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Social Care Workforce Periodical

Estimating Probabilities and Numbers of Direct Care Workers Paid under the National Minimum Wage in the UK:
A Bayesian Approach

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About *Social Care Workforce Periodical*

The *Social Care Workforce Periodical* (SCWP) is a regular web-based publication, published by the Social Care Workforce Research Unit, King's College London. *SCWP* aims to provide timely and up-to-date information on the social care workforce in England. In each issue, one aspect of the workforce is investigated through the analysis of emerging quantitative workforce data to provide evidence-based information that relates specifically to this workforce in England. The *Social Care Workforce Periodical* provide in-depth analyses of the latest available workforce data including the National Minimum Data Set in Social Care (NMDS-SC); for further details on NMDS-SC please visit http://www.nmds-sc-online.org.uk/. We welcome suggestions for topics to be included in future issues.

About the author

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Acknowledgments and disclaimer

Executive Summary

Direct care workers are the backbone of the social care workforce, constituting 72 per cent of the workforce, which is equivalent to an estimated 1.2 million workers in England alone. Long-term care has never received more policy and political attention in the UK than now. With growing demand for social care, a sustainable, affordable and fair supply of care is hard to agree politically. Attention has focussed on the growing needs for social care and ways of funding long term care needs but there has been less discussion about the workforce, pay levels and the impact of fiscal austerities on terms and conditions. While reforming the funding system of long term care is a policy goal, widespread cuts are taking place in local authorities although social care is meant to be protected from such moves. The majority of long-term care services is provided through the private sector, with growing numbers of people employing their own workers (through direct payments or personal budgets). While such changes are occurring, it is still the case that social care costs and budgets are closely tied to public and local government spending.

Evidence of low pay in the sector, particularly among direct care workers, is abundant, with the Low Pay Commission highlighting the care sector as one of most vulnerable sectors in terms of its workers being paid on or under National Minimum Wage (NMW) thresholds. Precise estimates of the probability of workers in the care sector being paid under the NMW, are unclear, however, because most are based on the Annual Survey of Hours and Earnings (ASHE) and the Labour Force Survey (LFS) which under-represent low wage jobs and the size of this sector in general. We focus in this report on the direct care workforce, which constitute the majority of the social care workforce in the United Kingdom (UK). The NMW came into effect in the UK during the last nine months of the 20th century (April, 1999), with the care sector arguably one of the main beneficiaries of the introduction of NMW. Nonetheless, it was, and remains, one of the lowest paying sectors in the UK.

Many researchers have observed a 'big bang' spike in pay rates in the care sector since the introduction of the NMW. They reported annual pay increases matching yearly increments in the NMW with no clear 'spillover' effects and the majority of pay rates being around and not surprisingly influenced by NMW levels. Indeed, recent pay analysis in the sector showed that the distribution of hourly pay rates is very narrow for direct care workers, particularly in the major sector provider, the private sector. Such pay structures not only pose different challenges in improving pay and status within the sector but also pose risks in maintaining at least the minimum rates, especially in the current economic climate.

A review of literature and data sources covering knowledge on the probability of direct care workers being paid under the NMW indicates that current estimates of 6 to 10 per cent are an under-representation. Moreover, estimates of numbers of direct care workers affected may be considerably under the true figures. These

issues are greatly influenced by the lack of sensitivity of databases used in capturing and estimating the total care workforce in the UK. In this report we present elaborate analysis aiming to provide more accurate estimates of the probabilities and numbers of direct care workers being paid under the NMW in the UK using different sector-specific data and accounting for previously available knowledge and estimates. We use two main datasets, the National Minimum Data Set for Social Care (NMDS-SC) to establish an overall distribution of pay among a considerably large sample of employees in England and computed adjusted rates using data from the Longitudinal Care Study's (LoCS) care workers' survey (Hussein et al 2010a).

Moreover, we do not aim to present new estimates of NMW in isolation from previous knowledge produced by the LPC and the ONS, using a Bayesian modelling approach. In considering a Bayesian model, it is necessary to appreciate that any samples will have bias, and are not necessarily independent (for example, we include more than one estimate produced by LPC using the same source of data). For these reasons the current analysis employs a 'hierarchical Bayesian' approach, which treats previous estimates as arising from a random process governed by the hyperparameters (α, β) to account for such dependencies. We programmed the algorithms of the hierarchical Bayesian model using R on Unix.

The report starts by discussing some of the challenges faced in calculating hourly pay rates of direct care workers, then discusses the advantages and challenges of such calculations using available national datasets. We produce an adjustment methodology and discuss the relevance of employing a Bayesian approach to account for existing prior knowledge. The report then provides details of the process of estimating the probabilities of direct care workers being paid under the NMW and estimates of the number of direct care workers in the UK.

An adjusted hourly pay rate ψ_n is derived using the following formula: $\psi_n = \frac{\psi}{1+\frac{\Delta t}{t}}$ where Δt refer to additional time not accounted for in the calculations of hourly pay rates. Conservative adjustment factors of unpaid time (22.7 min/week on average) and unpaid travel time (4.8 min/week on average) were derived from data obtained from care workers responding to a large survey (LoCS study; n=1,205). Using the adjustment formula and factors we produced an adjusted distribution of direct care workers hourly pay using a subset of the NMDS-SC, June 2011, direct care workers' records. On average, our conservative estimate of unpaid time resulted in an average reduction of hourly pay rates by a fraction of 0.01 (1%). This is a very conservative adjustment and it is likely that pay rates are affected by a higher percentage of unpaid time, however, we intentionally selected a small fraction of reported unpaid time to examine the effect of such slight adjustment on the overall distribution of direct care workers' pay levels.

A Bayesian hierarchical model considering prior knowledge reported by the LPC and ONS and using the 'new' adjust pay distribution as described, produced 'posterior' distributions of the probability of direct care workers being paid

under the NMW. The results indicate that 95 per cent credible intervals of the posterior inferences of $\alpha/(\alpha + \beta)$ range from 9.2 per cent to 12.9 per cent. These are very strong findings; which means taking all prior knowledge together with the very conservatively adjusted distributions of hourly pay rates. Such probabilities are higher than, but intersect with, other previous estimates. It is likely that when using a separate set of adjustments that are less conservative than the ones we used in this report that the posterior inferences will indicate considerably higher probabilities of being paid under the NMW. This is because of the very narrow distribution of hourly pay rates of direct care workers which is of great concern to many stakeholders. With the likelihood of more severe austerity measures and 'innovative' ways of making pay savings, more direct care workers will likely move under the threshold of the NMW.

To translate these probabilities to number of direct care jobs affected by very low pay (under the NMW); we estimated the overall care workforce in the UK. We used estimates for England produced by Skills for Care to calculate adjustment weights to estimates produced using the LFS for other countries in the UK. We used these estimates and the structure of the care workforce in England to produce estimates of number of direct care workers in the UK. Our analysis indicates that in the UK there are 1,695,598 direct care jobs, out of these from 156,673 to 219,241 are likely to be paid under the NMW.

The current research main recommendation is the urgent need for detailed conversations about pay and working conditions in the care sector. Such dialogue needs to take place in the light of the growing need for long-term care, the increasing emphasis on direct payments and personalisation and thus the shift of employment responsibilities to the individuals. Such conversations need to take into account immigration policies and of course the current financial climate. Immigration policies are very relevant here, given that a large percentage of direct care workers is undertaken by recent migrants, for example, 40 per cent of the care workforce in London are migrants; with three-quarters of migrants being from outside the European Union. The scale of very low-pay among direct care workers is much larger than previously anticipated and calls for attention.

Background

Direct care workers are the backbone of the social care workforce, constituting 72 per cent of the workforce, which is equivalent to an estimated 1.2 million workers in England alone (Skills for Care 2010). The care sector is estimated to employ about two million people at least in the UK. This means the social care workforce comprises a considerable proportion of the total labour force in England (an estimated 29 million people are in employment in the UK, Office for National Statistics 2011). However, the pay and status of care work are usually thought to be low. For example, the Low Pay Commission identified pay rates in this sector to be among the lowest in the UK across recent years (Low Pay Commission 2009, 2010, 2011). Pay rates are considerably lower within the private sector, which provides 75 per cent of social care services in England. However, the price of care services is greatly influenced by local government budgets.

