QualityWatch

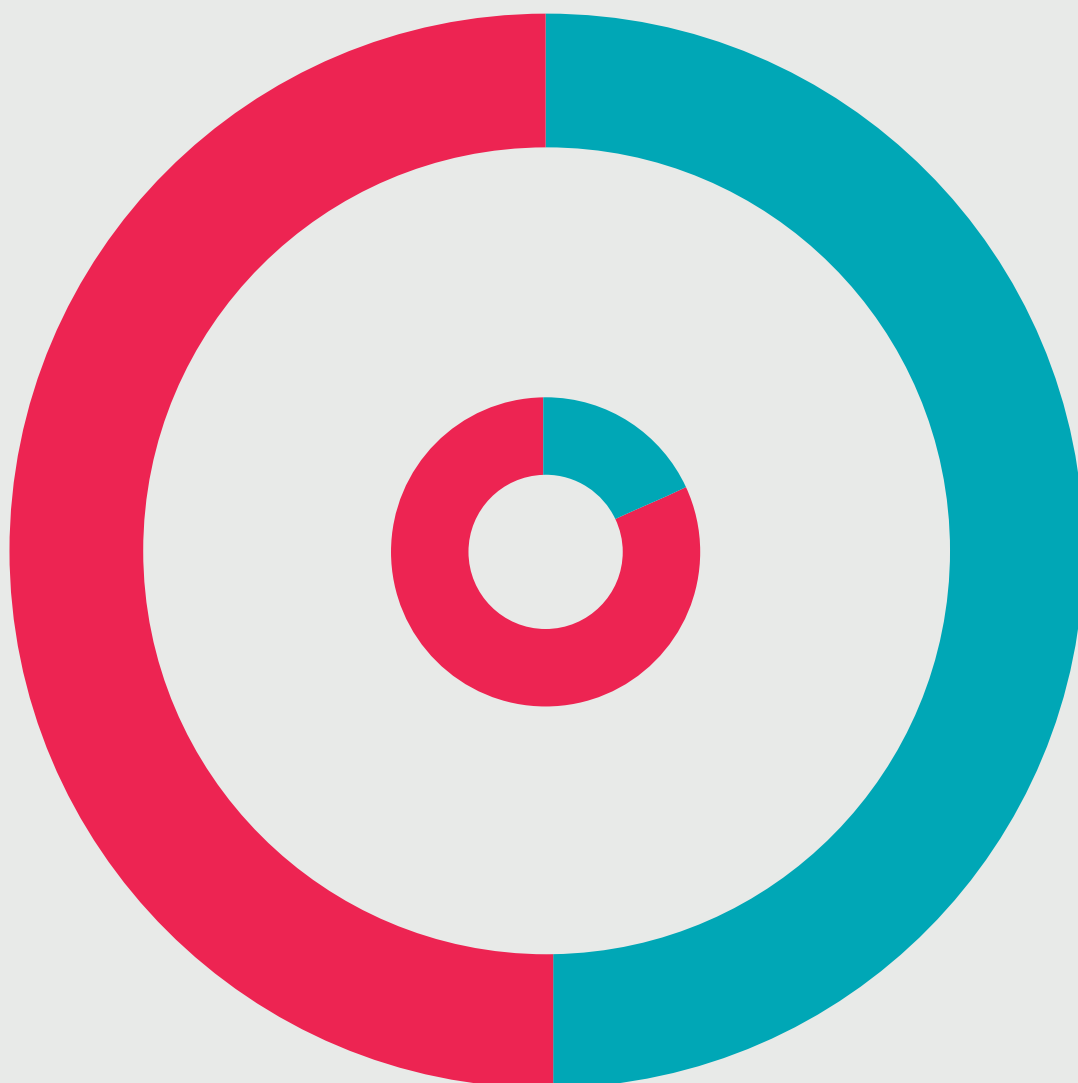# Focus on:
Hospital admissions from care homes – appendices

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About QualityWatch

QualityWatch is a major research programme providing independent scrutiny into how the quality of health and social care is changing. Developed in partnership by the Nuffield Trust and the Health Foundation, the programme provides in-depth analysis of key topics and tracks an extensive range of quality indicators. It aims to provide an independent picture of the quality of care, and is designed to help those working in health and social care to identify priority areas for improvement. The programme is primarily focused on the NHS and social care in England, but will draw on evidence from other UK and international health systems.

