Do health checks for adults with intellectual disability reduce emergency hospital admissions? Evaluation of a natural experiment

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† - Prior to publication Dr Shah died. His co-authors would like to pay tribute to him, who as the principal investigator on this study successfully led it from inception.

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Abstract

Background

Annual health checks for adults with intellectual disability (ID) have been incentivised by NHS England since 2009, but it is unclear what impact they have had on important health outcomes such as emergency hospitalisation.

Methods

An evaluation of a "natural experiment", incorporating practice and individual level designs, to assess the effectiveness of health checks for adults with ID in reducing emergency hospital admissions using a large English primary care database. For practices, change in admission rates for adults with ID between 2009-10 and 2011-12 were compared in 126 fully participating versus 68 non-participating practices. For individuals, changes in admission rates before and after first health check for 7,487 adults with ID were compared to 46,408 age-sex-practice matched controls. Incident rate ratios (IRR) comparing change in admission rates are presented for: all emergency, preventable emergency (for ambulatory care sensitive conditions (ACSCs)) and elective.

Results

Practices with high health check participation showed no change in emergency admission rate among ID patients over time compared to non-participating practices (IRR=0·97, 95%CI 0·78-1·19), but emergency admissions for ACSCs did fall (IRR=0·74, 0·58-0·95). Among individuals with ID, health checks had no effect on overall emergency admissions compared to controls (IRR=0·96, 0·87-1·07), although there was a relative reduction in emergency admissions for ACSCs (IRR=0·82, 0·69-0·99). Elective admissions showed no change with health checks in either analysis.

Conclusions

Annual health checks in primary care for adults with ID did not alter overall emergency admissions, but they appeared influential in reducing preventable emergency admissions.

Introduction

Adults with intellectual disability (ID) experience high levels of morbidity, hospitalisation and premature mortality.[1] In response to recommendations from the Disability Rights Commission,[2] in 2009 the English National Health Service (NHS) introduced an annual health check scheme as a Directed Enhanced Service (DES) in primary care for adults with ID.[3] This was intended to identify undetected health problems and improve prescribing and coordination with secondary care. Systematic reviews on the effectiveness of health checks in people with ID have confirmed that they are effective in identifying new health problems, improving uptake of preventive interventions and improving indicators of process of care.[4] However, there is little evidence on their effectiveness in modifying outcomes such as hospitalisation,[5] which is important for patients, carers and the health services. With only half of eligible adults receiving health checks by 2011-12,[6] this provided the opportunity to evaluate the scheme by viewing it as a "natural experiment".

In this paper we use a robust observational methodology, using practice and individual level designs, to assess whether the introduction of health checks in 2009 reduced emergency hospitalisation for adults with ID. We first compare high with low uptake practices, evaluating change in admission rates for all adults with ID, controlling for underlying differences between practices. However, the possibility remains that participating practices improved the care of their ID patients independent of introducing health checks. Therefore, we also present a matched cohort study comparing change in admission rates of individuals with ID who had health checks to that seen for a matched group of non-ID patients, controlling for secular trends in practice care or hospital admissions. Finally, a second matched cohort study for individuals with ID not receiving health checks is then used to confirm the specificity of findings to those having a health check only.

Methods

Data source

The Clinical Practice Research Datalink (CPRD) is a large primary care database representative of the UK population.[7] We included 343 practices in England recording data on 1/1/2009, anonymously linked to Hospital Episodes Statistics (HES) data. HES records clinical and administrative information on all NHS funded inpatient episodes, and allows for identification on method of admission (e.g. emergency), in addition to the primary reason for the admission.

Identification of patients with ID and their health checks

We have previously detailed our methodology for identifying adults (aged 18-84) with ID in CPRD in England.[8] Briefly, we included all codes used by the Quality and Outcome Framework (QOF) for learning disability,[9] plus additional codes for conditions usually associated with ID such as chromosomal and metabolic disorders (E-table 1). Health checks were identified by specific Read codes used by practices to facilitate future payment. We only

included health checks from 1/4/2009, the point from when practices received remuneration for carrying them out.

