. As such, these services provide a structured, proactive and expert-led approach, facilitating the early identification and treatment of health problems and the avoidance of inappropriate hospital admissions (Gordon, 2015; NHS England, 2016). Further, in taking responsibility for the management of residents' medication, they address an area of particular concern in care home medicine internationally. Research shows that around the world up to 75% of residents are prescribed at least one potentially inappropriate preparation (Barber *et al.*, 2009; Ferrah *et al.*, 2017), and although studies of interventions to reduce inappropriate prescribing have not yet resulted in consistent improvements in clinical outcomes, there is evidence of benefit in the reduction of drug burden (Alldred *et al.*, 2016; Thiruchelvam *et al.*, 2017).

In contrast, the provision of a predominantly indirect (training-focused) approach (Class 3) addresses the globally acknowledged

importance of increasing the confidence, knowledge and skills of care home staff (Nolan *et al.*, 2008). Many registered nurses working in care homes recognise that they are ill-prepared for their role and would benefit from external specialist training (Seymour *et al.*, 2010; Cooper *et al.*, 2017), particularly in wound management, bowel and catheter care, nutrition, dementia and end-of-life care (NAO, 2008; NHS England, 2016; Cooper *et al.*, 2017). More generally, it is important that appropriate training is available for all staff grades, and that they perceive this to be relevant to their needs. A systematic review indicated that interventions to change care home staff practice were more likely to have a positive effect on resident outcomes where they targeted specific care activities (eg, oral care and hygiene) as opposed to global practice (eg, quality improvement and philosophy of care) (Low *et al.*, 2015). Training must also be of sufficient quality. A recent review of education and training to enhance end-of-life care for nursing home residents concluded that the provided input was 'not of a standard that could be expected to alter clinical behaviour' (Anstey *et al.*, 2016: 353). Other research has indicated that training must also be systematic, planned and ongoing (Nolan and Keady, 1996; Nolan *et al.*, 2008). Indeed, in view of the typically high staff turnover in care homes, this is particularly important (Low *et al.*, 2015).

Arguably, a mixed direct and indirect approach (Class 2) would offer the most opportunity to improve the healthcare of care home residents. However, this is potentially the most time intensive and demanding model, for the skills required to provide individual support for residents are different from those needed to provide training. It is possible that the former (direct care) approach reflects the existing skill mix of services, and their preferred ways of working. To adopt the Class 2 approach would be likely to raise significant workforce issues relating to the composition of such services and the balance of time they spend on direct versus indirect care. Such decisions also have important implications for the number of care homes specialist services can support. Services placing a greater emphasis on direct care may be able to cover only a relatively small percentage of homes, leaving GPs to oversee the remainder, whereas services investing more time in training might potentially support a larger number of care homes. Alternatively, there would appear to be no reason why commissioners might not consider a two-tiered approach, whereby one provider takes responsibility for the ongoing training of care home staff across a wide geographical area, while another offers a more resident-focused service in a subset of homes. Obviously, each of these options carries associated costs, and choices must be made within the existing funding envelope. Irrespective of the approach adopted, in order to maintain benefits, services must be resourced at a sustainable level. However, the life expectancy of many past service initiatives had been less than three years (Davies *et al.*, 2011).

A taxonomy of specialist healthcare support services

The creation of a taxonomy of specialist healthcare support services provides a means of instilling order on the complexity of the real world by organising cases of interest into groups according to their measured similarity on observed variables (Bailey, 1994). Such classifications are important, not only because they enable researchers to define and compare complex cases, but because they provide for the study of 'relationships between organisational strategy, structure and performance' (Bazzoli *et al.*, 1999: 1683). They have thus been used extensively in health and social care research (Bailey, 1994; Bazzoli *et al.*, 1999; Nickerson *et al.*, 2013).

