Relationship between care home staffing and quality of care: a mixed methods approach

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Summary of Research

Care quality in care homes is coming under increasing scrutiny. The quality of care and life experienced by care home residents is influenced by the staff delivering and managing that care[1]. Therefore scrutiny of quality includes concerns over staffing levels, recruitment and retention and getting the right kinds of staff with the right skills costs. Staffing is the largest operating cost in most homes and often the first target for cost reductions. Yet the effects of cost reduction on quality is not clear. Beyond a broad recognition that, 'staff influence quality' little is known about the UK care home workforce and its relationship to quality in care homes. In this context the aim of this study is to examine the relationship between the deployment of the care home workforce (and associated skill mix) and the impact on: quality of care; outcomes for residents, relatives and staff; and the use of NHS resources. In addressing this aim it is recognised that quality is a complex, contested and dynamic concept. In this study the concept is operationalised using data collected at national and organisational level to measure quality, as well as seeking to understand quality by considering the views of different individuals - residents, relatives, care home staff, NHS staff, provider or commissioning organisation, regulatory bodies, and policy makers. To achieve the overall aim this study will:

1. describing variations in the characteristics of the care home nursing and support workforce
2. identifying the dependency and needs of residents and relatives in care homes and its association with care home staffing
3. examining how different care home staffing models (including new roles) may impact on quality of care, resident outcomes and the use of NHS resources
4. explaining how the care home workforce (numbers, skill mix and stability) can best meet the dependency and needs of residents
5. exploring and understanding the contributions of the nursing and support workforce (including innovations in nursing and support roles) in care homes to enhance quality of care
6. translating methods used for modelling the relationships between staffing and quality to provide a platform for sector-wide implementation

Our approach explores the structures, processes and outcomes of quality using a convergent parallel/simultaneous mixed method design[1], comprising 5 work packages (WP). Quantitative and qualitative data [WP1-4] will be collected and analysed separately and findings synthesised in WP5. WP1 [Obj 1] builds on existing data and literature to provide depth of understanding of variations in characteristics of the care home workforce, and comprises a realist review and surveys of care home managers and staff. WP2 [Obj 2, 3, 4] will model relationships between national workforce metrics (NMDS-SC) and CQC inspection ratings. These findings will inform and provide important context for WP3. Partnering with Bupa Care Services (hereafter Bupa), WP3 [Obj 2, 3, 4] is a longitudinal study of relationships between staffing inputs and quality outcomes for residents. We will calculate the incremental staffing requirements necessary for care homes to improve quality, as well as the costs associated with achieving better quality and outcomes in the sector. WP4 [Obj 4, 5] seeks to understand why variations in the relationship between staffing and quality exist through six purposively sampled case studies (care homes) using ethnographic mixed methods (observations, interviews, in site documentary analysis and diaries). Six focus groups (with care home vanguards) will seek to explore the case study findings with a broader range of participants in a broader context, thus, promoting transferability. WP 5 [Obj 6] synthesises the WPs and focuses on translating methods used for modelling to enable the care home sector to learn from this approach and maximise its utility in their particular context.

Our analyses will produce evidence to inform policy and organisational (care home) level decisions about staffing and the best ways to deploy the – valuable - staffing resource in care homes. The findings will have relevance for residents and relatives, care providers, commissioners, inspectors and policy makers.

[1] The study recognises differences in staffing arrangements and organisational characteristics across care homes with and without nursing and will study both of these contexts (including variability of homes in our sampling frames).

Background and Rationale

In the UK an estimated 405,000 older people live in circa 18,000 independently owned care homes: 5,153 nursing homes and 12,525 residential homes[2 3]. Government policy focusing on 'care at home'[4] means that older people are entering care homes later, sicker and frailer with complex needs (including dementia). People now living in residential homes would likely have been in nursing homes 5-10 years ago; nursing homes today provide care that was once delivered in hospitals[5-8]. This changing profile is set to continue as the social care system responds to financial constraints and reduced primary care NHS support to care homes. Understanding how best to provide care and support for residents through effective use of human resources in the care home sector is critical.

The delivery of care within care homes is highly contingent on the nursing and care support workforce but staffing, recruitment and retention levels are widely acknowledged as too low[9-11]. It is likely that there is considerable variation in staffing and turnover between care home organisations and individual homes. Yet little is known about what factors influence these variations and their impact on residents and relatives, staff, or use of NHS resources. More recent studies of services and quality in the sector have focused on the interface between care homes and NHS inputs to provide equitable and optimum care for residents[12]. The proposed study is unique in its focus on the staff employed within the care home and the relationship between how deployment of the care home workforce and its skill mix may impact on: quality of care; outcomes for residents, relatives and staff; and the use of NHS resources. Evidence, mainly from North America, suggests that 'inadequate' staffing levels in care homes negatively impacts on quality and that the numbers - rather than skill level - of workers that improves quality[13,14]. These findings must be treated cautiously as they are drawn mainly from cross-sectional studies; findings are inconsistent[14]; involve non-contemporaneous data sets and assume that staffing and quality are linearly related. Before residents and relatives, care providers, commissioners, inspectors and policy makers can make truly informed choices -and care homes can make decisions about the best way to deploy their valuable staffing resource - stronger and better evidence is required.

The main contribution of this work is its focus on identifying the most effective workforce models for care homes to benefit residents, relatives and staff. Policy and practice concerns about staffing levels, recruitment and retention in the sector, as well as the increasing public scrutiny of quality of care and outcomes in the sector, make this study timely. Understanding the associations between care home staff, care quality and NHS resource implications is important. We will estimate the incremental staffing requirements for care homes to improve quality, as well as the resource implications of achieving quality outcomes in the care home sector. We will also compare the performance of different homes considering the resources used and the mix and volume of services provided, and consequently to identify homes where real efficiency and quality improvements appear possible. The work will also take into consideration processes of care in the homes that provide understanding of how care home staff respond to residents' needs and to enhance and promote quality. This will be the first UK study to address this important focus on the care home workforce and its relationship to quality. It will make an important contribution to health and social care and methodological development in this field.

Evidence explaining why this research is needed now

Care homes have an important role in the provision of care for dependent older people and this role will increase as the population ages. Care homes provide care to residents who are aged, with poor self-perceived health, functional impairments, and multiple co-morbidities, including dementia[15 16]. It is known that requirements for care and treatment are increasing in intensity across the sector, and when compared to care demands of the care home resident population a decade ago[5 6 8]. This is due to chronic progressive conditions that require more intensive care and resources, changes in the role of care homes to manage acute patients following a hospital admission (step-down care) and to prevent an admission to hospital (step-up care)[17], as well as the important role of care homes in end of life care[18 19]. This mix of residents affects the type and level of care and services required. How to ensure quality of care for care home residents is the subject of ongoing international debate involving the public, policy makers, commissioners, providers, clinicians and researchers[5 20]. Quality of care – primarily poor care - has come under increasing scrutiny in recent years.

Staffing is the largest operating cost for care homes[21] and the quality of care provided within care homes is contingent on its staff. Staffing is a major concern in these settings because of the challenges in determining the appropriate numbers and type of staff required to meet the multidimensional and complex needs of residents[13]. The nursing and care assistant workforce in the care home sector is the key means of ensuring quality of care for residents and relatives, yet we know little of the relationships between this workforce and quality of care in UK care homes. UK studies need to be longitudinal and incorporate an understanding of the links between the structures, processes and outcomes that together comprise 'quality'. This understanding is the intention of our proposed work and we think it is timely given the practice and policy concerns regarding staffing, recruitment and retention in the sector[9-11]. This, alongside pressures on NHS services (including primary, community and emergency care), have made it timely to focus on staff employed in care homes and understand the relationships between nurse staffing (proportion of RNs and care staff, care staff of different levels and innovative roles) and how these models of staffing affects quality of care for residents to ensure optimal use of resources both within and from outside the care home to meet the health needs of this vulnerable population.

Understanding how to meet the increasing health needs of residents in care homes efficiently (given rising costs and demand) and how to use the workforce resource in care homes, to promote quality of care for residents, and to promote effective working between health and social care services is a societal priority. The proposed research, and associated work packages, will contribute to an understanding of nurse and care staffing levels and quality of care in the UK care home context. Our study will complement the existing NIHR portfolio of work by modelling robust data to illuminate the relationship between care home staffing, quality of care, resident outcomes and use of NHS resources.