We classified ID patients with high levels of support needs based on either a record of severe or profound ID or, where no record of severity was available (59%), at least two of the following: cerebral palsy/significant mobility problem, severe visual impairment, severe hearing impairment, epilepsy (excluding absence seizures), continence problem and use of percutaneous endoscopic gastrostomy (PEG) feeding (E-table 2). ID patients were estimated to be living in a communal setting by specific Read codes (E-table 3), or the presence of 3 or more people with ID with the same address flag.

Hospital admission outcomes

Our main outcome was a count of emergency hospital admissions, defined as distinct periods of care on the HES record. We were also interested in emergency admissions for ambulatory care sensitive conditions (ACSCs),[10] which are thought to be potentially preventable with better clinical management. We included 20 widely used ACSCs, adding 3 further conditions (constipation, aspiration, gastro-oesophageal reflux disease) which are more relevant reasons for admission among adults with ID.[11] We identified these using the primary ICD-10 diagnosis for the first episode of the hospitalisation (E-table 4). We also analysed elective admissions as an outcome, to test whether health checks had an impact on this aspect of care.

Practice level assessment of health checks

We classified practice participation in the DES by calculating the percentage of patients registered on 1/1/2009 on the QOF learning disability register that subsequently received a health check. For this analysis we restricted to 289 practices with complete data from 1/1/2009 to 31/12/2012, including all ID adults irrespective of whether they received a health check (Figure 1). We defined full practice participation (n=126) as ≥50% of their ID adults having a health check by 2010. Practices (n=68) with <25% adults having a health check by 2012 were classed as non-participating, with the remainder (n=95) having participation rates of 25-50%. We then compared practice hospital admission rates (total admissions divided by total registration time) in 2011-12 vs. 2009-10 between practices fully- and non-participating.

Individual analysis of first health check

For our analysis of individuals, we carried out a matched cohort that compared within subject, the rate of admission after the first recorded health check from 1/1/2009 to 31/12/2013, with that seen before the health check (Figure 1). Up to 7 controls (with no record of ID) were matched on age, sex and practice to control for any temporal trends in admissions during the study. 7,487 ID adults aged 18-84 with a first health check were identified and matched to 46,408 controls. We excluded the period 30 days either side of the health check to avoid it directly leading to an admission, or being the result of a recent discharge from hospital. All patients were required to be registered for at least 90 days prior to the health check, and be

alive for 90 days after it. All patients were followed to 31/12/2013, or their death if it was earlier. Those who de-registered from their practice were still included in the follow up as linkage to hospital admissions continues as long they remain resident in England.

Finally, we carried out a complementary analysis using 6,922 ID adults without health checks (Figure 1). We allocated a random index date based on the known dates of the health checks, and similarly matched them to 47,662 population controls. We then repeated the above analysis using the non-health check ID adults and their controls to check whether any observed changes in admissions for ID adults were specific to those receiving health checks only.

Statistical Analysis

The analyses used a conditional Poisson model (xtpoisson, Stata version 13), to compare the rate of change over time at a practice or individual level. At practice level, these were conditioned on practice, and all admissions from patients with ID were counted, using an offset term to account for total time registered. The effect of practice participation on hospital admissions was estimated by the interaction between practice participation (fully vs. none) and period (2011-12 vs. 2009-10). At individual level, we conditioned on individual as opposed to matchset, as accounting for the matching variables is not paramount in matched cohort analyses[12]. This model was fitted to ID adults and controls separately, estimating the individual change in hospital admission rate after as compared to before health check, with an offset accounting for time registered. A combined model of ID adults and controls with a case-period interaction provides an estimate of the effect of health checks on admission rates among adults with ID, adjusted for temporal trends in admissions. All models used a sandwich estimator to obtain robust standard errors.