In forming a taxonomy, the basic rule is that groups must be both mutually exclusive and exhaustive, while the goal is to minimise within-group variance and maximise between-group variance. As Bailey (1994) notes although this is simple to describe, in reality the complexity of the cases to which it is addressed can make it very complicated, and the creation of a taxonomy thus usually involves some form of statistical analysis. To date this has most commonly been cluster analysis (Nickerson *et al.*, 2013). However, it has more recently been argued that LCA has a number of advantages over cluster analysis in the formation of a taxonomy, including the fact that whereas standard cluster analysis methods use somewhat-arbitrary cluster criterion, LCA allows for rigorous statistical testing of model fit, assisting model selection. In addition, LCA is not limited to analysis of continuous dependent variables, can easily accommodate covariates and is more robust (has lower misclassification rates) to departures from the assumptions of equal variance and local independence (Eshghi *et al.*, 2011; Thorpe *et al.*, 2011).

Obviously the quality of any classification depends on ascertaining the fundamental characteristics on which it is based (Bailey, 1994), and the relatively small absolute number of services identified in this study restricted the analysis to four predictor variables. Future research studies may wish to explore other possible variables. However, the choice of variables used in the current analysis was clinically driven and informed by both an international literature review and professional guidelines. Moreover, the authors believe that the resultant classification fulfils all Nickerson's criteria for a taxonomy to be useful, in that it is:

- Concise, that is, it contains a limited number of dimensions and a limited number of characteristics in each dimension so as to not overload the researcher and make it difficult to comprehend;
- Robust, that is, it contains enough dimensions and characteristics to clearly differentiate the objects of interest;
- Comprehensive, that is, it classifies all known cases;
- Extendible, that is, it allows for the inclusion of additional dimensions and new characteristics if new types of cases arise, and the tracking of initiatives over time; and
- Explanatory, that is, it contains dimensions and characteristics that, rather than describing every detail of the cases in question, provide useful explanations of their nature (Nickerson *et al.*, 2013).

In considering these findings, however, it should be acknowledged that it is not known what proportion of the whole population the identified specialist healthcare support services represented. Although the research team went to considerable lengths to identify as many services as possible, involving multiple approaches to relevant sources, it is likely that some services will have been overlooked, particularly those lacking consultant involvement. This would not have affected the choice of constructs used in the modelling but may have affected the relative prevalence of the different models. It is also possible that the latter will have changed in the six years since the data were collected. Recent years have certainly seen an upsurge of interest in the best ways to provide enhanced support for care home residents with a view to preventing avoidable hospital admissions and enabling care home residents to remain in the care home at the end of life (Tucker *et al.*, 2018). However, research on the (generic and specialist) healthcare support received by care homes across Greater Manchester currently being undertaken by the research team suggests that most services are continuing to focus on the provision of direct support.

Conclusions

Other than a statutory duty to provide registration with a primary care provider, the obligations of NHS commissioners for the provision of community and specialist health care to care homes in England are not presently prescribed (Goodman *et al.*, 2015). It is thus perhaps unsurprising that reports repeatedly highlight a lack of consensus among commissioners about the services care home residents need, how these should be provided and what they should do, while there are also concerns about the unequal access to services between care home residents and people living at home (British Geriatrics Society, 2011; Carter, 2012). This is the first study to use LCA to identify a taxonomy of specialist healthcare services for care homes, providing a framework for the exploration of the extent to which different organisational forms are associated with better resident, process and service outcomes. As such it is hoped that it will enable researchers to start to move beyond the plethora of descriptive surveys of current NHS provision for this patient group, and facilitate exploration of what it achieves (Iliffe *et al.*, 2016). Clearly, given the diversity of wider healthcare arrangements for health care residents across the UK, it is unlikely that any single model of care will work in all localities. Nevertheless, as high-income countries around the world continue to try and shift the locus of long-term care from hospital to residential settings, such research is urgently required (WHO, 2015).

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Authors' Contribution. CH led the statistical analysis and the interpretation of the data and drafted the manuscript. ST participated in the design of the survey, helped plan the analysis, interpret the data and co-draft the manuscript. JH helped plan the analysis, interpret the data and co-draft the manuscript. RH participated in the design of the survey, managed the data collection and helped with the preliminary analysis. DC conceived of and managed the study, participated in the design of the survey, helped plan the analysis and interpret the data. All authors read and approved the final manuscript.