Aims and objectives

The overall aim of this study is to investigate the most effective workforce models of nursing and care support in care homes for the ongoing benefits of residents, relatives and staff. We will achieve this by:

1. describing variations in the characteristics of the care home nursing and support workforce
2. identifying the dependency and needs of residents and relatives in care homes and its association with care home staffing
3. examining how different care home staffing models (including new roles) may impact on quality of care, resident outcomes and the use of NHS resources
4. explaining how the care home workforce (numbers, skill mix and stability) can best meet the dependency and needs of residents
5. exploring and understanding the contributions of the nursing and support workforce (including innovations in nursing and support roles) in care homes to enhance quality of care
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Research Plan / Methods

Our methodological approach in seeking to address these study objectives is informed by a critical appreciation of existing research and an identified need to understand the structures, process and outcomes underpinning quality and utilise longitudinal data and analysis. We will draw on Donabedian's[22] widely used (in healthcare) theoretical framework to understand the quality of the care home workforce and quality of care for residents. In Donabedian's framework for quality assessment, *structure* is the relatively stable features of the organisation that affect its ability to deliver care and services; *process* is the interactions between provider and consumer; what is done for and with residents by the provider; o*utcomes* are the end results for consumers, attributable to antecedent care. Quality is a complex, contested and dynamic concept. In seeking to define it there has to be appreciation that several formulations are both possible and legitimate and dependent on individual views, values, expectations and preferences in the system of care. In the care home context this includes residents, relatives, care home staff, NHS staff, provider or commissioning organisation, regulatory bodies, and policy makers. This is complicated further in the care home context as it is important to consider quality in two domains: quality of care and quality of life. This complexity is recognised in our proposal by using the theoretical framework of Donabedian to focus

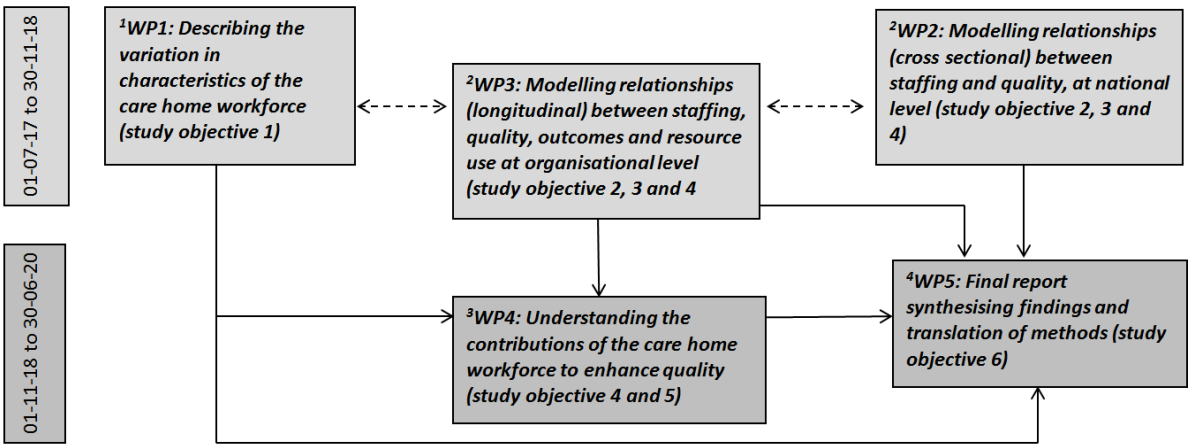
on structures, processes and outcomes of quality. This will enable us to explore, understand and explain 'quality' in this context and from a range of perspectives.

The ways in which quality is measured, monitored and reported in care homes is a topic debated internationally and difficulties arise because of the diverse range of views, values, expectations and preferences held by different key stakeholders. Two dimensions of quality can be identified for care home residents: quality of care and quality of life. Quality of care refers to clinical indicators (often associated with nurse staffing), including pressure ulcer prevalence, falls, or medication errors. Whereas quality of life refers to issues such as residents' opportunities for choice or autonomy. To date, measurement of quality in this sector (associated with staffing) has predominantly focused on clinical outcomes: a review by the PI[13] revealed 42 indicators of quality. Whilst important, these approaches do not capture quality as defined by residents and their families, or those providing care. Indeed, it has been suggested that these focus on 'negative' indicators of care.

Our study seeks to address quality as broadly as possible (within our work packages) and address structure, process and outcome. WP1 provides important context about the care home workforce through a national survey (structure) and the review which develops understanding and theories of how and why this workforce is related to quality in care homes (structure, process, outcome). In WP 2 and 3 we will use routinely collected measures of quality (outcomes) and will examine (longitudinally) the relationship of these with staffing (structure). In WP2 and 3 we will also address costs (outcome) associated with quality, considering the immediate costs to care home providers or providing higher quality care alongside the wider impacts of good or poor quality on the health and social care system. In doing so, they will test empirically the argument recently advanced by the Secretary of State for Health that higher quality costs less (https://www.gov.uk/government/speeches/good-care-costs-less). In WP4 will try to understand processes of care and how individuals within teams work to promote quality of care for residents in care homes. Schnelle[23] argues for a focus on care processes based on the premise that all care home residents deserve to receive good care even if they suffer from conditions that may prevent good clinical outcomes. Indeed, outcomes of long term care need to be expressed in terms of the relationship between expected and actual outcomes[24]: for some residents, realistic expectations for the outcomes of care may be maintained levels of health or slower-than-expected rates of decline, rather than improved health. Areas of practice that the case study data collection will focus on (to understand processes associated with quality) will include focusing on day-to-day life for residents (social participation; meaningful occupation; personal hygiene, cleanliness and comfort; personal appearance; dining experience; care home environment); health and well-being (prevention and reablement; access to GPs; sensory loss; diet; oral hygiene); and people and leadership in the home (care staff; nursing staff; care home managers)[20 25]. We do not plan to measure these in WP4 (for example using the ASCOT toolkit http://www.pssru.ac.uk/ascot/index.php) but seeking to understand these processes and how they might explain quality (as measured) in WP 2 and 3. WP5 constitutes an important translational phase of the research, through synthesis of the work packages (structure, processes and outcomes), dissemination and potential for wider adoption at the micro, meso and macro levels of service provision.

The study findings will be interpreted using an interactionist theoretical lens (WP5). Interactionist theory regards societal structures as socially constructed and constantly reshaped by human interpretation, social actions, and reactions. We will seek to understand the micro-social processes associated with care home staff negotiating their role and function, as well as how these interact with wider organisational (meso) and policy (macro) structures as they impose themselves on the individual. The study therefore seeks to gain understanding of the relationships between care home staffing and quality by examining the social systems of which they are part. We propose a mixed methods study comprising five linked work packages. The relationships between these work packages are represented below in our flow diagram of the study.

OVERVIEW OF STUDY



[1]Structure and process
[2]Structure and outcome
[3]Process and outcome
[4]Structure, process and outcome

WP1: Determining the characteristics of the care home nursing and support workforce and understanding care quality (study objectives 1, 3, 4, 5)

In 2014, there were approximately 280,500 staff working in care homes (with nursing). Registered nurses comprised 13% of this workforce (n=43,750) [26]. The size of the workforce in care homes (without nursing) is less clear[26]. The Skills for Care National Minimum Data Set (NMDS-SC) and Briefings (https://www.nmds-sc-online.org.uk/content/About.aspx) and literature provide the foundations for our examination of the characteristics of the care home workforce. The NMDS-SC provides a national and regional overview of the care home workforce in relation to: age and gender, time in sector, qualifications, turnover and vacancy rates, pay, diversity and number of migrant workers. Our aim is to provide ***depth*** of understanding and explore variations in the workforce across the sector. This contextual understanding is important for understanding the findings of other work packages.