The majority of day-to-day long-term care services is provided by direct care workers in a context of policy ambitions for staff to be qualified or to have some training, especially those working with certain groups, such as older people with dementia.   Additionally, with the policy of personalisation offering greater choices of care, new roles may involve supporting users to participate in wider society through employment and through greater engagement with local communities. The greater use of Direct Payments through personalisation looks set to change the usual structures of employer, employee and client relationships, with many users becoming both the employer and service recipient.

Long term care has never received more policy and political attention in the UK than now. With growing demand for social care, a sustainable, affordable and fair supply of care is hard to agree politically. During the last election social care was mentioned in many political debates. Attention has focussed on the growing needs for social care and ways of funding long term care needs (Dilnot 2010) but there has been less discussion about the workforce, pay levels and the impact of fiscal austerities on terms and conditions. It is anticipated that the Coalition Government will shortly publish its White Paper on long term care finance following the Dilnot Commission that reported in July 2011.The Commission concluded:

> *"the current funding system is in urgent need of reform: it is hard to understand, often unfair and unsustainable. People are left exposed to potentially catastrophic care costs with no way to protect themselves".*

While reforming the funding system of long term care is a policy goal, widespread cuts are taking place in local authorities although social care is meant to be protected from such moves. Such overall cuts are based on the views that:

"[economic] growth has to come from the private sector in our economy. We can't go on growing the government, we need jobs to come from private business. We have to make it easier for people to start businesses, to grow businesses and to expand and employ people." (David Cameron, October 2011, Conservative party conference[1])

While the vast majority of long term care services is provided by the private sector it remains very attached to the public purse, in the form of local authority means tested payments, paying long term care costs in the most economical way it can manage. With staff wages forming a considerable part of care costs, 80 to 85 per cent, the first possible option for those wishing to reduce costs may be to cut expenditure on wages. Unlike many other parts of the economy, social care has been considered almost as a 'recession proof' sector with its relatively high vacancy rates, with new evidence indicating a trend of declining vacancy rates from 2008 to 2010, albeit with a constant high turnover rates of direct care workers (Hussein and Manthorpe 2011).

While direct care workers provide essential services, pay in the care sector has been historically and continues to be very low in the UK. The Low Pay Commission reported continuous concern about low pay in the sector with some workers being paid under the National Minimum Wage (NMW) year on year. Previous pay analysis using data from the NMDS-SC indicated that the care sector operates with two tier pay levels. A relatively higher range of pay is earned by professional staff (such as social workers and nurses) and workers in managerial and supervisory roles. In contrast, at the other extreme, pay rates are considerably lower among direct care workers (such as home care workers and care assistants) and ancillary staff (such as cooks and cleaners). Overall, the hourly pay rate of direct care workers is on or near the National Minimum Wage (NMW) and very close to the pay rates of ancillary, non-care providing staff, such as cleaners in the sector, even though each group is expected to acquire appropriate skills (Hussein 2010a and 2010b).

The NMW came into effect in the UK during the last nine months of the 20th century April, 1999), alongside its introduction, the Low Pay Commission (LPC) was established in 1997 to recommend NMW rates (Manning 1997). The NMW was perceived as a legislative tool to maintain a 'minimum' wage. The initial rate was a modest £3.60 per hour and the policy intention was to start at a low threshold to minimise associated risks to labour market equilibrium, the rate thereafter increasing at a higher rate than both earnings and prices, especially since 2002, to reach £6.08 in October 2011 (for adults aged 21 years or older). Metcalf (2008) provides a thorough analysis of the impact on the NMW and concludes that it has raised the real and relative pay of low-wage workers and covers at least one in 10 workers. However, some studies found that the introduction of the NMW was associated with reduction in working hours (Steward and Swaffield, 2002). Furthermore, Metcalf (2008) concludes that the

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[1] http://www.guardian.co.uk/politics/blog/2011/oct/05/conservative-conference-2011-live-coverage

overall the introduction of the NMW was not associated with employment effects such as closure or growth. However, employment effects were observed in relation to care homes (one of the lowest paying sectors); with tentative evidence of lower employment growth (Metcalf 2008), but overall no 'systematic adverse effects' (Mason et al, 2006).

The care sector has been argued to be one of the main beneficiaries of the introduction of NMW (Dickens and Manning, 2004). Nonetheless, it was, and remains, one of the lowest paying sectors in the UK (Metcalf 2004, LPC 2011). It was estimated that nearly 40 per cent of workers in the sector were paid under the then newly introduced NMW, however, this percentage has considerably declined over the years with estimates of those not being paid the NMW ranging from 6 to 10 per cent (IFF Research 2008, LPC 2009, 2010 and 2011, Cangiano et al 2009). However, pay levels remain governed by the threshold of NMW, which tackles the most extreme low pay, but does not provide a 'route out of poverty' for many workers (Howarth and Kenway 2004).

Many researchers observed a 'big bang' spike in pay rates in the care sector following the introduction of the NMW. They reported yearly pay increases matching yearly increments in the NMW with no clear 'spillover' effects and the majority of pay rates being around and not surprisingly influenced by the NMW levels (Gilman et al 2002, Grimshaw and Rubery, 2010). Indeed, recent pay analysis in the sector showed that the distribution of hourly pay rates is very narrow for direct care workers, particularly in the major sector provider, the private sector (Hussein 2010a, 2010b). Such pay structures not only pose different challenges in improving pay and status within the sector but also pose risks in maintaining at least the minimum rates, especially in the current economic climate. Some evidence shows that public funding is struggling to keep pace with cost increases in the private sector including those associated with increases in the NMW (Cangiano et al 2009, Laing and Buisson 2010, LPC 2011).

Many argue that the very nature of care and the type of people the care sector attracts contribute to the low level of pay. Workers usually do not expect to be paid very well and while they expect high job satisfaction, they possess few qualifications, expect to work flexibly, locally and often part-time, and may lack bargaining power as largely non- unionised. At the same time, another set of determinants of wages are in place including the highly gendered nature of the care sector and debates around ways of rewarding 'emotional' work (England 2005). Following this argument, the causes of low pay in the care sector, for the most part, may lie within society, rather than outside. These 'internal' causes of low pay are many and varied and include the direct and indirect relations between public funding and wages in the sector (Howarth and Kenway 2004, UKHCA 2011). Current funding systems and the close tie to local authorities and government funding, even if the workforce is not directly 'hired' by a local authority (LA), mean that local funding levels indirectly impact on pay levels. Financial pressures on adult social care are predicted to increase in coming years - with local government expecting more than £1 billion budget cuts (ADASS 2011). Due to increased pressure to reduce costs, an emerging pattern of de-

tendering has been reported (UKHCA 2011) where care contracts are awarded on the basis of the lowest price bid submitted in real time.

One specific measure to identify levels of low pay in a sector, and to establish legal and statutory pay duties, is to establish the probability of workers being paid under the NMW. Although there are a number of estimates of this probability in the care sector, they mostly rely on datasets that are not sector specific and in many situations under-estimate the true situation. The most extreme estimate comes from the Office of National Statistics (ONS), with an estimated 0.8 per cent of the care workforce being paid under the NMW[2]. This is much lower than estimates produced by the Low Pay Commission (LPC) and other research based on the Annual Survey of Hours and Earnings (ASHE) and small surveys (LPC 2009, 2010, IFF Research 2008). In addition to sample representation issues, coverage of pay elements varies considerably between different data sources.

A review of literature and data sources covering knowledge on the probability of direct care workers being paid under the NMW indicates that current estimates of 6 to 10 per cent are an under-representation. Moreover, estimates of numbers of direct care workers affected may be considerably under the true figures. These issues are greatly affected by the lack of sensitivity of databases used in capturing and estimating the total care workforce in the UK. In this report we present elaborate analysis aiming to provide more accurate estimates of the probabilities and numbers of direct care workers being paid under the NMW in the UK using different sector-specific data and accounting for previously available knowledge and estimates. We use two main datasets, the National Minimum Data Set for Social Care (NMDS-SC) to establish an overall distribution of pay among a considerably large sample of employees in England and computed adjusted rates using data from the Longitudinal Care Study's (LoCS) care workers' survey (Hussein et al 2010). In this report we propose a methodology of adjusting pay distributions derived from the NMDS-SC, June 2011, using a conservative estimate of unpaid additional 'time' of work derived from LoCS data.