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References

- Akaike H (1987) Factor analysis and AIC. *Psychometrika* **52**, 317–332.
- Allred DP, Kennedy M-C, Hughes C, Chen TF and Miller P (2016) Interventions to optimise prescribing for older people in care homes. *The Cochrane Database of Systematic Reviews* **12**, CD009095.
- Anstey S, Powell T, Coles B, Hale R and Gould D (2016) Education and training to enhance end-of-life care for nursing home staff: a systematic literature review. *British Medical Journal Supportive and Palliative Care* **6**, 353–361.
- Bailey KD (1994) *Typologies and taxonomies – an introduction to classification techniques*. Thousand Oaks, California: Sage.
- Barber ND, Allred DP, Raynor DK, Dickinson R, Garfield S, Jesson B, Lim R, Savage I, Standage C, Buckle P, Carpenter J, Franklin B, Woloshynowych M and Zermansky AG (2009) Care homes' use of medicines study: prevalence, causes and potential harm of medication errors in care homes for older people. *Quality and Safety in Healthcare* **18**, 341–346.
- Bazzoli GJ, Shortell SM, Dubbs N, Chan C and Kralovec P (1999) A taxonomy of health networks and systems: bringing order out of chaos. *Health Services Research* **33**, 1683–1717.
- Briggs R, Robinson S, Martin F and O'Neill D (2012) Standards of medical care for nursing home residents in Europe. *European Geriatric Medicine* **3**, 365–367.
- British Geriatrics Society (2011) *Quest for quality: British Geriatrics Society Joint Working Party inquiry into the quality of healthcare support for older people in care homes: a call for leadership, partnership and quality improvement*. London: British Geriatrics Society.
- British Geriatrics Society (2016) *Effective healthcare for older people living in care homes: guidance on commissioning and providing healthcare services across the UK*. London: British Geriatrics Society.
- British Medical Association (2016) Government needs to address problems facing care home services, warns GP leaders. [Press release]. Retrieved 9 August 2018 from <https://www.bma.org.uk/news/media-centre/press-releases/2016/february/government-needs-to-address-problems-facing-care-home-services>
- Burns E and Nair S (2014) New horizons in care home medicine. *Age and Ageing* **43**, 2–7.
- Carter C (2012) *Failing the frail; a chaotic approach to commissioning health care services for care homes*. London: British Geriatric Society.
- Centers for Medicare and Medicaid Services (2012) Initiative to reduce avoidable hospitalization among nursing facility residents [Online]. Retrieved 9 August 2018 from <http://innovation.cms.gov/initiatives/rahnfr/>
- Clarkson P, Hays R, Tucker S, Paddock K and Challis D (2018) Healthcare support to older residents of care homes: a systematic review of specialist services. *Quality in Ageing and Older Adults* **19**, 54–84.
- Conroy S, Van Der Cammen T, Schols J, Van Balen R, Peteroff P and Luxton T (2009) Medical services for older people in nursing homes – comparing services in England and the Netherlands. *The Journal of Nutrition, Health and Ageing* **13**, 559–563.
- Cooper E, Spilsbury K, McCaughan D, Thompson C, Butterworth T and Hanratty B (2017) Priorities for the professional development of registered nurses in nursing homes: a Delphi study. *Age and Ageing* **46**, 39–45.
- Davies SL, Goodman C, Bunn F, Victor C, Dickinson A, Iliffe S, Gage H, Martin W and Froggatt K (2011) A systematic review of integrated working between care homes and health care services. *BMC Health Services Research* **11**, 320.
- Department of Health (2007) *Dignity in care: practice guide*. London: Department of Health.
- Department of Health (2008) *End of life care strategy – promoting high quality care for all adults at the end of life*. London: Department of Health.
- Department of Health (2009a) *Living well with dementia: a national dementia strategy*. London: Department of Health.
- Department of Health (2009b) *Living well with dementia: a national dementia strategy: implementation plan*. London: Department of Health.
- Dillman DA (2007) *Mail and internet surveys: the tailored design method, second edition*. New York: John Wiley and Sons.
- Donald IP, Gladman J, Conroy S, Vernon M, Kendrick E and Burns E (2008) Care home medicine in the UK – in from the cold. *Age and Ageing* **37**, 618–20.
- Dwyer R, Gabbe B, Johannes Stoelwinder JU and Lowthian J (2014) A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities. *Age and Ageing* **43**, 759–766.
- Eshghi A, Haughton D, Legrand P, Skaletsky M and Woodford S (2011) Identifying groups: a comparison of methodologies. *Journal of Data Science* **9**, 271–291.
- Ferrah N, Lovell JJ and Ibrahim JE (2017) Systematic review of the prevalence of medication errors resulting in hospitalization and death of nursing home residents. *Journal of the American Geriatrics Society* **65**, 433–442.
- Fowler FJ (2009) *Survey research methods*. Thousand Oaks, CA: Sage Publications Ltd.
- Goodman C, Davies SL, Gordon AL, Denning T, Gage H, Meyer J, Schneider J, Bell B, Jordan J, Martin F, Iliffe S, Bowman C, Gladman JRF, Victor C,