WP1 has three streams of work:

1. A realist literature review to understand the effectiveness of care home staffing focused on improving quality of care for care home residents. Realist synthesis is a systematic, theory-driven approach for making sense of diverse evidence about complex interventions [27]. We propose to identify, map, and test features (or mechanisms) of different approaches to staffing in care homes (context) and outcomes at resident, relative, service delivery and organisational levels of care. Review objectives will be:
   (i) Identifying which elements of care home staffing could potentially be effective, how they work, on what range of outcomes, why, for whom and in what circumstances
   (ii) Identifying opportunities and challenges to the acceptability of different staffing models designed to improve quality of care for residents in care homes

   To achieve this we will combine multiple sources of evidence to develop a programme theory of care home staffing and how it is causally related to quality (through mechanisms that operate, or not, according to context)[28]. We will use the broad search term 'quality' so that we can (as described above) develop and refine our definition of quality for study in subsequent work packages. This approach will ensure that our focus is not restricted and embraces processes (or mechanisms) considered important within this context and leading to outcomes considered to represent quality. There will be 3 stages to our review and we will work with our broader partners and networks to ensure we optimise opportunities for knowledge exchange and relevance of the review:

(i) *Defining the scope of the review: concept mining and theory developm*ent. We will conduct a review of published reviews to consider how mechanisms of care home staffing have been linked theoretically or empirically to quality of care for residents. The review aims to tease out the ideas, the assumptions, the logic or the 'programme theories' that underpin the interventions under inquiry. All policy-making and all interventions begin with theory: accounts of the causes of the problem under scrutiny ('quality') and conjectures on what changes must be made to the system in order to alleviate that problem ('staffing'). This will provide an important stage in defining quality. Our inclusion criteria in the initial stage will be: studies of any design which report on care home staffing AND report on quality in care homes AND report data from high income countries AND published in English language AND published between 2000 and 2017. We will share these findings at with the SSC (including PPI) to engage with key stakeholders to review, debate and refine this stage for relevance and validity. This stage will provide a narrative account of different staffing models and what is perceived to support effective working by care home staff and how this relates to quality of resident care. Emergent theories from this stage will inform the subsequent stage of the review process.

(i) *Theory refinement and testing:* We will conduct a literature review and test the relevance and rigour of the findings from stage one by drawing comparisons with the broader literature. We will search for relevant published literature (published since 2006 to reflect the changes in care home provision over the past decade) in a range of electronic databases (Medline, Embase, CINAHL, ASSIA, Social Care Online, Social Policy and Practice) using the principles of systematic review methodology[29]. It is difficult to specify inclusion criteria for later stages of the realist review because the process is iterative. However, and in addition to the criteria stated, we envisage that we will seek to include studies that: consider care home staffing and its relationship to quality; provide opportunities for learning for the UK setting (from international literature); and provide context relevant evidence on quality (beyond its relationship to staffing) that will help build our logic and theoretical propositions. We will check the reference lists of primary studies and reviews to ensure the comprehensiveness of our search[29]. An information specialist will support this work. Our inclusion criteria will be refined in this phase in light of emerging findings and theory and to reflect the iterative nature of realist synthesis[30]. We will ensure transparency in the reporting of our data extraction, quality assessment, refinement of theory and reporting of findings.

(ii) *Analysis and synthesis:* Finally, we will synthesise the relationships between mechanisms (processes and structures, for example staffing levels), contexts (such as type of setting, organisational factors) and outcomes (intended and unintended consequences and impact on quality of care for residents). Coded data from the literature will be used to confirm, refute or refine theories. Results will be shared and discussed in the research team to promote validity and consistency in any inferences and interpretations.

To promote dissemination of the review (beyond academic and practice journals), we will produce a briefing document for the sector (an approach already used by team members). This review will complement the realist review conducted by Goodman et al.[12]: focusing on the provision of health-related services *to* the care home and our review will be concerned with how staffing *in* a care home is related to quality of care and its improvement. Professor Goodman has agreed to act as a consultant for our review.

2. A self-completion postal questionnaire administered to a national sample of 4,000 care home staff, including staff employed by the care home provider engaged with WP3. A stratified random sample of 400 care homes (stratified by care home type: with nursing, without nursing, both) will be identified using the online directories provided by the Care Quality Commission (CQC) and carehome.co.uk. Care home managers from this sample will be asked to distribute 10 copies of the questionnaire to their staff for completion. The sample will include members of each staff group (care assistants, registered nurses, clinical leads and care home managers). The questionnaire will explore statements made by Skills for Care in descriptive overviews of this workforce (as detailed above) with the aim of adding breadth and depth of understanding of the characteristics and roles (required and 'extra' roles) of the nursing and support workforce, why and how these role characteristics are changing, and perceived impacts (opportunities and

challenges) of these changes. We anticipate a response rate of 20 to 25% (n=800 to 1000). Previous studies of care home staff populations have achieved response rates ranging from 15.8% [31] to 58%[32] and so this seems a reasonable estimate of response. We aim to increase response rates by keeping the questionnaire short to minimise burden for respondents, contacting care home managers by telephone[33] the following week to ensure the survey has been received, to answer any questions about the study and to encourage participation. We will also include a personalised covering letter to care home managers [34].

3. An online questionnaire focusing on staffing recruitment and retention will be administered to a random stratified sample of 4,000 care home managers representing 25% of 15045 registered care homes. We will use the University of Leeds online survey software (http://it.leeds.ac.uk/info/173/database_and_subscription_services/206/bristol_online_survey_accounts). Potential respondents will be randomly selected from the online database of care homes provided by the Care Quality Commission (http://www.cqc.org.uk/content/care-homes) to include care homes with and without nursing. Best practice methods in survey design will be used to enhance response rates[35]. Our aim is to enhance the perceived and actual benefits for busy care managers of responding (saliency) while minimising the perceived and real costs of questionnaire completion (by keeping the number of questions to a minimum). We will ensure clear questions, design and layout to make it as easy as possible for managers to respond. Based on previous surveys of care home managers [36], we anticipate a response rate between 20 and 25%. A postal option will be available to increase response rates and equity of participation.

   We aim to establish the perceptions of care home managers on recruitment and retention in their care home and to explain variations across the sector. We will use an adapted version of a questionnaire developed by a team in the US (personal correspondence and permission granted to use this[2]). The questionnaire has a maximum of 6 questions (a 7th asking whether the care home manager would be happy for the team to make further contact). We will expand upon the questionnaire findings by conducting a short telephone interview (15 minutes) with 80 care home managers purposively sampled from responders to the online survey. This will promote understanding of any patterns that emerge. Telephone interviews will be semi-structured and audio-recorded (with permission). Each of the sampled managers will be contacted by telephone and invited to participate. The researcher will call and interview managers from the list of survey responses until 80 interviews have been conducted.

The questionnaire element was approved at our PPI engagement event: care home managers indicated their willingness to support this WP and commented on brevity as supporting this decision.

Analysis of survey data: Descriptive summary statistics and frequency distributions will be used to describe quantitative survey data. We will use SPSS v.22.0 [37] to organise and analyse the data. We are aware that there may be potential response bias. We will have data on variables or characteristics for every home in the CQC dataset (regardless of whether the home participates) so we can check for systematic (statistically significant) differences in key variables or characteristics associated with the homes (for example beds, ratings) even if we cannot directly examine the same variables used in the questionnaire: (i) between those who "respond" (invited and complete) and those "non responders" (homes invited but who do not complete); (ii) between responders against the total CQC population of homes in their dataset; and (iii) between non responders against the total CQC population of homes in their dataset. These comparisons would be of value for assessing survey data quality (the absence of bias) beyond the most basic check: our response rate against those typically seen in the wider body of care home research (between 16 and 59%, as highlighted in our proposal). Beyond these "basic" checks we will adopt the decision framework approach for assessing (and mitigating) response (and more accurately, non-response) bias as suggested by Halbesleben & Whitman[38]. Having assessed the major **bias** (response/non response) the second major concern is loss of **precision** with a small number due to low response. A 25% response rate from the 4,000

[2]Adapted (with permission) from work of Denise Tyler, Assistant Professor of Health Services, Policy and Practice (Research), Brown University, US

would yield 1,000 homes. Taking into account the size of the population (around 16,000 homes in England) the 95% confidence intervals around a proportion would be around +/-3%[39] - a level of uncertainty precise enough to be useful managerially and in policy.

Qualitative data from telephone interviews will be thematically analysed using an iterative approach and managed and organised using NVivo v.10.

WP 2: Modelling relationships between staffing and quality at a national level (study objective 2, 3 and 4)

This work package will model the relationship between care quality, as measured in CQC inspection reports and the workforce characteristics of care and nursing homes, drawing on data on home and workforce characteristics from the National Minimum Data Set for Social Care (NMDS-SC). Care quality outcomes will be modelled as functions of the staffing resources of the homes while accounting for resident characteristics and the organisational characteristics of the home operator (Figure 1).