Moreover, we do not aim to present new estimates of NMW in isolation of previous knowledge produced by the LPC and the ONS, although this could be fulfilled directly by calculating the newly adjusted hourly rates of direct care workers. However, it is reasonable to assume that all samples used to produce previous estimates (those by ONS and LPC), along with our sample, are (partially) drawn from the overall population of direct care workers (with different degrees of bias). It is therefore our aim to try to include previous results along with new estimates to produce an overall estimate of the probabilities of being paid under the NMW for the overall UK population of direct care workers. A Bayesian data analysis approach should fulfil this target. In considering a Bayesian model, it is necessary to appreciate that all samples have bias, and are not necessarily independent (for example, we include more

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[2] http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-199905&format=print

than one estimate produced by the LPC using the same source of data). As such, it is not appropriate to try to pool the previous results in order to produce posterior inferences. Such an approach would not be very accurate and would, at a minimum, affect the standard error of the posterior estimations. For these reasons the current analysis employs a 'hierarchical Bayesian' approach, which treats previous estimates as arising from a random process governed by the hyperparameters (α, β) to account for such dependencies. We programmed the algorithms of the hierarchical Bayesian model using R on Unix.

The report starts by discussing some of the challenges faced in calculating hourly pay rates of direct care workers, then discusses the advantages and challenges of such calculations using available national datasets. We produce an adjustment methodology and discuss the relevance of employing a Bayesian approach to account for existing prior knowledge. The report next provides details of the process of estimating the probabilities of direct care workers being paid under the NMW and estimates of the number of direct care workers in the UK. We conclude by discussing the findings and implications in the final section.

Challenges in Calculating Hourly Pay Rates for Direct Care Workers

Long-term care in the UK is provided in different settings, with an increased emphasis on shifting services from residential care to people's own homes (through domiciliary care and other support). Domiciliary care accounts for 48 per cent of services while 35 per cent are residential services, the remaining services are provided in day and community care settings. The vast majority of services are provided by the independent sector (private and voluntary organisations); however, costs of services are influenced by local government budgets and spending as discussed above. There is an increasing trend of people employing their own workers, through use of direct payments or personal budgets, with an increase in the percentages doing so of 35 per cent from 2009 to 2010 (Skills for Care 2010).

When calculating the hourly pay rate of direct care workers in all of these service formations two main challenges are apparent. The first relates to estimating the exact amount of 'time' worked, this is complex arising from how services are provided and we will discuss this in further detail later. The second relates to available data and whether they are representative, reliable, relevant, and if they include different pieces of information in relation to pay elements in the sector. The advantages and limitations of major available datasets are discussed below.

What constitute working time?

The nature of providing care poses a number of complexities when attempting to calculate hourly pay rates. This is due to multiple factors. One of the main problems relates to the difficulties in establishing 'duration' of work, this can be particularly complex for domiciliary care workers but can also be the case in care homes. The fragmented nature of work, several shifts a day with possible breaks in between, poses a number of challenges in calculating the true 'duration' of work. For example, a worker may work a shift in the morning to assist during breakfast time in a care home, then remains 'on call' or is taking a 'break' while waiting for the next shift at lunch time. Another situation might arise for a domiciliary worker who makes a home visit at midday then takes a 'break' for an hour before another scheduled visit, some workers may be called to do another visit during the day. While these mean that such staff cannot undertake other work, most payments only relate to 'contact time' with users (UKHCA 2011) with increasingly tighter methods of calculating such 'contact time'. Evidence suggests that in considerable number of cases the calculated 'contact time' systematically under-estimates the exact time workers spend doing their job (UKHCA 2011, Rubery et al 2011). These patterns can also occur in care home employment, with more workers needed at certain times of the day, for example, breakfast, tea and bed-time. Rubery and colleagues found that the majority of their sample

(88%, n=50) of workers received no pay for the breaks between their shifts in the independent sector (Rubery et al 2011).

Another important issue, especially for domiciliary workers who constitute an estimated 48 per cent of all direct care workers (Skills for Care 2010), relates to all or some of the time and cost of travelling between clients, general waiting and costs associated with travel, and whether they are included in any 'contact time' payment. Recent research indicates no common practice of paying travel time for domiciliary workers and lack of compensation for time spent travelling between users. Not surprisingly, this is a concern for many workers (Rubery et al 2011). One practical 'solution' among different employers is the expectation that workers will complete their tasks in less than the time they are booked for to compensate for time spent travelling (Rubery et al 2011). Rubery et al (2011) found no common practice of paying travel time although some providers were paying an 'enhanced' hourly rate to account for travel, only 20 per cent of their sample were paying any kind of supplement for travel time. However, there is growing use of new technology, such as texting, to report the exact number of minutes workers spend with clients, with payments only being provided for contact time, accompanied by a trend towards shorter visits (Laing and Buisson 2011, UKHCA 2011). Travel 'costs' are another problematic area with no clear evidence in relation to reimbursing mileage or other costs associated with the use of public transport.

There is also the issue of over time, both in residential care and domiciliary care. The only available information comes from Rubery and colleagues' study which suggests that only a minority of independent providers ever pay overtime to staff, and when this happens it is only paid to staff contracted to work a certain number of hours, thus excluding all workers on 'zero hours contracts'[3], who constitute a large proportion of direct care workers (estimated to be around 32 per cent of direct care workers[4]).

For care homes, and some home care services, calculating pay rates for sleepover and on call time is also challenging. Government guidance in relation to each of these is different, 'on call' time should be included as 'working time', but judging which portions of sleeping time that should be paid is more complicated. The latter depends largely on the type of contract a worker holds and is the most difficult to calculate. Some workers are contracted on 'daily average hours agreement'[5], others work on a flat rate payment to account for care provided during 'sleep time'. The law in relation to payment during 'sleepover', on call and/or not working (e.g. between shifts) is complex and depends on types of contracts and circumstances. However, there are many areas where under

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[3] 'Zero hours contracts' are contracts of employment, which do not specify any number of hours that the employee will be required to work. The contract says that instead of working a specific number of hours per week, that worker must be ready to work whenever they are asked.
[4] Based on NMDS-SC data for England, June 2011
[5] Which is an agreement of the average daily number of hours worked and may include hours during the night, this type of contract is least sensitive to changing patterns of work during the night due to changes in users' circumstances, for example.

payment can occur and there is a need for specific detailed information to establish exact hourly pay rates.

Available data relating to pay in the care sector

There is currently no single dataset that includes complete information on all elements of pay in the care sector. There are, however, several datasets that can be used to estimate pay levels. Below is a brief discussion of each of these with limitations and advantages in estimating pay levels in the care sector.

Labour Force Survey (LFS)

The LFS is a national survey of private households in the UK and is the largest of the government's regular household surveys. The Office for National Statistics (ONS) conducts the survey and it collects data from approximately 60,000 households per quarter. The LFS provides information about occupations using the Standard Occupational Classification (SOC). The care workforce can be defined using occupations in the SOC, which uses information on the tasks or duties carried out, job titles, what people state they mainly do in their jobs, and whether any special qualifications or training are required of people to carry out their job. However, the LFS is not an ideal source to estimate the social care workforce, because neither the classification of occupations (SOC 2000) nor the classification of industries (Standard Industrial Classification: SIC 2003) lends itself to defining social care roles particularly well (Simon et al 2007; Skills for Care 2008). Even when considering a limited number of occupational categories 'care assistants and home carers' (code 6115 in the SOC 2000), and 'nurses' (code 3211 in the SOC 2000) to reflect the workforce, there are significant limitations.

The main issues relate to the fact that these categories do not enable one to separate out those working exclusively in the care sector. Another problem is that the category 'care assistants and home carers' covers both care workers and senior care workers, and does not distinguish between the two. More specifically, this SOC code covers a multitude of job roles (including some in children's social care) and does not exclusively determine the industry in which the person works (SfC&D 2009). A further problem is that the LFS underestimates the volume of the social care labour market, as shown by the comparison with the more reliable figures based on the NMDS-SC. For example, LFS estimates (average over four quarters) for 2007 provide a figure of 640,000 social care workers in the UK, while estimates based on the NMDS-SC suggest that the much greater number of 1.56 million workers are employed in the sector (Skills for Care 2010). There may be various reasons for this gap, such as the relatively small percentage of the LFS sample that is relevant to the sector, the exclusion from the LFS sample of people living in communal establishments (including care homes and care homes with nursing), a lower coverage of live-in care workers and people occupying casual jobs, and the inaccuracy of the scaling

factor as LFS estimates are derived from a relatively small sample of households and have to be scaled up by a factor of several hundred to tally with estimates of the relevant total population figures (Simon and Owen 2005, 2007). Additionally, all information is provided by people living in the households surveyed and information related to pay and earnings can be prone to recall and reporting errors (for example, see Tourangeau and Ting 2007).