- Mayrhofer A, Handley M and Zubair M (2017) *Optimal NHS service delivery to care homes: a realist evaluation of the features and mechanisms that support effective working for the continuing care of older people in residential settings*. Draft. London: HMSO.
- Goodman C, Davies SL, Gordon AL, Meyer J, Dening T, Gladman JRF, Iliffe S, Zubair M, Bowman C, Victor C and Martin FC (2015) Relationships, expertise, incentives and governance: supporting care home residents' access to health care. *An interview study from England. JAMDA* **16**, 427–432.
- Goodman LA (1974) Exploratory latent structure analysis using both identifiable and unidentifiable models. *Biometrika* **61**, 215–231.
- Gordon AL (2015) What is the case for care home medicine? The geriatrician's perspective. *The Journal of the Royal College of Physicians of Edinburgh* **45**, 148–153.
- Gordon AL, Franklin M, Bradshaw L, Logan P, Elliott R and Gladman JR (2014) Health status of UK care home residents: a cohort study. *Age and Ageing* **43**, 97–103.
- Government Equalities Office (2010) *Great Britain Equality Act 2010*. London: Stationery Office.
- Hanratty B, Lowson E, Grande G, Payne S, Addington-Hall J, Valtorta N and Seymour J (2014) Transitions at the end of life for older adults – patient, carer and professional perspectives: a mixed-methods study. *Health Services and Delivery Research* **2**, 17.
- Hays R, Clarkson P, Tucker S and Challis D (2012) Healthcare support services for care home residents. *Nursing Older People* **24**, 26–30.
- Iliffe S, Davies SL, Gordon AL, Schneider J, Dening T, Bowman C, Gage H, Martin FC, Gladman JRF, Victor C, Meyer J and Goodman C (2016) Provision of NHS generalist and specialist services to care homes in England: review of surveys. *Primary Health Care Research and Development* **17**, 122–137.
- Laing and Buisson (2010) *Care of the elderly people market survey, 2009*. London: Laing and Buisson.
- Lazarsfeld PF and Henry NW (1968) *Latent structure analysis*. Boston: Houghton Mifflin.
- Lievesley N, Crosby G, and Bowman C (2011) *The changing role of care homes*. London: BUPA and Centre for Policy on Ageing.
- Linzer DA and Lewis JB (2011) polCA: an R Package for Polytomous Variable Latent Class Analysis. *Journal of Statistical Software* **42**, 1–28.
- Low L-F, Fletcher J, Goodenough B, Jeon Y-H, Etherton-Beer C, MacAndrew M and Beattie E (2015) A systematic review of interventions to change staff care practices in order to improve resident outcomes in nursing homes. *PLoS One* **10**, e0140711.
- Magidson J (2005) *SI-CHAID 4.0 user's guide*. Belmont, MA: Statistical Innovations Inc.
- Magidson J and Vermunt J (2002) Latent class models for clustering: a comparison with K-means. *Canadian Journal of Marketing Research* **20**, 36–43.
- Mauro PM, Furr-Holden CD, Strain EC, Crum RM and Mojtabai R (2016) Classifying substance use disorder treatment facilities with co-located mental health services: a latent class analysis approach. *Drug and Alcohol Dependence* **163**, 108–115.
- National Audit Office (2008) *End of life care*. London: The Stationery Office.
- NHS England, Care Quality Commission, Health Education England, Monitor, NHS Trust Development Authority and Public Health England. (2014) *NHS five year forward view*. London: NHS England.
- NHS England (2015) *Quick guide: clinical input into care homes*. London: NHS England.
- NHS England (2016) *The framework for enhanced health in care homes*. London: NHS England.
- Nickerson RC, Varshney U and Muntermann J (2013) A method for taxonomy development and its application in information systems. *European Journal of Information Systems* **22**, 336–359.