Results

Practice level analyses of health checks and hospital admissions

Practices fully participating in health checks compared to those not participating (Table 1), were more likely to have larger numbers of ID adults in their practice, as well as higher percentages recorded living in communal establishments (median 20·0 vs. 7·7%) and having high levels of support need (median 22·2 vs. 15·2%).

A summary of hospital admissions (all emergency, emergency ACSCs, elective) among adults with ID during 2009-12 is shown in Figure 2 and analysed in Table 2. Emergency admission rates calculated in each quarter (Figure 2) tended to fall over time. This is summarised annually in Table 2 as a fall from 191·1 per 1000 patients per year in 2009-10, to 176·7 in 2011-12. Non-participating health check practices had consistently higher emergency admission rates throughout than those fully participating (Figure 2), with both groups experiencing a similar fall over time (IRR=0·97, 95%CI 0·78-1·19).

When emergency admissions for ACSCs were considered the pattern was different (Figure 2, Table 2). While these admissions had fallen among those fully participating in health checks (69·2 in 2009-10 to 56·3 in 2011-12 per 1000 patients), they tended to rise in practices not participating (70·1 to 77·1 per 1000 patients). A statistical comparison of the difference in this change showed an overall benefit of greater practice participation (IRR=0·74, 95%CI 0·58-0·95). There was no evidence of any difference in the change over time in elective admissions between fully- and non-participating practices (IRR=1·02, 95% CI 0·84-1·25).

Characteristics of ID adults with and without health checks

Among the 7,487 adults with ID with a first health check between 1/4/2009 and 31/3/2013, the average age was 42.6 years (s.d.=15·4), with 57.5% being male (Table 3). Almost 3 in 10 were classified as having high levels of support needs, with a similar proportion identified as being resident in a communal establishment. By contrast, the 6,922 ID adults without a health check were younger (mean=39·0) and less likely to have high levels of support needs or communal living recorded on their record.

Individual analyses of health checks and hospital admissions

Hospital admission rates before and after the health check are summarised in Table 4, and also for adults without health checks using their random index date. For adults with a health check, all emergency admissions rose by 22% from 145·7 to 173·2 annually per 1000 patients. By contrast, in their matched controls the rate increased by 27% from 58·9 to 70·2 (data not shown). Therefore, in the combined Poisson model, the interaction for the impact of health checks on adults with ID is estimated to be under 1 (IRR=0·96, 95%CI 0·87-1·07). ID adults without health checks had higher overall admission rates for emergency admission (186·0 vs. 145·7 pre index date), and a slight increase in admission rate post index date relative to their controls (IRR=1·05, 95%CI 0·94-1·17).

Emergency admissions for ACSCs among adults with health checks showed an association with change in admission rate post health check compared to controls (IRR=0·82, 95%CI 0·69-0·99). This trend was not replicated in ID adults without a health check (IRR=1·11, 95% CI 0·92-1·36). The change in elective admission rate was similar between ID adults with health checks and controls (IRR=0·96, 95%CI 0·87-1·06).

Table 5 summarises the estimate of the impact of health checks on emergency hospital admissions stratified by individual characteristics, both for ID adults with and without health checks. A significant rise in admissions among Down's syndrome adults with health checks compared to their controls (IRR=1·55, 95% 1·15-2·08), was replicated among Down's adults without health checks (IRR=1·55), suggesting a trend specific to this group. By contrast, while health checks reduced emergency admissions among ID adults with high levels of support needs (IRR=0·80, 95%CI 0·67-0·95), this was not replicated in similarly defined ID patients without health checks (IRR=1·07, 95% CI 0·85-1·35). A further analysis of ID patients with high levels of support needs receiving health checks also suggested a decrease in their emergency admissions for ACSCs compared to controls (IRR=0·76, 95%CI 0·56-1·01, data not shown).