Annual Survey of Hours and Earning (ASHE)

ASHE is based on a one per cent sample of employee jobs taken from HM Revenue & Customs (HMRC) PAYE records. Information on earnings and paid hours worked is obtained from employers and treated confidentially. ASHE does not cover the self-employed nor does it cover employees not paid during the reference period. It provides UK coverage but uses a relatively small sample, one per cent sample of PAYE records, which is then scaled up to match overall sector estimates. There are questions about how accurately the ASHE represents the whole care sector and the level of available sector-specify data to draw reliable conclusions. Skills for Care (2011) identifies number of difficulties associated with using PAYE data in deriving sector-specific estimates. One of the issues is that councils' central social services operations are not well distinguished in the statistics from other council operations, which includes regulation of the activities of providing health care, education, cultural services and other social services, excluding social security. Separating adults' and children's social care services still relies on assumptions in some areas. Integrated health and social care operations are recorded under healthcare. Some sheltered housing and supported living operations providing care are recorded under 'Renting and operating of Housing Association real estate'. Additionally, some employment agencies supplying social care staff are recorded under 'Temporary employment agency activities'. The fact that ASHE sample is drawn from PAYE records directly excludes part of the workforce, those people working on a self-employed basis by individuals employing care and support staff, for themselves or in a carer capacity, for example. While pay information may be more accurately reported from PAYE records than from individual workers (as the case with the LFS), issues arise around size and representativeness of the sample in a sector with great complexities in measuring and reporting pay elements.

There is some evidence that pay estimates derived from the ASHE are likely to under-report lower wages in the sector and to be more reflective of higher earners and those working in the public sector (which has significantly higher pay rates than the private sector, Hussein 2010). For example, in 2009 the Migration Advisory Committee (MAC) revised its wage requirement criteria for Senior Care Workers' visas to £7.80 per hour thus shifting down from the previous estimate based on 2007 ASHE data which estimated the average hourly rate for this group of staff to be £8.80. This level of £8.80 had been judged by various stakeholders to be much higher than reality (UNISON 2009).

National Minimum Data Set for Social Care (NMDS-SC)

The NMDS-SC is the first attempt to gather standardized workforce information for the social care sector. The NMDS-SC was developed by a technical working group comprising various stakeholders. Stakeholders included the Department of Health (the funders), Department for Education, Care Quality Commission, Children's Workforce Development Council, Local Government Association and employers. The NMDS-SC is managed by Skills for Care on behalf of the Department of Health. It aims to gather a 'minimum' set of information about services and staff across all service user groups and providers within the social care sector in England. The NMDS-SC was launched in October 2005, with the online version launched in July 2007; since then there has been a remarkable increase in the number of employers completing the national dataset. The NMDS-SC collects information from employers about the organisation and service(s) provided as well as total numbers of staff working in different job roles. Employers also provide information about individual staff members offering a detailed picture of the workforce.

The NMDS-SC is the best sector-specific data available, however, it covers England only. There is no sampling frame for the NMDS-SC, rather it aims to cover the whole sector and encourages all social care providers to complete the survey. The NMDS-SC is completed by providers on voluntary basis, with incentives attached to completion. The NMDS-SC, June 2011, provides information on over 500,000 individual workers, constituting the largest available sample for the sector. Pay information is provided by employers as part of the NMDS-SC; although pay data in particular are subject to high levels of missing information (Hussein 2010a, 2010b). However, pay data collection instruments in the NMDS-SC might not be sensitive to a number of elements identified above. For example, one figure is provided for hourly pay rates without other information indicating whether this is an enhanced rate or includes elements of travel time. Additionally, as with other information in the NMDS-SC, pay information is provided by employers with no supplementary records of PAYE, National Insurance contributions and without indication of whether hourly pay rates are already enhanced or not.

Cangiano et al (2009) compared hourly pay rates of care workers using ASHE (2003 and 2007); the LFS and NMDS-SC and found that both LFS and ASHE produce higher median hourly pay rates than the NMDS-SC. For April 2008, the difference between the highest estimate provided by the ASHE and the lowest based on the NMDS-SC (average of all care workers in adult services) was over £1.60 an hour (27 per cent). They account for some of these differences as being related to:

> *'the much smaller sizes of the ASHE and LFS samples of care workers (a few hundred, compared with several thousand for the NMDS-SC); .. an under-representation of workers at the bottom of the pay distribution by the ASHE and LFS; and a possible bias of [NMDS-SC] data based on employers' pay records in a sector where informal working arrangements are not*

> *uncommon – e.g. 'under-the- counter' and unreported payment of salaries below the National Minimum Wage.'* (Cangiano et al 2009- pp.22-23)

From the review of data above we propose a methodology of using the NMDS-SC pay distributions adjusted to account for some pay elements, particularly estimates of unpaid work and travel time. We use data from a large national survey of care workers, the Longitudinal Care Study (LoCS), to produce these estimates. The next section discusses this methodology in more depth.

Adjusted NMDS-SC pay data for unpaid work and travel time

The NMDS-SC provides pay distributions for a large sample of direct care workers in England; however, pay data do not include details of any unpaid work and travel time. The literature suggests that a considerable percentage of employers do not account for travel time (Rubery et al 2011) and work time calculations appear to systematically under-estimate actual working time (Laing and Buisson 2011). We propose a methodology to adjust hourly pay rates as derived from the NMDS-SC using recent data provided from a relatively large sample of care workers. The latter is extracted from responses to a national survey as part of the Longitudinal Care Study (LoCS), conducted by the Social Care Workforce Research Unit.

The Longitudinal Care Study (LoCS)

The Longitudinal Care Workforce Study (LoCS) is a longitudinal multi method study of the adult social care workforce in England. The study has two waves of data collection; the first took place during 2010-2011. Social care staff were recruited primarily from purposefully selected four case studies, from the public, voluntary and private sectors. An additional national sample was recruited to complement the sample drawn from the four sites. As part of the study, staff members were asked to complete a survey (with options to complete online or on paper). The survey collected information on work history, working conditions and future plans. It included a series of pay-related questions, collecting information on pay levels, additional working hours during the past two weeks, additional shifts, travel time, and various payment rates.

The sample we used is based on 1,205 responses, of whom just under half (44.6 per cent; n=537) said that they travel between clients or users as part of their job. Among these, 46.9 per cent said that their travel time is completely unpaid[6]. Average travel time between clients was 22.8 minutes and we used a fraction of 4.8 minutes to estimate 'unpaid' travel time. Participants were asked to indicate the number of additional shifts and hours, if any, they worked during the past two weeks[7]. They were then asked if these hours were paid the same, above, less than their usual rate or were unpaid. In our calculations we only included those

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[6] We considered the group who indicated that their travel time is paid in a rate that is less than their usual rate to be paid the usual rate and did not do any adjustment for lower pay rates

[7] With different questions related to day, night and weekend unpaid extra hours

who explicitly indicated that 'all' additional hours were unpaid. Participants indicated that on average each work an additional 131 minutes unpaid per week. To account for the possibility of workers over-estimating their unpaid time we used a fraction of this time and calculated a factor of a mean of an additional 22.7 minutes of unpaid 'work' time per worker per week.

In addition to the above fraction of extra time we assumed only 'one' unpaid trip of an average of 4.8 minutes per week was unpaid. We then adjusted a subset[8] of the NMDS-SC, June 2011, direct care workers' records using these estimates derived from LoCS by different workers and employers' characteristics. An adjusted hourly pay rate ψ_n can be derived using the following formula: $\psi_n = \frac{\psi}{1+\frac{\Delta t}{t}}$ where Δt refer to additional time not accounted for in the calculations of hourly pay rates[9]. On average, our conservative estimate of unpaid time resulted on an average reduction of hourly pay rates by a fraction of 0.01 (1%). This is a very conservative adjustment and it is likely that pay rates are affected by a higher percentage of unpaid time, however, we intentionally selected a small fraction of reported unpaid time to examine the effect of such slight adjustment on the overall distribution of direct care workers' pay levels.