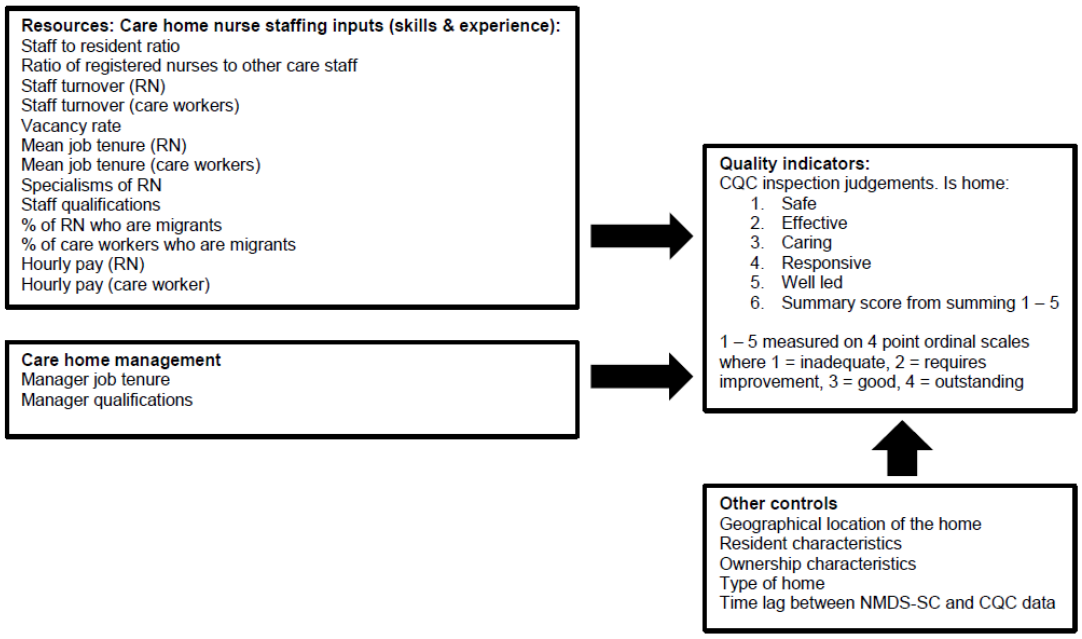
The NMDS-SC is a linked establishment-employee data set, maintained by Skills for Care, which provides information on 2,744 nursing homes and 7,086 care homes (60% of all care and nursing homes regulated by the CQC). Data is entered by the homes themselves, with 90% of homes on the database updating their records at least once a year. Data go back to 2007. Skills for Care have a well-established set of protocols for checking data quality so that poor quality data can be excluded from the analysis. The NMDS-SC will be merged with a database containing CQC inspections scores by establishment that will be assembled from CQC inspection reports data. Data will be linked through shared geographical identifiers (i.e. address, postcode).The current CQC inspection regime began in October 2014. CQC anticipate that every nursing and care home in the country will have been inspected by March 2017, so there should be a CQC report for every home within the NMDS-SC.

CQC inspectors make judgements about whether care and nursing homes are safe, effective, caring, responsive and well led. The results of their judgements are reported as being inadequate, requiring improvement, good or outstanding. These judgements will be treated as ordinal data, which will be used as dependent variables in cross-sectional ordered logit regression analysis that takes into account the clustering of homes operated by the same provider. Independent variables related to staffing will be drawn from the NMDS-SC and will include: staff turnover and stability by job role, vacancy rates by job role, staff experience by job role, staff qualifications, nurse specialisms, % of workers who are migrants by job role, pay rates by job role and staff to service user ratios. The NMDS-SC also contains limited controls for home, resident and organisational characteristics; whether the home is operated by a local authority, private or third sector provider, size of organisation, size of home, geographical location of the home, and the type of residents (such as dementia, learning disabilities or frail elderly). Separate modelling will be conducted for care homes with nursing and care homes without nursing as staffing structures will be different. As far as possible, NMDS-SC data will be matched to the time period in which the CQC inspection took place, but in some cases, data may be out of date if there has been a long time lag between a home last updating its record and the CQC inspection (although 90% of homes have provided data in the 12 months prior to an inspection). Therefore the models will also include a control for the size of the time-lag between data entry and inspection. We will also test the sensitivity of results to data-entry time lags by examining results for subsamples of homes where data has been entered into the NMDS-SC in the 3 months and 6 months prior to inspection before coming to a judgement on the most accurate model specification in the light of appropriate diagnostic tests.

If the results of the analysis suggest that particular workforce characteristics are associated with better inspection scores, the analysis will be taken further to consider the potential additional costs (savings) to the sector of changing staff configurations to those associated with ‘good’ scores. The results of the analysis will be used to identify the optimal staffing mix and staff/resident ratio associated with a care home which achieves ‘good’ scores. These staffing levels will have unit costs assigned to provide an estimate of the resource costs for this ‘optimal’ care home, This will be conducted separately for care homes with nursing and care homes without nursing. Costs for staffing grades and configurations will be identified based on national sources such as PSSRU[40], inclusive of all on costs and overheads. In all cases the midpoint on the pay scale for a particular grade will be

used. In addition to the 'optimal' care home, the costs associated with the characteristics of the 'average' care home will be assessed. The average staffing levels will have the unit costs applied to estimate the resource cost for the 'average' care home. This will be conducted separately for care homes with and without nursing. A comparison will be made between the average and optimal care homes to provide a raw estimate of the incremental cost difference a change in staff configuration may have. A limitation of the analysis will be allowance for overheads, which may be variable in respect to a care home size or funding model, however subgroup analysis will be explored based on organisational characteristics if the data permit. Sensitivity analysis will be conducted varying the input parameters of staffing levels within reasonable upper and lower bounds to account for uncertainty in these estimates. These upper and lower bounds will be defined as part of the analysis.

Figure 1: The relationship between workforce characteristics and care quality outcomes



Relationships between quality indicators and workforce resources will be modelled using ordered logit analysis that accounts for the clustering of homes within the same organisations.

The findings of this work package will provide important context for WP3 which seeks to develop a more detailed and nuanced understanding of the relationships between the care home workforce and quality, outcomes and resource use, working with longitudinal data and more detailed quality measures from a large care home provider.

WP3: Modelling relationships between staffing, quality, outcomes and resource use at an organisational level (study objective 2, 3 and 4)

Drawing on the theorisation of quality set out above, the broadly defined processes and outcomes of care quality can be conceptualised as an outcome of staffing inputs (an aspect of structure), but staffing is only one of the factors that influences care quality. Figure 2 below represents a theoretical model of the relationship between care quality and staffing inputs that also takes into account other (potentially confounding factors) that also affect care quality. The model operationalises care quality by focusing on quality related resident outcomes that are likely to result in costs to this NHS. The work package therefore tests the hypothesis that higher quality care will result in lower costs across the health and social care system. This work package will operationalise this model through a retrospective observational study of the relationship between nurse and care worker staffing inputs (specifically the amount of RN and care workers care hours per resident per week and/or month and the ratio of registered nurses to un-registered care staff, i.e. skills mix) and quality outcomes set out in figure 2. Specifically, the study will examine variation over time in staffing levels, skills mix and the case-load of the care or nursing homes that arises naturally from changes to case-load, staff

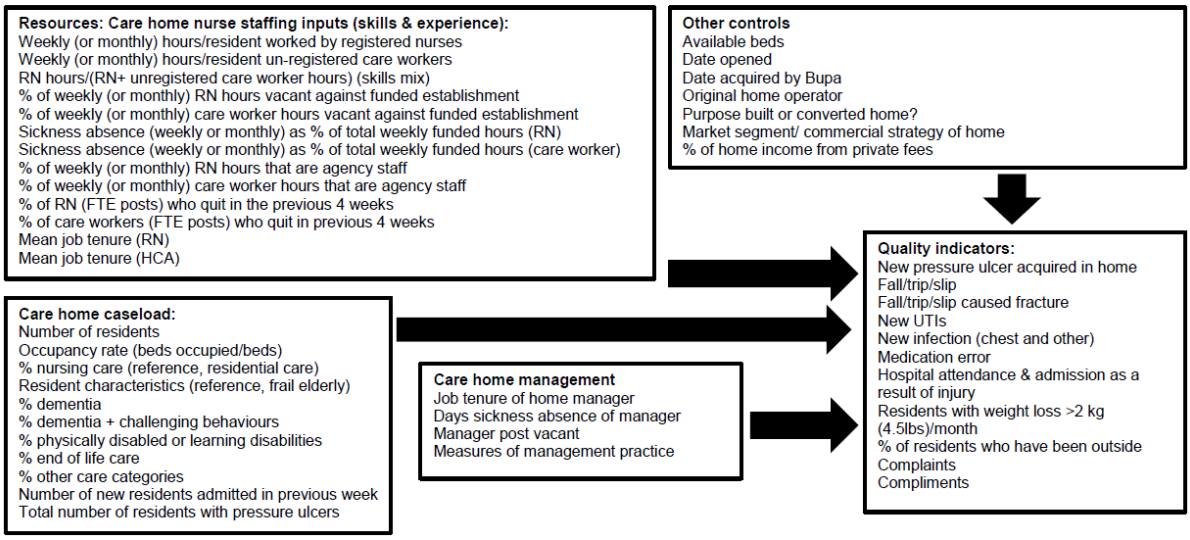
absence, unfilled vacancies and periods of under-occupancy, to examine the relationships between care inputs and resident care. This study is important because while there is limited evidence from the US (most studies are cross-sectional, may be biased from failure to control for confounding variables, like case load, and fail to account for processes such as maturation[41]), there are no UK studies on the relationship between nurse staffing levels and resident outcomes[13].