The QualityWatch website **www.qualitywatch.org.uk** presents key indicators by area of quality and sector of care, together with analysis of the data. This free online resource also provides research reports, interactive charts and expert commentary.

About this report

QualityWatch Focus On reports are regular, in-depth analyses of key topics; these studies exploit new and innovative methodologies to provide a fresh view of quality in specific aspects of health and social care. This QualityWatch Focus On report explores how care home residents use hospital services, and how this can prompt improvement in the way care is provided.

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Appendix 1:
Estimating likelihoods of HES activity coming from a care home, and indirect standardisation

The methodology used to assign a probability that a given patient was admitted from a care home is provided here. For most of the analyses in the report to which Appendices 1 to 5 relate (Smith and others, 2015), we restricted ourselves to looking at all older people activity (patients aged 75 and over) recorded as coming from a postcode containing a care home. For the indirect standardisations, however, we attempted to calculate the exact activity coming from care homes using local area data. Then, using care home resident populations data obtained from the 2011 Office for National Statistics (ONS) census as the denominator, we calculated standardised activity rates.

Calculation of the probability of being a care home admission

Total population within the Lower Super Output Area (LSOA) = N

The LSOA contains j postcodes with populations $m_1...m_j$

The number of residents in the LSOA aged 75 and over = $N(75)$

The census provides the number of care home residents in each LSOA = R_k

The number of non-care home residents in the LSOA = $N - R_k$

Proportion of non-care home residents aged 75 and over in the LSOA

$$P(75) = (N(75) - R_k) / (N - R_k)$$

For each postcode within the LSOA we assume a care home population of r_j based on the number of beds at the homes within the postcode.

If we assume that the age distribution of the population outside the care homes within the LSOA is uniform, the expected number of non-care home residents aged 75 and over within postcode j could be approximated as $(m_j - r_j) P(75)$.

Thus, for a unit of hospital activity from postcode j, the probability that they come from a care home can be estimated by:

P(care home resident) = $r_j / ((m_j - r_j) P(75) + r_j)$

These probabilities were then applied, at small area level, to activity derived from Hospital Episode Statistics (HES) to estimate the amount of activity from care homes.

Note that we have made the assumption that the majority of residents at older people's care homes are aged 75 and over (a recent census carried out by Bupa reported that 82.5 per cent of its UK care home residents were aged 75 and over (Centre for Policy on Ageing, 2012). We have also assumed maximum occupancy for each care home.

Adjustments to the ONS denominator

The ONS census appears to under-count care home residents, possibly due to newly admitted residents being enumerated at their previous private residential address. This in turn could lead to artificially higher rates when performing indirect standardisation, simply due to using denominators that underestimate the real size of the population. In order to improve the accuracy of the estimated size of the care home population, a scaling factor was applied to each of the age and sex population categories reported in the census. In the 2011 census 274,040 people were reported as living in care homes, compared with an estimated 325,000 (Wittenberg, 2013), hence a scaling factor of 1.19 (325,000/274,040) was applied to each of the care home population segments. The final populations used in the analysis can be seen in Table A1.1.

Table A1.1: Care home populations by age and sex reported in the 2011 census, along with the adjusted populations used in the indirect standardisations

Gender	Age	Population	Adjusted population
Male	75-84	26,741	31,714
Male	85+	31,691	37,584
Female	75-84	56,322	66,796
Female	85+	130,438	154,694

Calculation of indirectly standardised activity rates

Indirectly standardised rates were calculated for elective admissions, emergency admissions, outpatient appointments and Accident & Emergency (A&E) attendances for people who were likely to be living in a care home, using the following steps:

1. Calculate national activity rates by broad age group and sex for all patients aged 75 and over using the national populations as the denominator (the reference rates).

2. Apply the age- and sex-specific reference rates to the adjusted care home populations and sum to obtain the expected levels of activity.