Figure 1 presents the cumulative density function of hourly pay rate of direct care workers as derived directly from the NMDS-SC, June 2011 (plain) and that after adjusting using factors derived from the LoCS study (adjusted). The graph shows the effect of this conservative adjustment on the hourly pay rate distribution with a slight shift to the left (towards lower pay rates). Due to the narrow distribution of the original pay distribution among direct care workers, the observed slight shift in hourly pay rates is likely to affect a large number of workers and move their hourly pay rates across the NMW thresholds.

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[8] We only adjusted workers paid on hourly rates, assuming that extra time worked by those on annual contracts are more likely to be reimbursed. This is a conservative assumption based on findings from the small sample of Rubery and colleagues (2011).
[9] Unadjusted hourly pay rates for direct care workers are calculated directly from NMDS-SC (June 2010 release) using similar methodology of data extraction and cleaning as discussed in detail in Issues 6 and 7 of the SCWP (Hussein 2010a and 2010b).

Figure 1 Density function of plain and adjusted hourly pay rates of direct care workers
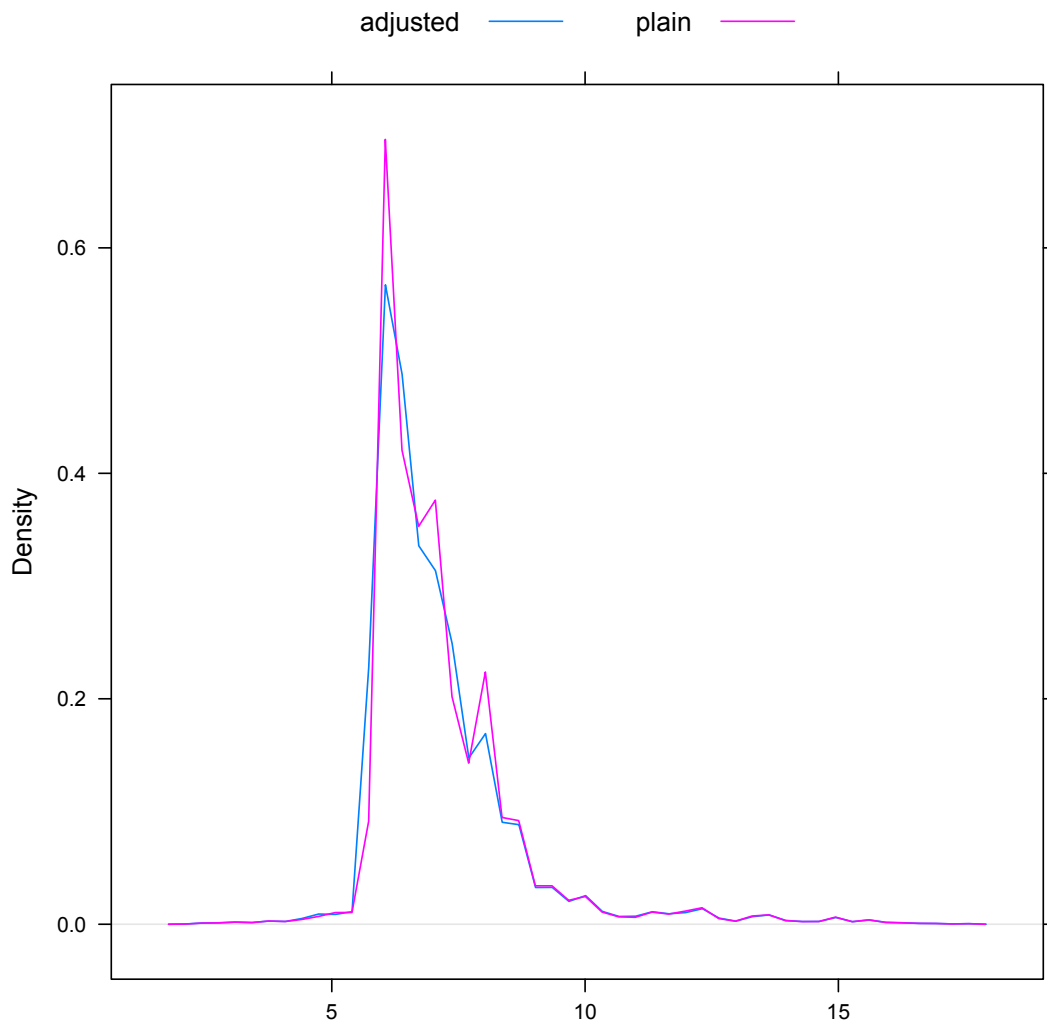
Estimating the Probability of Direct Care workers paid under the NMW

Using the adjusted distribution of direct care workers' hourly pay rate we can calculate directly the percentage of those being paid under the NMW. However, as explained above, our aim is to set the current analysis in the context of previous knowledge and to make best use of such knowledge. We employed Bayesian modelling, which relies on Bayes' Theorem, using data to update prior beliefs about parameters. Bayes' Theorem tells us how to update "prior knowledge" about parameters or hypotheses in light of new data and how to arrive at "posterior understanding" about the same parameters. There are a number of reasons why we opted for performing a Bayesian analysis, chief among them is to account for previous knowledge but also to overcome some of the problems associated with 'traditional' estimates. One of the main problems is that in traditional statistics the basis for declaring a result to be 'statistically significant' relies on p value[10], which has no unique value for any set of data. Another problem with traditional analyses is that they produce impoverished estimates of parameter values, with no indication of trade-offs among parameters and with confidence intervals that are ill defined because they are based on p values. Unlike traditional statistics, Bayesian analysis does not provide a 'point[11]' estimate but a whole posterior 'distributions' over the conjoint parameter space. The posterior distribution indicates the relative credibility of every possible combination of parameter values. In particular, the posterior distribution reveals complete information about correlations of credible parameter values. This posterior distribution can be examined in any way deemed meaningful by the analyst. In particular, any number of comparisons across group parameters can be made without penalty because the posterior distribution does not change when it is examined from different perspectives.

Bayesian inference is also computationally robust, with no difficulty with unequal numbers of data points in different groups of an experiment (unlike standard methods, for example, ANOVA).   Bayesian analysis also facilitates straightforward methods for computing power and replication probability. There are no p values and no corrections are required for multiple comparisons, most importantly, Bayesian analysis can implement cumulative scientific progress by incorporating previous knowledge into the specification of the prior uncertainty.

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[10] The p value is the probability of obtaining the observed value of a sample statistic (such as t, F, χ^2) or a more extreme value if the data were generated from a null-hypothesis population and sampled according to the intention of the experimenter.

[11] In traditional statistical analysis the point estimate is the value for the parameter that makes the model most consistent with the data in the sense of minimizing the sum squared deviation or maximizing the likelihood (or some other measure of consistency). Point estimates do not provide any information about the range of other parameter values that are reasonably consistent with the data.

The parameters in question here are the probability of direct care workers being paid under the NMW. The prior knowledge comes from previous estimates produced by the LPC[12] and ONS. And the new data are the adjusted hourly pay rates deducted from both the distribution of pay obtained from NMDS-SC and a conservative estimate of unpaid time calculated from LoCS survey. Prevalence of being paid under the national minimum wage is calculated from the adjusted data using age and time thresholds, as presented in Table 1, to represent the 'new' information about the estimate in question.