- Nolan M, Davies S, Brown J, Wilkinson A, Warnes T, McKee K, Flannery J and Stasi K (2008) The role of education and training in achieving change in care homes: a literature review. *Journal of Research in Nursing* **13**, 411–433.
- Nolan MR and Keady J (1996) Training for long term care: the road to better quality. *Reviews in Clinical Gerontology* **6**, 333–342.
- Nylund KL, Asparouhov T and Muthen BO (2007) Deciding on the number of classes in latent class analysis and growth mixture modelling: a Monte Carlo simulation study. *Structural Equation Modeling* **14**, 535–569.
- Petscher Y, Schatschneider C and Compton DL (2013) *Applied quantitative analysis in education and the social sciences*. New York, NY: Routledge.
- Pickard L, Comas-Herrera A, Costa-Font J, Gori C, di Maio A, Paxtot C, Pozzi A, Rothgang H and Wittenberg R (2007) Modelling an entitlement to long-term care services for older people in Europe: projections for long-term care expenditure to 2050. *Journal of European Social Policy* **17**, 33–48.
- Rodríguez-Benavente A, Herrera-Usagre M, Palop-Río Á and Barrera-Vargas Á (2017) ISQUA17-2039 Patient-centred care and leadership standards compliance: a latent class analysis. *International Journal for Quality in Health Care* **29** (Suppl 1), 26–27.
- Seymour JE, Kumar A and Froggatt K (2010) Do nursing homes for older people have the support they need to provide end-of-life care? A mixed methods enquiry in England. *Palliative Medicine* **25**, 125–138.
- Smith P, Sherlaw-Johnson C, Ariti C and Bardsley M (2015) *Focus on: hospital admissions from care homes*. London: The Health Foundation and the Nuffield Trust.
- Steves CJ, Schiff R and Martin FC (2009) Geriatricians and care homes: perspectives from geriatric medicine departments and primary care trusts. *Clinical Medicine* **9**, 528–533.
- Thiruchelvam K, Hasan SS, Wong PS and Kairuz T (2017) Residential aged care medication review to improve the quality of medication use: a systematic review. *Journal of the American Medical Directors Association* **18**, e1–87.
- Thorpe JM, Thorpe CT, Kennelty KL and Pandhi N (2011) Patterns of perceived barriers to medical care in older adults: a latent class analysis. *BMC Health Services Research*, **11**, 181.
- Tolson D, Rolland Y, Andrieu S, Aquino J-P, Beard J, Benetos A, Berrut G, Coll-Planas L, Dong B, Forette F, Franco A, Franzoni S, Salva A, Swagerty D, Trabucchi M, Vellas B, Volicer L and Morley JE (2011) International association of gerontology and geriatrics: a global agenda for clinical research and quality of care in nursing homes. *Journal of the American Medical Directors Association* **12**, 184–189.
- Tucker S, Wilberforce M, Brand C, Abendstern M and Challis D (2014) All things to all people? The provision of outreach by Community Mental Health Teams for Older People in England: Findings from a national survey. *International Journal of Geriatric Psychiatry* **29**, 489–496.
- Tucker S, Buck D, Roe B, Hughes J and Challis D (2018) Hospital admissions and place of death of residents of care homes receiving specialist healthcare services: Protocol for a systematic review. *Journal of Advanced Nursing* **75**, 443–451.
- Vermunt JK and Magidson J (2005) *Latent GOLD 4.0 user's guide*. Belmont, MA: Statistical Innovations Inc.
- Vermunt JK and Magidson J (2013) *Latent GOLD 5.0 upgrade manual*. Belmont, MA: Statistical Innovations Inc.
- Wittenberg R and Hu B (2015) *Projections of demand for and costs of social care for older people and younger adults in England, 2015 to 2035*. London: Personal Social Services Research Unit, London School of Economics.
- World Health Organization (2015) *World report on ageing and health*. Geneva: WHO Press.