Discussion

In this study we found little evidence to suggest that the introduction of incentivised health checks by NHS England for adults with ID in 2009 had any discernible impact on subsequent overall emergency or elective admissions. However, when we only considered potentially preventable emergency admissions (ACSCs) we found that practices which were fully participating in health checks experienced a greater fall in admissions than those not participating. This beneficial association with preventable admissions was replicated when we looked directly at individuals with ID who had a recorded health check. This analysis also suggested a wider benefit of health checks on all emergency admissions among those with more complex health needs.

We believe our study is the first to report benefits of health checks for adults with ID on a health outcome as opposed to process measures.[13] While a systematic review has shown the effectiveness of health checks in detecting unrecognised health needs in people with ID,[4] it highlighted the lack of evidence regarding whether their provision translated into important longer term benefits, such as a reduction in avoidable hospitalisations or mortality. The evidence for effectiveness of health checks in general adult populations is similarly uncertain, with no evidence that they reduce mortality, hospitalisation or disability[14]. In the UK, NHS health checks for 40-74 year olds have been shown to increase the identification of cardiovascular risk factors in a large untreated population,[15] but their impact of longer-term outcomes is still unclear.

Reducing emergency hospital admissions is a major international concern to contain healthcare costs, but evidence for successful community interventions is limited.[16] While our primary outcome of emergency hospital admission showed no change after introduction of health checks for subjects with ID, evidence for a reduction in potentially preventable admissions was consistent in all our analyses and plausible. Given that admissions for ACSCs represent less than 1 in 5 emergency admissions in the UK,[10] it is unsurprising that we did not detect a change for the broader group. Among adults with ID in our study, admissions for epilepsy contributed about 45% of emergency admissions for ACSCs, so one possible explanation is that health checks are facilitating better overall management of epilepsy and seizures among patients with ID. This would be an important benefit, as improved service provision of ID patients with epilepsy has been identified as a mechanism for reducing excess mortality among all people with ID.[5]

Our study reached a similar conclusion from two different analytic strategies, one based on practice comparisons and the other on individuals. As these used slightly different patient groups and definitions of time, this outcome would not necessarily be expected. For example, individual analyses suggested emergency hospital admissions were rising among ID patients post health check, while practice level analyses showed a fall during 2011-12. The rise in admissions in the same individuals is partly explained by their ageing over time, plus the requirement to be alive at the health check, resulting in deaths only post health check (and associated admissions). By contrast, practice trends were based on a fluid group of all ID

patients aged 18-84 years in each year, keeping average age effectively constant and allowing deaths within the year.

Our study has some limitations. We were not able to comment on the quality or overall content of the health checks that have taken place. Although there is published guidance on what the GP should cover during a health check,[3] a general observation from our data extract is that there is substantial variation in what is recorded, which is likely to mirror what is taking place in the health checks. We have not attempted to make any economic costing of the effectiveness of the health check scheme. A small Scottish trial of nurse delivered health checks for adults with ID demonstrated cost effectiveness compared to standard care.[17] However, they did not include hospitalisation costs, except accident and emergency attendances, which may have led to them underestimating potential economic savings.

The analysis at practice level was unmatched, and likely subject to residual confounding from unmeasured factors at both practice and individual level, as we would expect practices that participate in the DES to be different than those that don't, and possibly have differing characteristics of ID patients. For example, practices that went on to regularly carry out health checks in our study already had lower emergency hospital admissions rates among their ID patients at the outset in 2009. These practices might have further reduced admissions anyway, and subsequent adoption of health checks may simply be a marker of other improvements in their care over the study period.