3. Sum the individual probabilities of each piece of activity coming from a care home (see above on calculating the probability of being a care home admission) to obtain the observed levels of activity.

4. Divide the observed activity by the expected activity to obtain the indirectly standardised rate.

The indirect standardisations were also repeated using the actual activity counts from HES (i.e. without adjusting for the probability of coming from a care home) as the observed values and unadjusted populations from the ONS census as the denominators. The rates produced were similar to those calculated using the methodology outlined above, showing the analysis is not particularly sensitive to whether the probability weightings are applied.

Appendix 2:
Comparisons between activity rates at the LSOA level grouped according to care home resident population

Owing to the large differences we observed in the age- and sex-standardised activity rates for patients admitted from care home postcodes, coupled with the noted issues with definitively identifying patients in care homes, an additional analysis was undertaken to investigate differences in activity rates between patients admitted from a postcode containing a care home and the older community dwelling population.

Age- and sex-standardised rates were calculated at the small-area (LSOA) level for elective and non-elective admissions, outpatient appointments and A&E attendances. The LSOAs were then grouped into five categories according to the ratio of people recorded as living in care homes to the number of people aged 75 and over in the LSOA based on data from the 2011 ONS census. Observed and expected values were then calculated across these five groups. These analyses essentially compared the differences in standardised activity rates between areas containing high proportions of care home residents and those areas with lower proportions.

Age and single-year age groups (up to the age of 90) are available by LSOA and so a more refined standardisation was possible than that based on the broader census age bands. In addition, as we were comparing area-level rates, these analyses did not rely on uniquely identifying individuals from care homes and avoided any possible confounding factors associated with potential misidentification. Figure 3.4 in the main report (Smith and others, 2015, page 13) and Table A2.1 below show the relevant standardised activity rates by LSOA group. Again, we observed more non-elective activity (emergency admissions and A&E attendances) and lower elective activity (elective admissions and outpatient appointments) than would be expected in LSOAs with larger numbers of care home residents, relative to their general older population.

Table A2.1: Inpatient, outpatient and A&E standardised activity rates, grouped according to the number of care home residents per person aged 75 and over in LSOA

Ratio of care home residents to older people in LSOA	Number of LSOAs	Age- and sex-standardised activity rates			
		Emergency admissions	Elective admissions	Outpatient appointments	A&E attendances
0 – 0.2	27,956	96.5	102.1	102.0	96.0
0.2 – 0.4	3,395	111.3	93.5	92.4	110.0
0.4 – 0.6	1,085	125.0	86.5	89.9	126.8
0.6 – 0.8	281	132.2	81.2	85.3	134.2
> 0.8	127	145.7	76.7	83.7	151.0

Appendix 3:
Analysis of a subset of activity where we were confident of identifying care home admissions

As a final validation, we also examined the differences in crude activity rates between areas where we were confident of definitively identifying hospital activity belonging to care homes, and the remaining non-care home dwelling older population.

By linking to the ONS 2011 census postcode data, we identified hospital activity from postcodes which contained a care home, and also had fewer than three households with people living in them at the postcode (and coupled with large postcode populations are strongly indicative of the presence of a communal establishment), and compared the activity rates with those of the remaining older population in the surrounding area. This analysis was performed at the LSOA level and crude activity rates were constructed for the care home resident population using hospital activity from postcodes containing a care home, and also fewer than three households with people living in them, as the numerator and number of care home beds as the denominator.

The corresponding non-care home activity rates were calculated using the remaining 75 and over hospital activity in the LSOA as the numerator and the total number of 75 and overs in the LSOA minus the number of care home beds within the LSOA as the denominator. Note here that we assumed that all care home residents were 75 and over and that homes had maximum occupancy. We also restricted this analysis to LSOAs containing care homes providing exclusively older people's or dementia services.

In total, we identified 551 homes located at postcodes containing a care home that also had fewer than three households with people living in them. The results can be seen in Table A3.1.