Drawing on data provided by Bupa, the model represented in Figure 2 will be estimated using weekly and/or monthly incidences of the outcome variables by care home over a four year period (284 care homes over 48 months provides a sample of 11,472 home/month observations or 49,712 home/week observations). A second set of analysis, incorporating the results of the management practices survey (described below), will cover a shorter time period (i.e. the time period after the management practices survey has been carried out). Bupa have already provided a sample of the data. Data extraction and organisation methods have been piloted and initial analysis to determine appropriate estimation techniques has been carried out. In the light of this preliminary analysis a number of different modelling approaches will be implemented, and results compared. The overall aim of this econometric modelling is to represent empirically the theoretical model set out in Figure 2. A range of different methods will be used, because each method has strengths and limitations. Comparing results from different methods will allow the research team to come to a judgement about which method best represents the theoretical model. The results will then be used to inform economic modelling.

Specifically, simple pooled cross-sectional regression models will be used to estimate the relationships between care quality outcomes and staffing inputs, controlling for home caseload and control variables. The form of regression analysis will depend on the functional form of the quality indicators; either logit (for dichotomous variables) or count data models (because quality indicators are not normally distributed). Results of such analysis are typically subject to upward bias resulting from omitted variables. Therefore conditional fixed effects models will be estimated to fully control for the effects of time invariant omitted variables. The limitation of fixed effects models are that they mask the variation in relationships that may exist between different types of home. Growth mixture modelling[42] is a method that incorporates such variation into the modelling design by first estimating empirically whether homes can be clustered according to their observed characteristics and then examining (a) whether relationships between staffing and quality outcomes vary across different clusters of home and (b) whether the clusters of homes change over time. Finally, the longitudinal structure of the data will be exploited to estimate within and between home (random intercept and random slope panel multilevel) models. This approach takes into account nested structure of the data and partitions statistical estimations into level one (observations for each care home) and level two (observations across time). Such a hierarchical analytical procedure is more robust than single-level modelling, in that it rules out biased estimates caused by interdependence of observations across time[43]. A baseline model will be considered first, such that relationships between staffing inputs and care quality outcomes are assumed time invariant. Thereafter, the variation of quality indicators across time will be modelled in (random intercept) followed by the variation in staffing inputs across time (random slopes), forming a comprehensive framework for assessing the effect of staffing inputs on care quality outcomes.

Our partner for this study is Bupa, one of the UK's largest providers of care homes. It owns and operates 284 care and nursing homes and has an English resident population of ~15,000 residents. Bupa' s care service portfolio is diverse: residential, nursing, re-ablement, rehabilitation, dementia care, specialist dementia care, learning disabilities, specialist mental health, young person disabled units and end of life care. Bupa's funding comes from the public sector and individual private fees. It employs ~4,500 nurses and ~14,000 care workers. Partnering with Bupa allows the research team access to high quality data on care inputs and outcomes based on Bupa's own administrative data, without the need for costly data collection through surveys. In addition to this administrative data, we will develop a diagnostic survey tool to assess the management practices used in each home, drawing on the successful[44] approach to measuring management practices developed by Bloom and colleagues[45], and integrate this into the data-set.

Figure 2: The relationship between nurse staffing, skills mix and care quality outcomes at the care home/week or month level[1]



The model represented above is, for the sake of simplicity, static. In practice, we will estimate dynamic models, which examine relationships between nursing staffing inputs and case load from previous weeks or months on care quality indicators.

[1] Quality related incidents judged to be more serious are recorded when they happen using an incident reporting database (e.g. pressure ulcers, UTIs, falls that result in hospitalisation), so can be analysed by week, other incidents (e.g. weightloss, complaints and compliments, % of residents who have been outside) are captured through monthly reports.

The study will use data that Bupa routinely collects as part of its own internal staffing and quality monitoring processes. Key outcomes of interest are indicators of poor quality care issues: incidence of falls, pressure ulcers acquired while in the home, bacterial infections, weight loss, use of anti-psychotic medicines, medication errors, falls with injury, clinical incidents and unplanned hospital admissions. We will also examine residents' and relatives' subjective evaluations of care quality and CQC ratings to capture variation in quality across homes. Informed by a systematic review of the literature[13] and the views and judgements of Bupa's senior nurse-managers, the determinants of these outcomes will be modelled (using regression analysis), as a product of the demands on and resources available to each home. The specific variables that we will use in the analysis are summarised in Figure 2 (above).

Modelling and simulation will be developed through an iterative process, drawing on group modelling techniques[46], in which Bupa will be fully involved. This involves: (1) an initial facilitated discussion of organisation, management practices and data with key Bupa staff (with nursing, quality assurance and operations remits), to formulate initial model specifications; (2) Further meetings to report results and gage Bupa staff reactions and responses to them, with further iterations of modelling possible in the light of discussions and reflection. This process will also give consideration to what Bupa can learn from the results, and what organisational and management changes might be suggested by them.

The econometric modelling described above will provide estimates of the association between input parameters such as staff levels and staff mix and health outcomes, such as pressure sores, falls, hospitalisations etc. Where a significant relationship is found, the marginal or impact effect (depending on whether it is a continuous or discrete explanatory variable) will be estimated. This will provide an indication, relative to the sample average care home, of how a change in staffing inputs up (down) may reduce (increase) the occurrence of a health outcome which attracts a corresponding cost (saving). Staffing inputs in the care home will be converted to costs using validated national unit costs[40]. The costs incurred in treating each health problem (outcome) will be estimated by conducting a literature search to identify the resource implications of the problem (e.g. medication errors, pressure ulcers, bacterial infections and unplanned hospital admissions) in the care home sector. If necessary this will be supplemented with information gathered from local experts. From these results costs (savings) will then be estimated by applying national reference costs[47]. The analysis will provide

an indication, of the potential (costs) savings, on average, for a small change in the input parameters such as staffing, compared the average. The analysis will distinguish between care homes of different types (with/ without onsite nursing, specialised, e.g. in dementia care) and if the data permits, a subgroup analysis assessing differences in the marginal effects across these care home types will be explored. The distribution of effects across the National Health Service will be considered, since care homes may incur the additional staffing costs, whereas the NHS will save on treatment costs if health outcomes of residents are improved. Sensitivity analysis will be conducted to account for uncertainty in the estimates of marginal effects and for the unit costs associated with the treatment of health outcomes.

WP3 will also employ data envelopment analysis (DEA) to compare the performance of different homes. Drawing on the theoretical foundation of rational choice theory we start from the premise that staffing configurations that increase quality at the lowest cost will be most likely to influence sector adoption decisions. Alongside this theoretical rationale, the purpose of using this method is to identify informative cases for qualitative study in WP4, where 'informative' are examples of homes that get very good, poor or typical quality related outcomes for a given level of staffing input. DEA is mathematical programming technique developed by Charnes et al.[48]. It represents a non-parametric analytical approach common in operations research, but it has been also extensively used to evaluate the efficiency of health care organisations. DEA allows the measurement of efficiency in accordance with theoretically based concepts of production efficiency in the presence of multiple inputs and multiple outputs[49]. In this case the outputs are the quality indicators represented in model 2, while the inputs, are the factors that affect these outcomes, including staffing. DEA estimates the efficiency frontier (maximum efficiency levels based on the observed data), and compares the efficiency of a care home against this benchmark. Thus, there are essentially two questions that can be answered employing this analytical approach: (i) what is the highest possible output(s) level given a set of inputs or (ii) what is the lowest amount of inputs needed to obtain a set level of output(s)? [50]. Results of WP3 will be contrasted with the results of WP2, to give insight into the extent to which the omission of measures of care home case load (which are not available in the WP2 dataset) bias results. Specifically, analysis equivalent to that conducted for WP2 can be conducted for all Bupa care homes studied in WP3 (i.e. CQC inspection ratings as the outcomes variables, with independent variables as per the WP2 NMDS-SC analysis). We will then conduct analysis where 1) we change the independent variables so that they are as per the analysis specified in WP3 and 2) change the outcome variables so that independent variables are as per WP3 and outcome variables are WP2 (i.e. CQC ratings). In this way we will be able to compare how closely WP2 results mirror the results based on more detailed measures of quality and workload workforce from WP3 in order to assess the value of the WP2 results. WP 2 and 3 will complement each other and provide foundations for discussion with the sector of what data can most usefully inform workforce plans and the effective use of available human resources. The model represented in figure two may also be refined and developed iteratively in response to the findings of the realist synthesis carried out as part of WP1.