Table 1 National minimum wage by age groups and period[13]

Date	Age group		
	21+	18-20	16-17
01-Oct-11	£6.08	£4.98	£6.68
01-Oct-10	£5.93	£4.92	£3.64
01-Oct-09	£5.80	£4.83	£3.57

The concept of Bayes' Theorem has been adopted in providing accurate estimates related to different hypotheses, however, the implementation of Bayesian data analysis is quite complex, albeit that it has been relatively simplified using a set of algorithms known collectively as Markov chain Monte Carlo (MCMC). Nonetheless, it remains demanding in terms of computation time and complexity. MCMC provides an elegant and computationally efficient way of approximating posterior probabilities of model parameters, the quantities of interest in Bayesian inference. MCMC is not limited to Bayesian analysis and has been used in maximum likelihood framework; however, the MCMC method more naturally fits a Bayesian framework. In this analysis we employ a specific strand of Bayesian data analysis called "Hierarchical Bayesian" (HB) estimations model, which employs a framework for describing statistical models that can capture dependencies more realistically than non-hierarchical models. It is necessary to appreciate that any samples have bias, and are not necessarily independent (for example, we include more than one estimate produced by LPC using the same source of data). As such, it is not appropriate to try to pool the previous results in order to produce posterior inferences. Such an approach would not be very accurate and would, at a minimum, affect the standard error of the posterior estimations. The HB approach treats previous estimates as arising from a random process governed by the hyperparameters (α, β) to account for such dependencies. HB models have a number of important benefits; the most relevant ones to us in this analysis are the robustness and accuracy of final estimates. For further detailed discussions of these models we refer the reader to the following references - Hastings (1970), Lee and Sabavala (1987), Steffey (1992), Consonni and Veronese (1995), and Lynch and Western (2004).

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[12] We used estimates provided in the 2009, 2010 and 2011 Low Pay Commission reports.
[13] There are different 'lower' rates for apprenticeships for people under the age of 19 years old, however, it is not possible to identify this group of people using the NMDS-SC

Implementing the Hierarchical Bayesian model

In the presence of previously published estimates (prior knowledge) of direct care workers being paid under the national minimum wage (%UNMW), it is not correct to ignore previous relevant knowledge and it is more appropriate to adopt a Bayesian data analysis approach in deriving our new estimates. The model applied in this article is hierarchical because of the process of estimating the parameters.

Following a Bayesian approach we estimate different θ_i each is based on (or estimated from) samples $\boldsymbol{y}_i$ drawn from the population of UK's direct care workers such that:

$$\mathcal{P}(\theta_i|y_i) \propto \mathcal{P}(y_i|\theta_i)\mathcal{P}(\theta_i)$$

$\boldsymbol{\theta_i}$ Are drawn from a distribution with unknown parameters vector φ. Therefore, a posterior distribution for θ, φ can be written as follows:

$\mathcal{P}(\theta, \varphi|y) \propto \mathcal{P}(y|\varphi, \theta)\mathcal{P}(\varphi, \theta)$, where φ is an unknown hyperparameter with it's own joint conditional posterior distribution:

$$\mathcal{P}(\varphi|y) \propto \int \mathcal{P}(y|\varphi, \theta)\mathcal{P}(\theta|\varphi)\mathcal{P}(\varphi) \, d\theta$$

We know that $y_i \sim Bin(n_j, \theta_i), \theta_i \sim Beta(\alpha, \beta)$. We can write the joint posterior distribution of all parameters as follows:

$$\mathcal{P}(\theta, \alpha, \beta|y) \propto \mathcal{P}(y|\theta)\mathcal{P}(\theta|\alpha, \beta)\mathcal{P}(\alpha, \beta)$$

It then follows that:

$$\mathcal{P}(\theta, \alpha, \beta|y) \propto \prod_{i=1}^{I} \theta_i^{y_i}(1-\theta_i)^{n_i-y_i} \prod_{i=1}^{I} \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} \theta_i^{\alpha-1}(1-\theta_j)^{\beta-1} \mathcal{P}(\alpha, \beta)$$

The posterior density of $\boldsymbol{\theta}$ could b writing as following:

$$\mathcal{P}(\theta_i|\alpha, \beta, y_i) \propto (1-\theta_i)^{\beta+n_i-y_i-1} \prod_{i=1}^{I} \theta_i^{y_i}(1-\theta_i)^{n_i-y_i} \prod_{i=1}^{I} \frac{\Gamma(\alpha+\beta)+n_i}{\Gamma(\alpha+y_i)\Gamma(\beta+n_i-y_i)} \theta_i^{\alpha+y_i-1}$$

And the posterior density of α, β could be written as follows:

$$\mathcal{P}(\alpha, \beta|y) \propto \mathcal{P}(\alpha, \beta) \prod_{i=1}^{I} \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} \prod_{i=1}^{I} \frac{\Gamma(\alpha+y_i)\Gamma(\beta+n_i-y_i)}{\Gamma(\alpha+\beta+n_i)}$$

If we assume $\alpha \sim Gamma(S_\alpha, R_\alpha), \beta \sim Gamma(S_\beta, R_\beta)$ we can reach a derivation of the conditional posterior distributions for α and β:

$$\mathcal{P}(\alpha|\beta,\theta,y,S_\alpha,R_\alpha) \propto \left(\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}\right)^I \alpha^{S_\alpha-1}e^{\alpha(\sum_{i=1}^I \ln\theta_i-R_\alpha)}$$

$$\mathcal{P}(\beta|\alpha,\theta,y,S_\beta,R_\beta) \propto \left(\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}\right)^I \beta^{S_\beta-1}e^{\beta(\sum_{i=1}^I \ln(1-\theta_i-R_\beta))}$$

We performed these stochastic integrations via MCMC (Markov Chain Monte Carlo) approximation in order to estimate the densities of $\theta_i, \alpha/(\alpha+\beta)$. We implemented an iterative process of hyper Metropolis-Hastings/Gibbs sampling algorithm. We programmed the algorithms of the hierarchical Bayesian model using R on Unix. The Gamma parameters used for this implementation and results of posterior inferences are listed in Table 2. Figure 2 presents the distribution of four of the posterior distributions of the probability of care workers being paid under the NMW.

Figure 2 Samples of posterior distributions with different hyperprior specifications
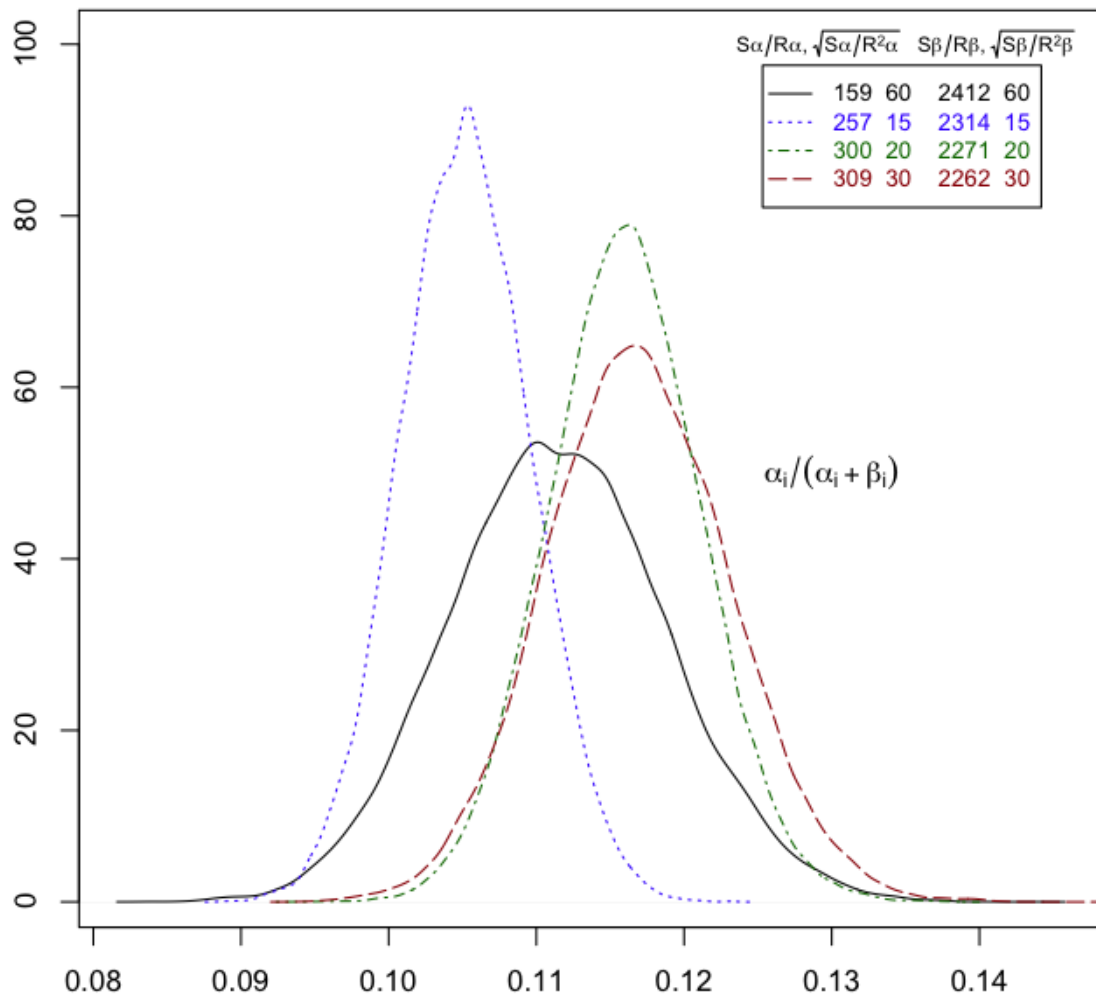
Table 2 Results of hierarchical Bayesian model under different gamma hyperprior specifications