In order to control for any practice level changes over time, we matched individuals with ID receiving health checks to population controls in the same practice. This analysis now adjusts for any change (artefact or real) across practice or hospitals during the study. However it fails to account for changes specific to people with ID, that may have happened in the UK in light of several high profile reports during this period.[2,18] Therefore we similarly analysed ID patients without health checks, assigning them a random date instead of a health check date. Since this group showed no fall in ACS admissions compared to their controls, it provided additional evidence for the effectiveness of health checks. This contrasts with our finding that adults with Down's syndrome increased emergency admissions by 55% post health check, but since a similar increase was seen in Down's adults *without* health checks, we concluded the trend was specific to Down's and not health checks. This increase may reflect the premature ageing associated with Down's such as early onset Alzheimer's disease,[19] combined with better survival into middle age in part due to advances in childhood cardiac surgery.[20]

In England an increasing number of adults with ID now live in the community, and as a result, the GP's role in managing their health has increased. Preliminary work around the time of the introduction of health checks in 2009 in England suggested there were no associated higher costs in terms of service use,[21] however costs implications since are not clear and should be evaluated. It has been argued that regular health checks for adults with ID are an efficient way of closing the health inequality gap that this group may experience, however this may also be widened if more easily managed patients are more likely to get health checks.[22] In our study, the decrease in emergency admission rates for ACSCs was more marked (27%) when we directly compared participating with non-participating practices, which suggests that there may be a "practice level benefit" of health checks, where changes in care have

benefited all ID patients within the practice irrespective of whether they have the health check. However this may be an over simplification, as a recent serious case review in the UK into the deaths of two adults with ID found that they had been invited to a health check but had failed to attend.[23] Interestingly, our analysis of individuals suggested that health checks produced the greatest benefit in reducing emergency admission to hospital in those with more severe and complex needs.

In summary, to continue to successfully address issues of health inequality and discrimination for adults with ID, the policy implications from our results are: (1) to increase the practice uptake of the health check DES from current levels (<60%) towards a suggested and necessary target of 90%;[22] (2) to ensure that all eligible adults, especially those with the most severe or complex needs, receive an annual health check within practices who participate in the DES.

What is already known on this subject?

A systematic review of the impact of health checks for people with intellectual disabilities in 2014 concluded that while health checks were "effective in identifying previously unrecognised health needs, including life threatening conditions", very few studies had "evaluated the extent to which providing health checks for people with intellectual disabilities leads to health benefits either in the short or long term". We were not aware of any study that used emergency hospitalisations as an outcome when evaluating health checks.

What this study adds?

Whilst there was no evidence to suggest that health checks had an impact on overall emergency hospital admissions for adults with ID, the study did reveal a reduction in preventable emergency hospitalisations after the introduction of health checks. These findings should encourage further implementation of health checks to include all general practices in England, in addition to wider participation within practices already carrying them out.