WP4: Understanding the contributions of the care home workforce to enhance quality (study objective 4 and 5)

The study of contributions of the care home workforce to enhance quality is essentially a study of social actions and the complex processes surrounding these actions[51,52]. The study of context is essential to understanding the impact of structure and process upon care quality (outcome). We will conduct a multiple-case (embedded) design[53]. Case study design is appropriate to focus our in-depth exploration of explanatory processes and comparisons between different contexts[53 54].

Six case sites will be purposively sampled from WP3 to represent the variations in relationships between staffing and quality in Bupa homes (for example homes with lower and higher quality, or different quality but similar staffing levels), sites which have changed over time (longitudinal analysis demonstrates changes in quality associated with changes in staffing) and representing care homes with nursing (n=2), care homes without nursing (n=2) and dual registered homes (n=2). All three types of home will be sampled in order to capture variation in organisational context. In addition, these care homes will vary in terms of their characteristics, such as locality, size, CQC rating, profit or not for profit status, funding arrangements for residents (local authority or self-funding) and turnover rates (informed by findings from WP3). The rationale for using Bupa homes from WP3 is that we will seek to understand *why* variations may exist. We will then, through focus groups, test our

understanding with a range of care home providers and generate hypotheses about potential solutions to support the sector.

Ethnographic methods are appropriate within a case study design as our focus is on the context in which care takes place and the work carried out by individuals and teams in this context[55]. Each case study will therefore make use of qualitative methods (non-participant observation, interviews, staff diaries and focus group discussions) to develop an understanding of this contribution. By using this range of methods we will be able to gain insight into individual and group behaviours and interactions to understand how individuals within teams work to promote quality of care for residents in care homes. We will focus on describing (rather than measuring) a range of care processes in WP4 to understand how and why staffing is related to quality in care homes. The findings from the review (in WP1) will be used to further develop and guide this focus. Donabedian's framework [22] and emphasis on process will be used to structure data collection and to inform our analyses.

Data collection will have four components:

(i) **Documentary analysis** of minutes of residents and relatives' meetings: In order to understand relatives and residents' perceptions of quality of care in each care home, we will undertake a thematic analysis of the minutes of monthly meetings. Minutes from meetings over the twelve month period leading up to the observation period (n=12 per home) will be requested from the care home manager. These records are publicly available. This will help us to identify and understand broader perspectives of quality in the care home (and not measured in WP3) and inform interviews with residents and relatives. We anticipate some limited quantitative analysis of local data (for example, staffing counts or attendance at meetings) to corroborate claims of phenomena such as "engagement".

(ii) **Non-participant observation** of staffing in the care home (nurse and support worker in nursing homes and support staff in care homes without nursing) and the work of these staff in public areas of the care home. Observation will enable us to capture (through people and events) everyday behaviours, actions and interactions and understand and explain the occupational, organisational or cultural factors that impact on quality of care. In particular, we will observe caring work and interactions between staff and residents (representing the mix of resident dependency and need in the home), staff and relatives or visitors, between staff employed by the care home, and care home staff and NHS staff visiting the care home.[3] We will spend a total of 40 hours in each care home to conduct this observational work, sampling different time periods (including weekdays and weekends, between the hours of 07.00 and 23.00). Different time periods will be used to ensure that we capture interactions in different settings and contexts including group activities (for example crafts or musical activities). It is anticipated that observations will take place in communal areas of the care homes, such as residents' lounge and dining room (it would not be appropriate to observe in private areas, such as a resident's bedroom), to capture different interactions within the context. To prevent data collection becoming unmanageable, observation records will be semi-structured and guided by our understanding of care quality[34]. Data collection will be structured to describe setting (physical environment, context, rules), participants (who, number of roles), activities ('technical' or caring/social interactions, sequence of events), interactions (what takes place and how, rules), frequency or duration (how typical), and subtle factors (dress, symbolism). Verbal and non-verbal communication (or its absence) and the language used between staff and residents and relatives will be described[34]. Observation records will be of concrete descriptions rather than research interpretations of events[56] Researcher feelings and impressions will be recorded separately to observational descriptions as these can inform the analysis of observation data[56]. Researcher reflections on their potential impact on participants will also be recorded. Non-participant observation is a key component of ethnographic methods and has been selected because it provides data on caring interactions that can be compared with participant descriptions of experiences and perspectives[55]. It will also provide a focus for staff reflection on interactions and care. An important aspect of this observational work will be to pick up on how changes in staffing

[3] We are aware of SOFI (http://www.cqc.org.uk/category/keywords/sofi) and dementia care mapping tools (http://www.brad.ac.uk/health/dementia/dementia-care-mapping/) and will use similar approaches to our observation work to gather detail of the social world that surrounds individual residents and how this might impact on quality of care and life.

might impact on care and quality (for example when 'short of staff'). Periods of observation will be cross-referenced with information about staffing during that period (for example staff rotas, skill mix, use of bank or agency staff, absenteeism information provided by the care home manager). Observations will also enable an understanding of how care staff respond to health needs of care home residents and engage with NHS resources visiting and contacting the home (pharmacists, community nurses, GPs, occupational therapists and physiotherapists).

(iii) **Interviews** with a range of key individuals (including residents, relatives, care home staff, NHS staff) to explore perspectives on the concept of quality and opportunities and challenges for staff to influence quality. Participants will include care home staff (n=18; 3 from each case site) and other clinical NHS staff (visiting the home n=18; 3 from each case site). Interviews will also be conducted with residents and their relatives (n=36; 6 from each case site) to understand their perspectives on quality and how this relates to staffing. Interviews will be guided by existing understandings of quality of care. The interviews should last between 30 and 60 minutes and be held face to face. Interviews enable an in-depth exploration of staff, resident and relative experiences[57]. Researchers will approach staff members to represent managers, registered nurses, support workers and NHS staff. Potential resident participants will be purposively sampled from a list of those identified by care home managers. Care home managers will know residents (including whether they have mental capacity to take part in research) and will be able to introduce researchers to the residents to gain informed consent. Where possible we will engage relatives of these residents. We will also display posters in the home inviting participants to contact us.

(iv) **Staff diaries** will be used so that nursing and support staff from each case site (3 staff from 6 case sites; n=18) will be invited to write about their experiences of delivering care and quality retrospectively and selectively. Participant diaries provide an intimate description of participants' experiences[58]. They enable participants to tell their own story[59] and have previously been used in studies of health behaviours[60] and experiences[61]. Using participant diaries will enable greater depth of understanding of staff perspectives and experiences of care quality. They will also provide a means of verifying behaviour by comparing observed interactions with participants' perceptions of interactions. The diaries will be semi-structured and staff will be asked to record one diary entry for 7 days of work that reflects a moment that they perceived to have significantly impacted on them in a positive or challenging way. This Critical Incident Technique (CIT)[58] will enable us to gather data on participant's behaviour in specific circumstances. Participants will be asked to describe the incident in their own words and to include any information that they feel is relevant. Participants will be asked to complete a critical incident diary entry either on paper or electronically for each week over a four week period. Each participant will then be invited to participate in an interview to focus on these moments and reflect on what can be learned about the relationship between staffing and quality. This approach is supported by Bupa to promote staff involvement with the quality agenda in Bupa homes. However, we appreciate that staff will need support to complete this activity. We will explore opportunities for sustaining this approach should it prove beneficial for the organisation and lessons from this will be shared with the broader care home sector. The interviews will be held face to face and should last no longer than 30 minutes.