Table A3.1: Crude rates by activity type split by patients from a care home versus the remaining population aged 75 and over

Activity type	Crude rate: care homes (activity per bed)	Crude rate: non-care homes (activity per adjusted older population at LSOA)
Elective admissions	0.10	0.35
Emergency admissions	0.57	0.32
Outpatient appointments	1.30	2.92
A&E attendances	0.61	0.41

Appendix 4:
Examining the differences in reasons for attending hospital between people living at a care home postcode and the general population aged 75 and over

To examine whether there were any differences in the reason patients were admitted to hospital between people living in a postcode containing a care home and the general older population, we looked at the primary diagnosis of the patient's admission episode, which indicates the condition principally responsible for the patient being admitted. Logistic regression was performed at the patient level, adjusting for the patient's age and gender, using the primary diagnosis as the independent variable, and a flag indicating whether the patient was admitted from a care home postcode as the dependent variable. Regression models were split by admission method for inpatients. This allowed us to identify those primary diagnoses associated with a high or low likelihood of the admission being from a care home postcode. We excluded diagnosis codes, which appeared only infrequently in the data.

A full breakdown of the diagnoses associated with a higher likelihood of a patient being from a care home postcode can be seen in Table A4.1 (page 38). The adjusted admission proportion is essentially the proportion of a particular primary diagnosis accounted for by patients from a care home postcode, but adjusted to take account of the differences in age and sex between care home and non-care home postcode populations. This tells us how strong a predictor a particular primary diagnosis is of a patient selected at random coming from a postcode containing a care home. The ratio of proportions is a measure of the difference between the likelihood of a patient being admitted with a given primary diagnosis: a ratio of two would mean that an emergency admission from a care home is twice as likely to have a particular primary diagnosis than a similar admission from the remaining population. The ratio was not, however, adjusted for age and sex. The primary diagnoses for which emergency admissions from care home postcodes were under-represented are shown in Table A4.2 (page 39).

Table A4.1: Primary diagnoses associated with a higher likelihood of a patient being from a care home (emergency admissions)

Primary diagnosis	Adjusted admission rate	Admissions from care home postcode	% of all admissions from care home postcode	% of all admissions from non-care home postcode	Ratio
Pneumonitis due to solids and liquids	0.41	3,091	1.6%	0.3%	5.1
Alzheimer's disease	0.33	1,088	0.6%	0.2%	3.4
Epilepsy	0.32	1,449	0.7%	0.3%	2.9
Convulsions, not elsewhere classified	0.32	1,832	0.9%	0.3%	3.0
Vascular dementia	0.31	1,089	0.6%	0.2%	3.2
Volume depletion	0.28	2,139	1.1%	0.3%	3.1
Unspecified dementia	0.26	1,372	0.7%	0.2%	3.0
Complications of genitourinary prosthetic devices, implants and grafts	0.23	1,512	0.8%	0.4%	1.9
Other sepsis	0.23	2,686	1.4%	0.6%	2.1
Open wound of head	0.19	4,577	2.3%	1.2%	2.0
Pneumonia, organism unspecified	0.18	16,708	8.5%	5.1%	1.7
Superficial injury of head	0.18	3,147	1.6%	0.8%	1.9
Unspecified acute lower respiratory infection	0.18	6,605	3.4%	2.0%	1.7
Fracture of femur	0.17	11,173	5.7%	3.2%	1.8
Other disorders of urinary system	0.17	15,320	7.8%	4.9%	1.6
Total			**37.7%**	**20.1%**	

Table A4.2: Primary diagnoses associated with a lower likelihood of a patient being from a care home (emergency admissions)

Primary diagnosis	Adjusted admission rate	Admissions from care home postcode	% of all admissions from care home postcode	% of all admissions from non-care home postcode	Ratio
Atrial fibrillation and flutter	0.06	1,636	0.8%	2.0%	0.4
Angina pectoris	0.06	1,482	0.8%	1.7%	0.4
Abdominal and pelvic pain	0.07	1,715	0.9%	1.7%	0.5
Pain in throat and chest	0.08	4,022	2.1%	3.8%	0.5
Acute myocardial infarction	0.08	1,682	0.9%	1.4%	0.6
Heart failure	0.08	3,617	1.8%	2.8%	0.7
Haemorrhage from respiratory passages	0.09	1,036	0.5%	0.8%	0.7
Unknown and unspecified causes of morbidity	0.09	1,202	0.6%	0.8%	0.8
Total			**8.4%**	**15.0%**	

A model was also fitted for outpatient attendances using treatment function as the independent variable; the results are shown in Table A4.3.