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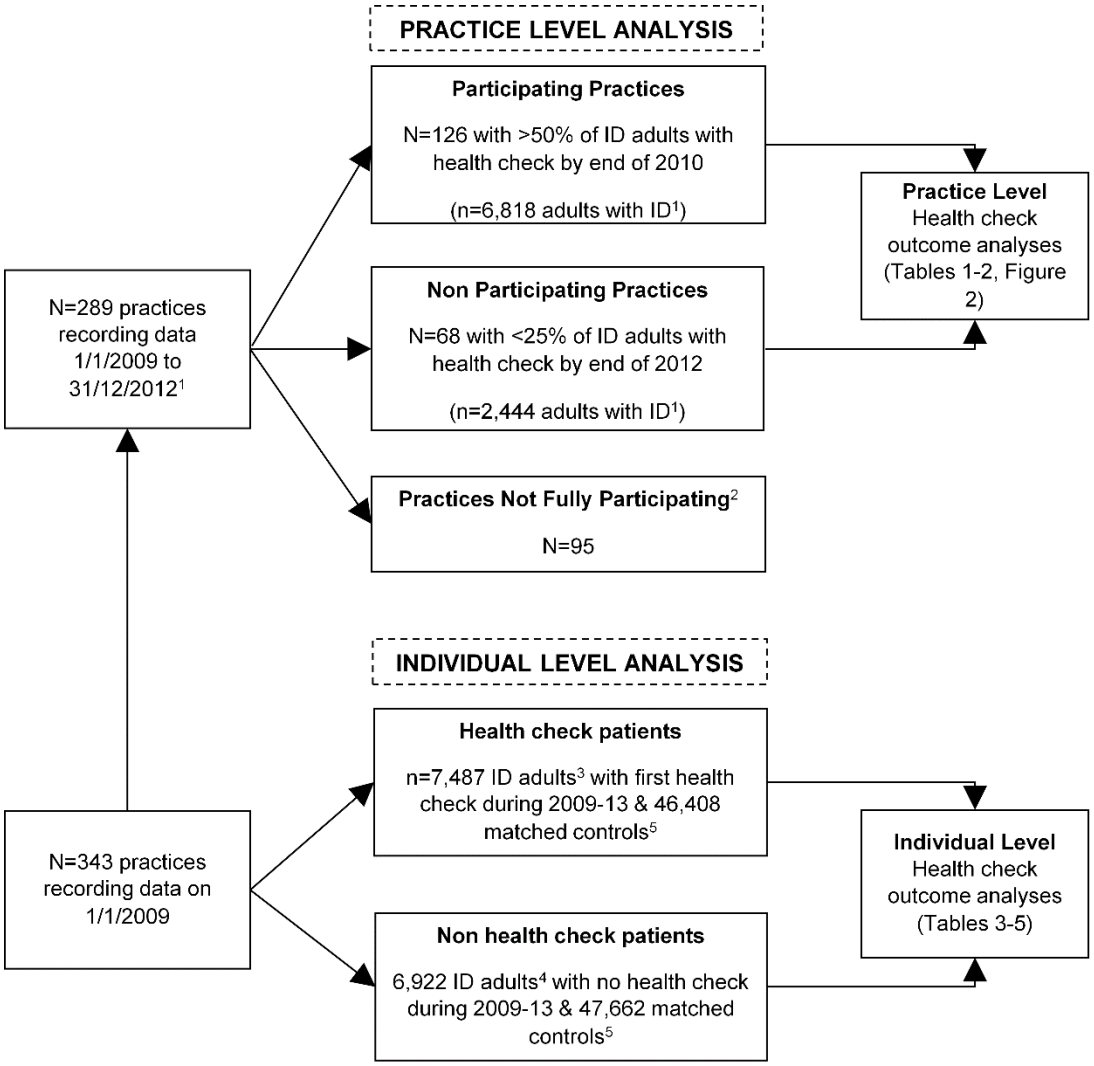
Conflicts of Interest

"All [living] authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) which declare: all authors had financial support from the National Institute for Health Research for the submitted work".

Details of Contributors

SMS conceived the study and led the project from inception until his death. IMC took over leadership on the project and is the guarantor for the paper. IMC undertook the analysis. All authors contributed to the development of the project methodology, interpretation of the results, and drafting of the paper.

Figure 1: Summary of number of practices, adults with ID and matched controls used in analyses



[1] 14,080 adults with ID with ≥1 registered day in these practices during 2009-12 irrespective of Health Check
[2] Practices with 25-50% of ID adults with health check by end of 2010, or only achieves >50% during 2011-12
[3] ID adults must have been registered for 90 days prior to health check and be alive for at least 90 days after it
[4] ID adults without health checks were assigned an index date using the distribution of known health check dates
[5] Controls subject to same criteria as above using their case's health check date as index date

Figure 2: Hospital admissions in each quarter during 2009-12 by practice level of participation in health checks