Gamma Priors				Posterior Inferences (mean, SD, 95% Credible intervals)				
				θ_1	θ_2	θ_3	θ_4	
				Mean	Mean	Mean	Mean	$\alpha/(\alpha+\beta)$
S_α/R_α	$\sqrt{(S_\alpha/R_\alpha^2)}$	S_β/R_β	$\sqrt{(S_\beta/R_\beta^2)}$	SD	SD	SD	SD	SD
				(95% C-I)	(95% C-I)	(95% C-I)	(95% C-I)	(95% C-I)
285	10	2286	10	0.1141	0.1077	0.1099	0.1168	0.1115
				0.0047	0.0066	0.0066	0.0071	0.0032
				(0.1051, 0.1235)	(0.0952, 0.1208)	(0.0971, 0.1232)	(0.1033, 0.1310)	(0.1054, 0.1179)
300	20	2271	20	0.1163	0.1118	0.1140	0.1213	0.1160
				0.0052	0.0077	0.0077	0.0082	0.0052
				(0.1063, 0.1267)	(0.0971, 0.1272)	(0.0993, 0.1293)	(0.1056, 0.1378)	(0.1059, 0.1263)
231	20	2340	20	0.1095	0.0993	0.1014	0.1077	0.1023
				0.0051	0.0074	0.0075	0.0080	0.0921
				(0.0997, 0.1196)	(0.0851, 0.1142)	(0.0871, 0.1164)	(0.0924, 0.1237)	(0.0921, 0.1129)
257	15	2314	15	0.1109	0.1019	0.1041	0.1106	0.1052
				0.0049	0.0070	0.0070	0.0075	0.0044
				(0.1015, 0.1207)	(0.0886, 0.1158)	(0.0906, 0.1181)	(0.0962, 0.1255)	(0.0966, 0.1139)
309	30	2262	30	0.1168	0.1127	0.1148	0.1222	0.1169
				0.0055	0.0083	0.0083	0.0089	0.0062
				(0.1063, 0.1267)	(0.0969, 0.1294)	(0.0989, 0.1315)	(0.1052, 0.1401)	(0.1049, 0.1293)
159	60	2412	60	0.1141	0.1079	0.1099	0.1166	0.1115
				0.0058	0.0089	0.0089	0.0095	0.0074
				(0.1029, 0.1255)	(0.0910,0.1257)	(0.0929, 0.1279)	(0.0985, 0.1357)	(0.0974, 0.1262)

The results presented in Table 2 show that the %UNMW of direct care workers is stable, with a mean 'stable' around 10 per cent, with different values of the gamma hyperprior parameters, indicating consistent and accurate results. 95 per cent credible intervals of the posterior inferences of $\alpha/(\alpha + \beta)$ range from 9.2 per cent to 12.9 per cent. Figure 2 highlights the concentration of different posterior distribution of estimates of the direct care workers' population paid UNMW to be around the range 10 to 13 per cent. These are very strong findings; which mean taking all prior knowledge together with the very conservatively adjusted distributions of hourly pay rates, it is with 95 percent credibility that the true %UNMW is likely to lie within 10 to 13 per cent. The latter probability is higher than, but intersects with, other previous estimates (LPC 2009, 2010, 2011, IFF Research 2008). It is likely that when using a separate set of adjustments that are less conservative than the ones used in this report that the posterior inferences will indicate considerably higher probabilities of being paid UNMW. This is because of the very narrow distribution of hourly pay rates of direct care workers, which is of great concern to many stakeholders. With the likelihood of more severe austerity measures and 'innovative' ways of making pay savings, more direct care workers will move under the threshold of the NMW.

Estimating the number of direct care workers in the UK likely to be paid under the NMW

In order to estimate the number of direct care workers paid under the NMW we need to estimate the total number of direct care workers in the UK. Assessing the size and breakdown of the direct care workforce in the UK presents some statistical challenges, particularly with regard to the categorisation and recording of data in different UK countries.. However, reliable estimates are produced by Skills for Care that reflect the workforce in England. As there are no comprehensive estimates of the care workforce for the other UK countries, we adopt a similar approach used by Cangiano et al (2009), which uses estimates derived from the LFS and NMDS-SC to produce an adjusting factor for LFS data in England. We can then use the same factor but for estimates based on the LFS for Scotland, Wales and Northern Ireland. Simon and colleagues (2007), using LFS data, estimated the care workforce in England to be 1,012,000 jobs[14] and in Scotland to be 88,000. Their estimates of the care workforce in England are significantly lower than that produced by Skills for Care (2011), using different data sources including the NMDS-SC and Inter-Departmental Business Register (IDBR) data (PAYE and VAT registered operations). Skills for Care estimates that the care workforce in England include 1,768,000 individual jobs; out of these **1,316,000** jobs are estimated to involve the provision of direct care (Skills for Care 2011).

Using England based estimates we produce a 'weight' or a correction factor[15] that can be applied to estimates of the care workforce in other countries in the UK derived from the LFS. Applying the correction factor, a more accurate estimate for the care workforce in Scotland should be in the range of **154,000**. In Wales, the workforce is estimated to be **88,773** people, and in Northern Ireland, **40,140** jobs using LFS data (Cangiano et al 2009). Using similar adjustments, more accurate figures for Wales and Northern Ireland are likely to be in the range of **155,353** and **70,245** jobs respectively. There is no available reason to assume the structure of the social care workforce varies dramatically between England and other countries in the UK because the little comparative research on the structure of the workforce across the different countries does not suggest this (Simon et al 2007; Cangiano et al 2009). Thus we can assume that the share of direct care jobs in other countries of the UK is similar to that in England (75% of overall jobs in the care workforce, Skills for Care 2011). Such estimates indicate that a total of **284,699** direct care jobs are in Scotland, Wales and Northern Ireland, resulting in a total of **1,695,598** direct care jobs in the UK. Table 3 details these estimates.

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[14] We are using jobs as one worker may be subject to unpaid additional time in separate jobs.
[15] The scaling (correction) factor used is 1.75.

Table 3 Estimates of total social care workforce and direct care jobs in different countries in the UK and estimates of direct care workers paid under the National Minimum Wage in the UK

Estimates	Direct care jobs	Social care workforce
Number of Jobs in the **UK**	**1,695,598**	2,147,598
England	1,316,000	1,768,000
Wales	115,500	154,000
Scotland	116,515	155,353
Northern Ireland	52,684	70,245
Estimates of number of direct workers paid UNMW in the **UK**		
Lower bound 95% credible interval (0.0924)	**156,673**	
Upper bound 95% credible interval (0.1293)	**219,241**	

Given that the structure of care provision does not vary dramatically vary across different countries in the UK, with all countries being affected by government spending and budgets, we feel it is reasonable to assume that pay levels and structure derived from England based data (adjusted NMDS-SC) can represent the whole of the UK. This is especially so, given that the previous analysis of Cangiano and colleagues (2009), which attempted to compare pay rates derived from NMDS-SC, LFS and ASHE, indicted that the effects of geographical coverage 'do not seem' to have a significant effect on the structure of wages (p.23). Therefore, we can use the results of the posterior distribution of %UNMW produced by the hierarchical Bayesian model in conjunction with estimates of the total direct care workforce in the UK detailed above to estimate the total number of direct care workers likely to be paid under the NMW in the whole of the UK. The posterior inferences thus indicates that between **156,673** to **219,241** direct care jobs in the UK are paid on average an hourly rate that is lower than the National Minimum Wage.