Table A4.3: Treatment functions associated with a higher likelihood of a patient being from a care home (outpatient attendances)

Treatment function	Adjusted appointment rate	Outpatient appointments	% of all appointments from care home postcode	% of all appointments from non-care home postcode	Ratio
Speech and language therapy	0.15	3,737	0.7%	0.1%	5.9
Old age psychiatry	0.13	54,803	11.0%	2.3%	4.7
Dietetics	0.11	4,943	1.0%	0.2%	4.0
Adult mental illness	0.09	5,401	1.1%	0.3%	3.3
A&E	0.08	3,085	0.6%	0.2%	3.2
Intermediate care	0.05	10,249	2.0%	0.7%	2.8
Neurology	0.05	5,732	1.1%	1.0%	1.2
Diabetic medicine	0.05	6,158	1.2%	1.1%	1.2
Total			**18.8%**	**6.0%**	

Appendix 5: Variation in admission rates between postcode areas, split by the types of services offered

Care homes that provide services to older people often provide a range of additional services. Figure A5.1 provides a breakdown of these additional services offered by care homes providing services for older people, based on 2011 data.

Figure A5.1: Breakdown of additional services provided by care homes that also provide services for older people
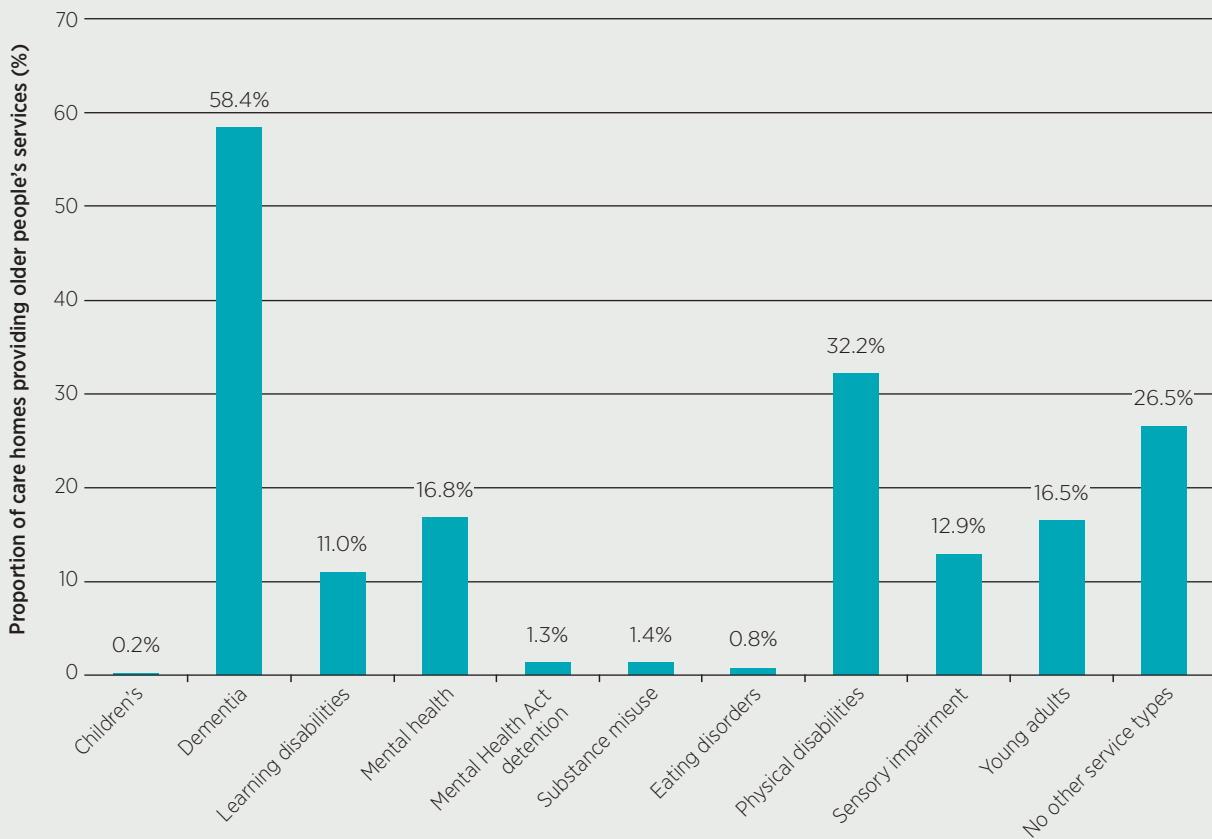
In our initial analysis of variation in emergency admission rates between postcode areas containing care homes, we initially included all homes providing services for older people. As in the main section of the report, rates were defined as the number of emergency admissions from a given postcode area divided by the number of beds in that area. Following conversion to z-scores (see page 24 of the main report: Smith and others, 2015), it was observed that a larger proportion of postcode areas than would be expected were found towards the lower end of the z-score distribution (see Figure A5.2).