Our aim in this work package will be to capture perspectives over time which will facilitate understanding of how processes may have changed to promote quality (retrospective) and what may need to change in the future to respond to quality (prospective). The same researchers will conduct observations and interviews in each setting to enable them to build rapport and relationships within the care homes. This was suggested by care home staff in our PPI engagement activities. One hour of observation in each home will be conducted by both researchers to assess observer consistency and dependability[62] .

The final component of this work package will be to convene **focus group discussions** to share and explore (anonymised) case study findings with a broader range of participants (beyond the case sites) and to understand the case study findings within a broader context. Focus groups will generate further study data by using the group discussion (and group processes) to understand priorities and questions for participants[63]. Focus group discussions will be conducted in areas where the six care home vanguard sites are established[4] and engage participants from these care home collaborations

[4] https://www.england.nhs.uk/ourwork/futurenhs/new-care-models/care-homes-sites/

(up to 8 in each discussion; total n= 48 participants), which will include care home and NHS staff, as well as public representatives.

Analysis of qualitative data: Data from each method (documents, observations, interviews, and diaries) in each case study will initially be analysed separately using thematic analysis[64]. Using constant comparative technique[65] we will compare all data to understand similarities and differences, initially by understanding each case site (and the actors within the context) and then across the case sites. Our approach to analysis will enable us to move from description to interpretation and explanation. This will involve inductive (data driven) and deductive (theory driven) processes during analysis, as well as the 'abductive challenge' of taking these data and proceeding to the likeliest possible explanation. Initially we will understand each case site and then we will explore similarities and differences across the case sites. These processes will identify differences between care homes with different characteristics. Focus groups (discussing the case site findings) will be analysed for thematic content *and* process[66], and also subjected to constant comparative techniques. To promote quality, the following strategies will be used: description of the participants to provide context (credibility and transferability), transparency of the research process and use of theory (transferability), evidence of consistency using multiple examples from data (dependability), involvement of two members of the research team in data analysis, and engagement of the wider research team, informants and participants with interim findings (confirmability)[62]. Our aim is to create new and plausible connections and explanations for understanding the relationship between care home staffing and quality. This supports our mixed methods approach: findings from WP4 will be related to other work packages. In our report we will ensure transparency of reporting so that our interpretations and explanations can be scrutinised by consumers of the research findings.

WP5: a platform for translation and dissemination (study objective 6)
WP5 will synthesise the results from WPs 1-4. To do this we will undertake a convergent parallel mixed method design[67]. For each WP we will collect and analyse quantitative and qualitative data separately (adhering to standards of quality and excellence for each method, and as described for each work package). WP5 will bring together these independent analyses (prior to disseminating them) to provide a rich understanding of the relationship between care home staffing and quality of care for residents and outcomes for residents, relatives and staff (care home and NHS). The synthesis will be narrative (rather than statistical) and framed using relevant theory (for example, Donabedian) to hypothesise and test/challenge observed qualitative findings, and statistical trends and/or differences) and extant empirical research. Mindful of the variety of formal methods for primary research (c.f. Dixon Woods et al.[68]), we will adhere to relevant best practice[69 70]. Where WP studies reflect a study design with appropriate reporting guidance in place, for example the review and survey in WP1, we will base our reporting on that guidance (e.g http://www.equator-network.org/reporting-guidelines/). We will promote clarity and transparency in our reporting and dissemination of findings (linked to data sources) to enable judgement of the quality of our inferences and conclusions. Our model for understanding theoretical perspectives and work packages for developing this understanding of quality have been represented in a model of the study (uploaded document).

The work package will have 3 key aims and components:
1. Understanding the social network(s) associated with using knowledge of the relationship between care home staffing and quality
2. Mapping the social action requirements associated with adoption of a model of care home staffing and quality
3. Increasing awareness and dissemination of care home modelling

Work packages 1 to 4 each address a different uncertainty regarding the relationship(s) between care home staffing and quality. WP1 provides information on who the work force are. WPs 2&3 will describe the variation and relationships (between staffing and quality) within a significant part of the care home sector (BUPA and other national level providers submitting data to Skills for Care NMDS-SC[71]), whilst WP4 will unpack the generative factors that shape quality in rich detail in a care home context. WP5 represents a translational stage from the 'academic' context and into the practical arena of the wider care home sector: it focuses on creating a platform for evidence and theory based implementation beyond the project, and dissemination during it. WP5 is framed by, social action-

based, Normalisation Process Theory[72 73] and theories of diffusion and adoption[74 75]. The aim of WP5 then is to develop a platform for translation and the spread/dissemination of the parsimonious modelling approaches used in the wider care home sector thus extending the reach, scope and potential for the work and findings of WP1-4.

The modelling in WP2 and 3 represent a form of health technology: *'…organized knowledge and skills in the form of…procedures and systems developed to solve a health problem and improve quality of lives.'*[76] Adoption and spread of the technology will result from a complex mix of active and static factors:[75] the attributes of the innovation, the characteristics of intended adopters, potential agents of informal social influence, characteristics of the care home providers and environments, the nature of any dissemination and the planned implementation strategy.[74 75 77]

WP5 will increase the value of knowledge push, pull and exchange activities:

- Push: we will plan and implement approaches to push (disseminate) knowledge towards care homes based on their needs for the technology
- Pull: we will work with care home knowledge users to plan and implement strategies to "pull" knowledge from the models and modelling in ways that are useful for their decision making
- Exchange: we will bring the research team and care home knowledge users together through an interactive (but systematic) process as part of an integrated knowledge translation[78]

1. Understanding the social network(s) associated with using knowledge of the relationship between care home staffing and quality

All behaviour is embedded in social networks[74 75 79-81] and understanding (using techniques such as social network analysis/SNA) can increase the spread and adoption of innovations[79 82]. SNA to enhance the spread and implementation of health technologies is under researched generally in healthcare but is beginning to demonstrate its worth for understanding care home knowledge transfer and networks[80]. Based on extant research, the need for more research into the value of SNA for increasing technologies such as the modelling of WPs 2 & 3 has been highlighted[82].

We will undertake a social network analysis in three key areas of the care home market: large providers (over 20,000 beds, for example Four Seasons); a medium size provider (around 10,000 beds, for example Barchester Healthcare) and a small independent provider (accessed through NIHR ENRICH). Using a name recognition approach[81] from a staff list in each organisation (home manager level or above and corporate/HQ/back office services or regional contacts for small providers) we will ask participants for details of people who are important in shaping how they might use information on staffing and quality in their organisation. We will also include space to allow for names and roles of individuals beyond the name recognition list. Each care home *'actor's'* role and some biographic/demographic data (length of experience in the organisation, formal training in using information for decision making or management) will be captured. Our core conventional SNA questions (for example, *'how important is this person in shaping how you might use information on staffing and quality?'*) will be piloted in care homes associated with research team members and the advisory group for acceptability and understanding and adapted prior to commencement. We will ask about intentions to use modelling methods and results in their care home provider context and the extent and nature of their feelings towards such modelling and model results for them. The survey instrument will also contain an embedded ~20 question adapted NoMAD scale for assessing social action requirements for adoption and use of modelling and results (see later in WP). Thus, each respondent will be asked to complete a single questionnaire to capture biographic, network, and social action-focused information.

We will aim to capture network data from two large and medium size and a regional (Yorkshire and Humber) network of smaller independent care homes. Fifty percent response rates are sufficient for robust specification of social networks, and we will explore whether mutual or reciprocal ties in our data will allow use of multiple imputation methods for dealing with missing data.[83,80] We will maximise response rates by administering the SNA questionnaires using best practice in surveys with healthcare professionals[35] and postal and web based alternatives for respondents. We will also offer telephone and web based support from a research team member for instruction, queries or support to complete. Respondents will be able to complete the questionnaire at home or at work. The SNA will explore two primary questions:

- Are network characteristics of the care home providers associated with an increased probability that they will intend to make use the modelling methods and results in their care home organisation?
- Are social networks that feel more positive towards the idea of modelling staffing and quality and/or using the results of such modelling more likely to report intention to use such modelling or the results for decisions in their care homes?