Discussion and Conclusion

Direct care workers are the backbone of the social care workforce, with an ageing population and longer ill-health years the demand for social care is expanding. Consequently the demand for direct care workers is expanding. However, direct care jobs have been traditionally, and continue to be, often very low paid with poor status and image. The social care workforce constitutes a considerable portion of the overall UK economy, but little public debate is ensued in relation to pay and conditions within the sector. Several debates are in taking place in relation to funding the cost of long-term care and in relation to migration. However, no clear connections are made between the two albeit the fact that migrants constitute a considerable portion of the UK care workforce.

Previous analysis highlighted the poor pay levels in the care sector particularly among direct care workers and 'other' staff (ancillary jobs such as cleaners) in the sector. Detailed analysis of pay in the care sector derived from the NMDS-SC (Hussein 2010a and 2010b) indicated two-tier pay levels in the care sector. For direct care workers, the analysis showed that sector of work (private, local authority or voluntary) has the most significant and numerically largest effects on pay levels; where direct care workers particularly in the private sector earn considerably less than their counterparts in local authorities (ß= -3.008, p<0.001, Hussein 2010b). This is particularly worrying given that the private sector employs 75 per cent of direct care workers. However, the costs of services provided through the private sector are perceived to be attached to the public purse, in the form of local authority means tested payments, paying long term care costs in the most economical way it can manage. With staff wages forming a considerable part of care costs, 80 to 85 per cent, one of the first possible option for those wishing to reduce costs may be to cut expenditure on wages.

Type of settings of service was also significantly associated with pay levels, where direct care workers working in adult community care services were reported to have the highest wages, followed by those in day care services, while direct care workers in both residential and domiciliary services earned significantly less. In terms of personal characteristics, only ethnicity, in itself, is significantly associated with pay among direct care workers. Workers who were identified by their employers as belonging to Black or minority ethnic groups (BME) had a significantly lower hourly pay rate.

One specific measure to identify levels of low pay in a sector, and to establish legal and statutory pay duties, is to establish the probability of workers being paid under the NMW. While the care sector has been argued to be one of the main beneficiaries of the introduction of NMW (Dickens and Manning, 2002it was, and remains, one of the lowest paying sectors in the UK (Metcalf 2004, LPC 2011). The Low Pay Commission reported continuous concern about low pay in the sector with some workers being paid under the NMW year on year. While there are several estimates of percentages and numbers of care workers being paid under the NMW, they mostly rely on data sources that are not particularly sector specific and are likely to under-represent those on lower pay. This results

in under-estimates of both the prevalence of workers being paid under the NMW and, of greater concern, the number of workers affected by this.

The main aim of this report is to provide more accurate estimates of the probability and number of direct care workers affected by the NMW using recent and adjusted data to account for some of periods of extra time that are highly likely to be unpaid. In this report we present elaborate analysis aiming to provide more accurate estimates of the probabilities and numbers of direct care workers being paid under the NMW in the UK using different sector-specific data and accounting for previously available knowledge and estimates. We use two main datasets, the National Minimum Data Set for Social Care (NMDS-SC) to establish an overall distribution of pay among a considerably large sample of employees in England and computed adjusted rates using data from the Longitudinal Care Study's (LoCS) care workers' survey (Hussein et al 2010). We propose a methodology of adjusting pay distributions derived from the NMDS-SC, June 2011, using a conservative estimate of unpaid additional 'time' of work derived from LoCS data. We have not computed any estimates for staff payment of their own travel costs, such as petrol or use of public transport.

The analysis also aim to try to include previous results along with new estimates to produce an overall estimate of the probabilities of being paid under the NMW for the overall UK population of direct care workers. We adopted a Bayesian data analysis approach to accumulate previous knowledge and produce more accurate posterior distributions of the probability of direct care workers being paid under the NMW. We chose a hierarchical Bayesian model to account for the dependency of previous estimates. We also produce new estimates of the total social care and direct care workforce in the UK. The estimates are based on Skills for Care estimates of the workforce in England and adjustments to estimates based on the Labour Force Survey to the workforce in Scotland, Wales and Northern Ireland. The analysis focuses on direct care workers and does not provide estimates for 'other' workers, who are also affected by low pay in the sector.

The results of the model indicate that, using a very conservative adjustment of additional unpaid time (Averaging 22.7 extra unpaid minutes per week and 4.8 minutes unpaid travel time per week), the probability of direct care workers being paid under the NMW has a credible interval ranging from 9.2 to 12.9 per cent. These probabilities are higher than, but intersect with, previous estimates, which range from 6 to 10 per cent (LPC 2010, 2011, IFF Research 2008). More importantly, estimated numbers of workers being affected by pay under the NMW are much larger than previously estimated (these range from 27,000 by the ONS and 48,000 by LPC). The current analysis estimates that between156,673 to 219,241 direct care jobs are affected by this in the UK. Such a large gap is directly linked to considerably lower estimates of the overall social care workforce in the UK, but also reflects the higher probability estimates. The current estimates are likely to provide an under-representation of the true probabilities and numbers of workers paid under the NMW, mainly due to the exclusion of those working in the grey or casual economy, individual employers and by relying on pay distributions derived from the NMDS-SC data which are

collected from employers and are not support by supplementary pay documentations.

The NMW came into effect in the UK at the end of the 20th century (April, 1999), alongside its introduction, the Low Pay Commission (LPC) was established in 1997 to recommend NMW rates (Manning 1997). The purpose of the NMW was to raise the pay of low-wage workers above what it otherwise would be. The reasons for being paid under the NMW, non-compliance, are multifaceted. Some may be for good reasons, for example, if employees receive substantial benefits such as free accommodation, which is not recorded in the data sets. However, the main concern is related to the known fact that many workers do not show up in the ASHE or LFS data records, or who appear in the data (e,g NMDS-SC) but whose hourly earnings figures are overstated, normally because hours are under-reported. Previous research (see, for example, LPC 2005, Metcalf 2008) indicates that this non-compliant group is growing, however, it is virtually impossible to quantify. Compliance depends in part, as Metcalf (2008) explains, on enforcement action from the HM Revenue and Customs (HMRC), Metcalf estimates, however, that a typical employer can expect a visit from HMRC once every 320 years.

Furthermore, some researchers conclude that compliance with NMW has no impact on workers who are not directly affected by, or who are not on the threshold of, the NMW (Dickens and Manning 2004). Many researchers observed a 'big bang' spike in pay rates since the introduction of the NMW. They reported yearly pay increases matching yearly increments in the NMW with no clear 'spillover' effects and the majority of pay rates being around and not surprisingly influenced by the NMW levels (Gilman et al 2002, Grimshaw and Rubery, 2010).

In the specific care sector where there are close ties with local government spending, fiscal austerities and further government spending reductions may have direct and indirect effects on direct care workers' pay. There is some anecdotal evidence from discussions with trade union representatives, workers and employers that new systems of pay calculations are being introduced for care workers, these may include 'real time accounts' that pay for visits by the minute with some indications that current systems of recording work duration may round down the number of minutes of face to face contact time resulting on systematic under recording of work time. Such methods of measuring work time (for example, in domiciliary care visits) may offset any margin of extra pay to substitute for travel time and costs. Other possible effects of cost-cutting exercises are likely to be related to direct care workers' responsibilities, for example, some restructuring of roles and duties to include some of those traditionally performed by nurses. There is also some anecdotal evidence in terms of reducing the number of direct care workers on shifts. Thus, there are implications for both workers and the quality of care provided.

The current research main recommendation is the urgent need for detailed conversations about pay and working conditions in the care sector. Such dialogue needs to take place in the light of the growing need for long-term care, the increasing emphasis on direct payments and personalisation and thus the

shift of employment responsibilities to service users and families, current immigration policies and the current financial climate. Immigration policies are very relevant here, given that a large percentage of direct care work is undertaken by recent migrants (Cangiano et al 2009, Hussein et al 2010b and 2011); for example, 40 per cent of the care workforce in London is provided by migrants; with three-quarters of migrants arriving from outside the European Union (Hussein 2011). The scale of very low-pay affecting direct care workers is much larger than previously anticipated and calls for attention.

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