Figure A5.2: Distribution of emergency admission rates between postcode areas containing an older people's care home
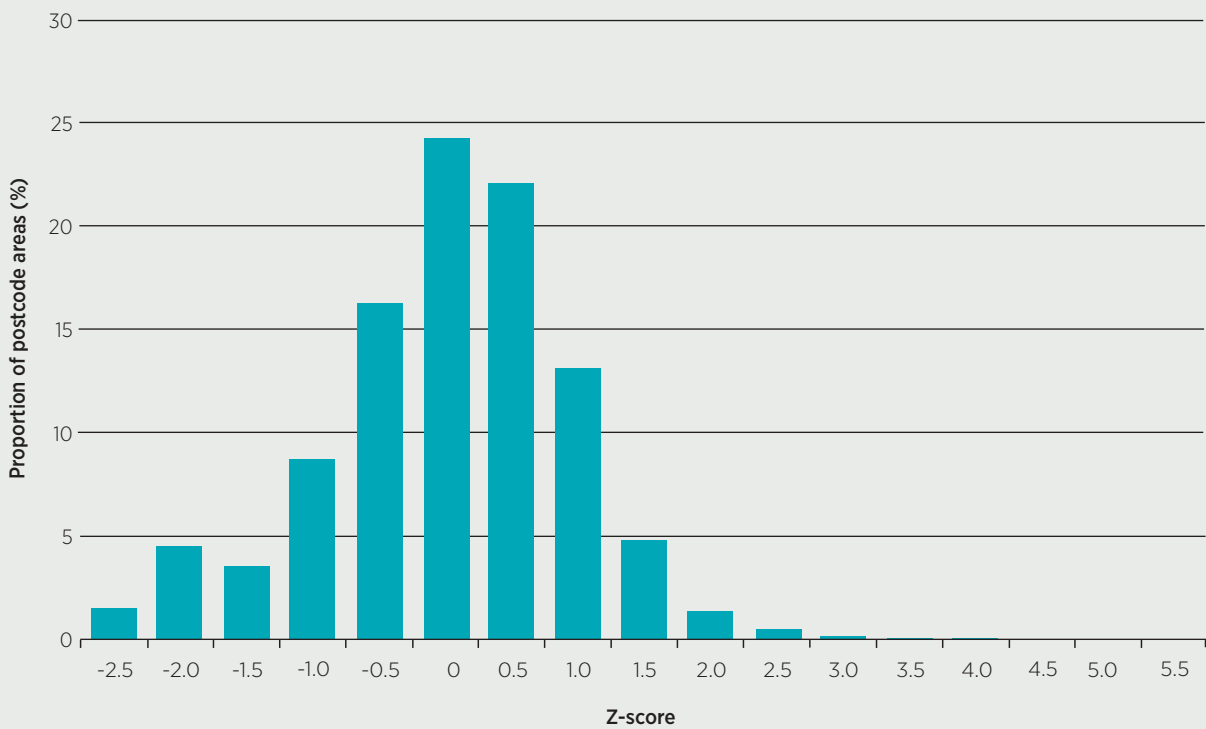
Further analysis of the postcode areas comprising this part of the distribution revealed that the majority of the homes found here were older people's homes offering other services. Figure A5.3 shows the median z-score by the classification of home based on the services provided. The analysis was also repeated to include all homes and not just those providing services to older people. Care homes providing additional services, with the exception of dementia services, appear to follow a different distribution than those offering solely services for older people and should potentially be treated as a separate group (or groups).