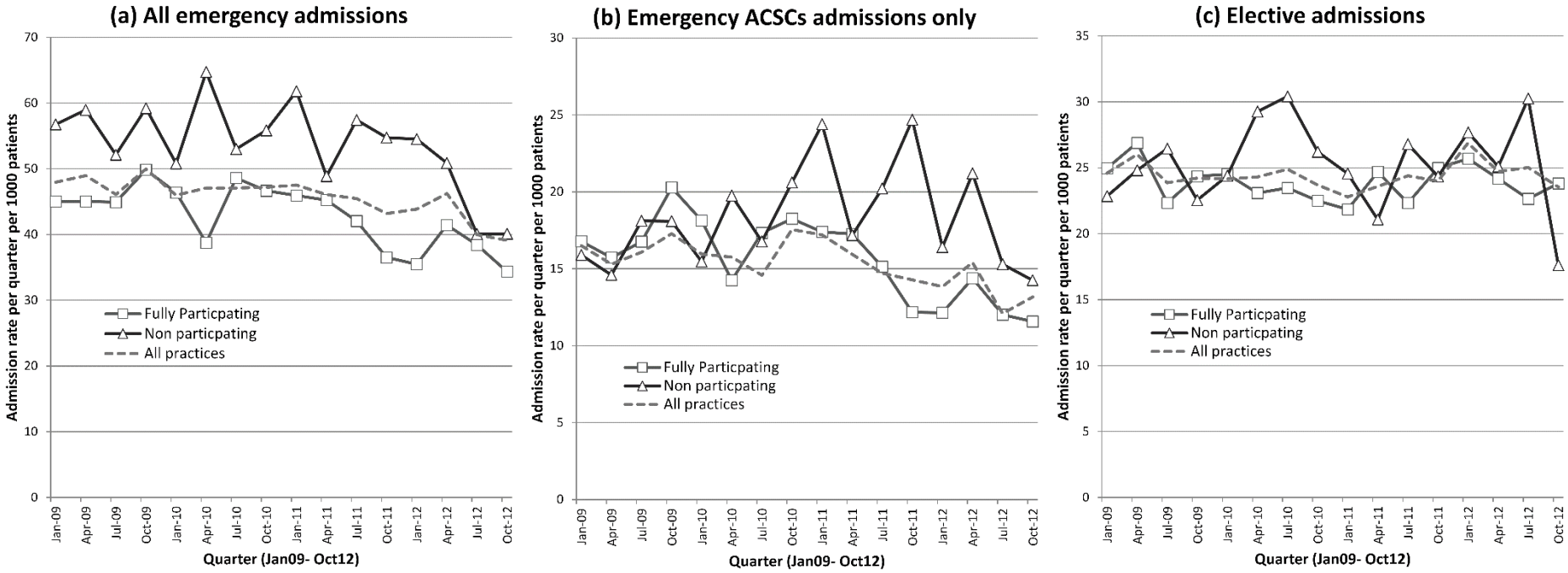


Table 1: Summary of adults with ID in each practice by practice level participation in health checks

	All Practices (N=289)		Non participating Practices (N=68)		Partial participating Practices (N=95)		Fully Participating Practices (N=126)	
	Median	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**
Adults with ID summarised at practice level†								
Total registered during 2009-12‡	43·0	25·0-64·0	36·0	16·0-50·0	46·0	31·0-64·0	45·0	24·0-79·0
Number registered on 1/1/09 only	34·0	19·0-52·0	26·5	12·5-39·5	34·0	23·0-53·0	38·0	19·0-61·0
% with health Check by end of 2010	43·1	1·6-65·8	0·0	0·0-0·0	22·2	4·3-41·7	69·5	60·0-80·0
% with health Check by end of 2012	66·7	28·6-81·8	0·0	0·0-11·8	58·6	41·0-68·8	81·8	74·2-87·9
Mean Age	41·6	38·7-44·8	41·9	38·9-45·8	40·5	37·5-43·8	42·6	39·4-45·0
% Male	57·6	50·0-64·3	55·6	50·0-64·5	58·3	50·0-63·2	57·5	50·0-65·0
% High levels of support needs	18·8	10·5-27·0	15·2	8·2-21·6	17·4	10·2-27·8	22·2	14·0-30·0
% Communal establishment residence	9·7	0·0-26·4	5·9	0·0-23·1	8·6	0·0-21·4	15·8	2·3-34·2

Note: Fully participating practices had >50% of their ID adults with a health check by end of 2010. Non-participating practices had <25% of their ID adults with a health check by end of 2012. 95 (partial participating) practices did not meet either criterion. 72 of the 289 practices had zero participation by 2010, which fell to 35 by 2012.