From the network data we will first describe the networks. Firstly, by graphically visualising it (using UCINET and Netdraw software (https://sites.google.com/site/ucinetsoftware/home) and then by using network property metrics such as centrality, cohesion, distance between actors, density and cliques. Having described the network we will answer our primary questions by first dichotomising intention to use the modelling and model results and then constructing logistic regression models to explore how the independent variables of network characteristics (such as in-degree centrality, weak ties between subnetworks) and positivity towards modelling staffing and quality predict intention to use.
The resulting analysis will allow us to maximise the use of tried and tested methods of behaviour change such as opinion leaders[84] (the SNA will highlight potential opinion leaders and provide information for targeted marketing (such as the extent of any negativity towards modelling and model results). Whilst the value of SNA for long term care sector is beginning to be established in a North American context, and some initial ethnographic work in UK to assess feasibility from a resident's perspective, this will be the first time that such analysis has been carried out in this part of the care home sector.

2. Mapping the social action requirements associated with adoption of a model of care home staffing and quality.
Social network analysis will capture the networks in which spread and adoption are embedded and we will compliment this by mapping the requirements for the 'social action' needed to use the modelling and model results of WP2 and 3 in their care home contexts. These requirements are conceptualised using Normalization Process Theory (NPT).[72 73 77] NPT puts forward four constructs representing the work people do when implementing an innovation such as staffing quality modelling:

- Coherence: the sense-making work that staff in care homes would need to do individually and collectively when operationalizing modelling for quality and staffing
- Cognitive Participation: the relational work care homes would do to build and sustain a viable 'community of practice' to support modelling and use of results
- Collective Action: the operational work care home providers would undertake to enact a 'modelling and use of model results'
- Reflexive Monitoring: the appraisal work that care home providers would undertake to assess and understand the ways that modelling and model results might affect them and their networks (http://www.normalizationprocess.org/what-is-npt/npt-core-constructs/).

We will adapt the NoMAD survey tool[85] by developing a specific introduction about the modelling and model results, questions about the care home provider respondents' roles and general attitudes towards modelling staffing and quality and the results, and providing the opportunity for care home providers to highlight areas of uncertainty (unanswered questions) about the modelling. NoMad and NPT has been used in a variety of health research contexts and has the advantage of adaptability and brevity; with a 'core' of 20 questions and a history of use to explore innovation and health technology adoption. This will be done by the research team in conjunction with our PPI partners and network contacts.

We will analyse the results using descriptive statistics focusing on the counts and median responses associated with questions and sub sets (sections) of questions targeting the four 'core' constructs. The survey will provide a target for implementation efforts rather than a definitive representative picture of sector segmentation or relationships between provider characteristics and the constructs. The survey will be administered as part of the unitary questionnaire (encompassing SNA and biographic/demographic information) by post (if preferred) or electronically using the University of Leeds' existing survey technology (http://it.leeds.ac.uk/info/173/database_and_subscription_services/206/bristol_online_survey_accounts) and we will use SPSS ver 22.0[37] (www.spss.com) to organise and analyse the data.

The two elements of the work package will be triangulated[86 87] and will provide a platform for further operationalization, development and implementation of a sector-wide approach to modelling and use of model results for care home policy and decision making. Our approach is pragmatic but will be framed using the theories that guided each method (implementation and diffusion of innovation approaches, network theory, expected utility and normalisation process theory)[86]. Whilst pragmatic we will encourage transparency through reporting how theory and the results of the work package intersect and the analytic choices made by the team. PPI engagement revealed support for this WP.

3. Increasing awareness and dissemination
Dissemination of findings will be carried out alongside the research, guided at every stage by the patient and public involvement representatives, care home network of managers and the study advisory group. The dissemination strategy will be tailored to the most relevant audiences, who are expected to be residents and relatives, policy makers, commissioners, providers, professional bodes (such as the Royal College of Nursing, the Royal College of General Practitioners, and the Royal Pharmaceutical Society), and the care home industry. We will ensure that the findings of the research are accessible to care home residents and their relatives through dissemination strategies informed by Age UK, ENRICH, National Care Forum, DH Care Sector Nursing Taskforce, and the Residents and Relatives Association. Our links with the My Home Life Programme and the English Community Care Association will enable us to share our findings with a wide network of care home providers and staff.

A project blog will be maintained during the project, with twitter feed from researchers sharing their experiences and emerging findings. Two of the co-applicants have recently used this approach and had great success in rapidly engaging a wide range of care home staff and interested health professionals (http://nursingincarehomes.blogspot.co.uk). We will also host a webinar towards the end of the project, to reach the broadest possible audience. This is particularly useful for public sector staff, who may not have access to funding for conference attendance. In addition, short summaries of the study and its policy implications will be developed for hard copy and electronic dissemination.

Emerging findings will be discussed with and presented to colleagues associated with the applicants' organisations, as well as members of the CLAHRC (Older People's Theme) in Yorkshire and Humber. This will help to ensure that the research remains both robust and relevant. All the co-applicants have active national and international networks relevant to older adults and care homes. We will use these to disseminate our findings and promote the implementation into practice. Academic papers will be submitted for publication in peer reviewed general journals and those with a focus on elderly health care, such as Age and Ageing. National and international conference presentations will be sought, at events attended by professionals with a strong interest in older people such as the British Geriatric Society, Royal College of Nursing and the Gerontological Society of America. We will also target sector trade press (including Care Talk, Caring Times, Care Home Professional, Care management Matters, Caring UK) and professional nursing journals (such as Nursing Standard, Nursing Times, Nursing Older People).

Plan of investigation
This work will be completed within 36 months (1 July 2017 to 30 June 2020).

Project management
Spilsbury (PI) will have research management responsibility (finance and governance) and overall leadership for ensuring delivery of the research, liaising with collaborators, supervising research staff, and ensuring the final report and short reports are submitted to deadline and with timely outputs. The PI will report to the funder and the appointed study steering committee (SSC).

Each work package (WP) has a named lead and dedicated research team members to work with them to ensure progress and timely delivery. We will monitor progress through:

- Team monthly reporting: The PI will liaise with WP leads (either face-to-face or by teleconference for distant team members) to receive a summary of progress and achievements, plans for the coming month, and any challenges or risks to the progress of the study.

- Project management group (half yearly team meetings): Six face-to-face project management group (team) meetings will be convened in Leeds over the lifetime of the project. These will be attended by all team members to review progress and, overlap with the study steering committee (SSC).
- Study steering committee (SSC) meetings, care home network meetings and residents and relatives' advisory group: Four SSC meetings (in Leeds) and six care home network meetings plus six separate residents' and relatives advisory meetings (in Yorkshire) will be convened during the lifetime of the project.

Approval by ethics committees
We will seek ethical approval in two stages: (i) WP1 (surveys), 2 and 3 (workforce data); and (ii) WP 4 (case studies) and 5 (translation surveys). This will promote a timely start for the proposed work *and* ensure that findings from early stages inform the latter stages of work (sequential design

Patient and Public Involvement
Involvement of the public and stakeholders in the early stages of developing this study proposal confirmed that the research topic is a priority for care home organisations and their staff, residents and their relatives. The proposal has been discussed at a range of meetings (attended by KS and BH) with representatives from Bupa, Four Seasons Healthcare, Residents and Relatives Association, My Home Life, National Care Forum, Skills for Care, Care Quality Commission, Health Education England and Registered Nursing Home Association. The PI has also shared the project with the Department of Health's Care Sector Nursing Taskforce (of which she is a member). The representatives of these bodies have supported the proposed work and have agreed to a role on the project advisory group.

We are working with the NIHR Clinical Research Network (CRN) Yorkshire and Humber who are actively engage with care home staff, residents and relatives developing a network of 'research ready' care homes (ENRICH) and have a primary care network. We will work with the CRN (and their national care home and the primary care networks) to support and facilitate the research proposed in our work packages. ENRICH have agreed to actively seek ways to support our recruitment to the survey (WP1), as well as liaising with other ENRICH networks in England to support this work package. In addition, they will support dissemination and translation of the work in WP5.

At outline stage we conducted an engagement event with care home managers and staff about the work. This event sought their views on ways to engage staff with our study and data collection methods, and their input on: writing an 'easy guide' to our research (short simplified protocol) to ensure this is accessible for staff; piloting the questions in our surveys to ensure these are worth asking, easy to respond to, and acceptable; suggestions on how to promote engagement with the study and outputs. We have created a care home manager network forum to meet during the life of the project due to enthusiasm from this group. The newly formed Residents and Relatives' Forum (NIHR CRN) will provide an important group to inform our ongoing study. We have also consulted with the Service User and Carer Forum (University of Leeds) which includes relatives who have a loved one residing in a care home.

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