Figure A5.3: Median z-scores for admission rates by care home type found within postcode area, for all homes and separately for those providing older people's services

References

Centre for Policy on Ageing (2012) *A Profile of Residents in Bupa Care Homes: Results from the 2012 Bupa census*.

Smith P, Sherlaw-Johnson C, Ariti C and Bardsley M (2015) *Focus On: Hospital admissions from care homes*. The Health Foundation and Nuffield Trust.

Wittenberg R (2013) *Long Term Care for Older People: Economic issues*. Presented at the Myers JDC Brookdale Institute, Jerusalem, 25 December.

About the authors

Paul Smith is a Senior Research Analyst at the Nuffield Trust. He joined the Trust in 2013 and works on a variety of research projects, primarily harnessing large administrative datasets. He has over eight years' experience in complex quantitative and qualitative analysis and consultancy to NHS organisations.

With particular expertise in healthcare datasets and financial systems within the NHS, Paul has worked with several healthcare providers and commissioners, regulators, government bodies and academic institutions. Prior to joining the Trust, Paul worked for McKinsey and Company as a Healthcare Analyst. He has also worked for Humana Europe, the Care Quality Commission and Newchurch Limited.

Chris Sherlaw-Johnson is a Senior Research Analyst at the Nuffield Trust. He joined the Trust in January 2014 from the Care Quality Commission (CQC). At the CQC he ran a surveillance programme, which involved the continuous monitoring of quality of care indicators across health and social care in order to identify potentially concerning patterns of outcomes. This was a continuation of a programme he helped to set up at the Healthcare Commission, which prompted the decision to investigate Mid Staffordshire NHS Foundation Trust; he also led the statistical analysis that supported the Mid Staffordshire investigation.

Chris began his career at the Department of Trade and Industry, where he developed forecasting models of the civil aviation market in order to advise on funding decisions for British aerospace projects. He later joined the Clinical Operational Research Unit at University College London (UCL) where he helped to develop tools that hospitals could use for monitoring outcomes, including the now widely used Variable Life Adjusted Display (VLAD) approach.

Cono Ariti is a Senior Research Analyst at the Nuffield Trust. His research interests include the evaluation of complex community interventions using large administrative datasets in areas such as telehealth and predictive risk modelling. Cono joined the Trust in 2013 from the London School of Hygiene and Tropical Medicine (LSHTM), where he was a Lecturer in Medical Statistics. At LSHTM he worked on the planning, design and analysis of randomised clinical trials and observational studies in the areas of cardiovascular disease, malaria and tuberculosis. He was responsible for developing predictive risk models for cardiovascular disease and retains an Honorary Lectureship at LSHTM. Prior to joining LSHTM, Cono was Vice President of Statistics at Capital One Bank Europe, where he led the development and application of risk modelling tools.

Martin Bardsley is Director of Research at the Nuffield Trust. He leads a specialist team undertaking a range of quantitative research projects, most of which aim to exploit existing information systems in the NHS. He has over 20 years' experience in health services research and analysis. Before joining the Trust he worked in healthcare regulation. He was Assistant Director at the Commission for Health Improvement before moving to the Healthcare Commission, where he led its work on new ways to use information to target regulatory activity. This included groundbreaking work on the use of multiple indicators and time series analyses for surveillance.

Martin is a Fellow of the Faculty of Public Health and in the 1990s he established a London-wide resource on public health information. This work led to a number of reports on health in London, including the first Public Health Report for Greater London in 1998. Prior to that, Martin had worked on the application of outcome measurement, which formed the basis of his PhD. He was also involved in early stages of the application of Diagnostic Resource Groups in the UK – work that eventually led to Payment by Results. Martin is a member of the board of CLOSER, a project funded by the Medical Research Council on longitudinal surveys; and a member of the Peter Sowerby Commission.

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