† - Medians are calculated among all ID adults registered on 1/1/2009, except for "Number registered during 2009-12". First, a mean is calculated at practice level, and then a median of the practice means is then calculated.

‡ - Patients who spent at least one day registered during 2009-12

Table 2: Hospital admissions in 2011-12 vs. 2009-10 by practice level of participation in health checks

Practice Status	Outcome	Annual Rate in 2009-10 per 1000 person years	Annual Rate in 2011-12 per 1000 person years	Practice Period IRR† (95% CI)	Practice Change in IRR (95% CI) for fully participating vs. non-participating practices‡
All practices (N=289)	All Emergency Admissions	191·1	176·7	**0·92** (0·86-0·99)	_
	Emergency ACSCs Only^{o}	64·9	58·6	**0·91** (0·82-1·00)	_
	All Elective Admissions*	117·1	119·2	**1·02** (0·95-1·09)	_
Fully participating Practices (N=126)	All Emergency Admissions	183·6	160·6	**0·88** (0·80-0·96)	**0·97** (0·78-1·19)
	Emergency ACSCs Only^{o}	69·2	56·3	**0·82** (0·72-0·92)	**0·74** (0·58-0·95)
	All Elective Admissions*	112·4	114·0	**1·02** (0·92-1·14)	**1·02** (0·84-1·25)
Non participating Practices (N=68)	All Emergency Admissions	226·9	205·3	**0·90** (0·75-1·09)	**1·00**
	Emergency ACSCs Only^{o}	70·1	77·1	**1·10** (0·89-1·36)	**1·00**
	All Elective Admissions*	125·9	127·3	**1·00** (0·85-1·19)	**1·00**

Note: Fully participating practices had >50% of their ID patients with a health check by end of 2010. Non-participating practices had <25% of their ID patients with a health check by end of 2012. 95 practices did not meet either criteria and were excluded from the comparison.

* - Exclude patients with abnormally high elective rates (average > 6/year)

^{o} - For definition of ambulatory care sensitive conditions please refer to E-Table 1

† - This represents the within practice change in admission post health check compared to pre health check estimated from conditional Poisson model

‡ - This represents the within practice post health check change in admissions between the fully participating practices versus the non participating practices estimated from conditional Poisson model

Table 3: Characteristics of registered adult patients with ID by whether they had a health check between April 2009 and March 2013

Individual characteristic	ID patients with health check		ID patients without health check	
	n	%	n	%
All	7,487	100%	6,922	100%
Gender				
Women	3,183	42·5%	2,889	41·7%
Men	4,304	57·5%	4,033	58·3%
Age at health check/index date				
18-34 years	2,579	34·5%	3,159	45·6%
35-54 years	3,136	41·9%	2,432	35·1%
55-84 years	1,772	23·7%	1,331	19·2%
Down's Syndrome				
No	6,573	87·8%	6,283	90·8%
Yes	914	12·2%	639	9·2%
Autism Spectrum Disorder				
No	6,744	90·1%	6,423	92·8%
Yes	743	9·9%	499	7·2%
High support needs†				
No	5,452	72·8%	6,031	87·1%
Yes	2,035	27·2%	891	12·9%
Lives in communal establishment				
Not recorded	5,574	74·5%	6,111	88·3%
Yes	1,913	25·6%	811	11·7%

† - Has been classed as having Severe or Profound ID by GP or has 2 or more of the following in addition to an ID diagnosis: epilepsy, cerebral palsy or significant mobility problem (wheelchair use or greater problem), severe visual impairment, severe hearing impairment, a continence problem or use of PEG feeding.

Table 4: Summary of hospital admission rates in adults with ID pre and post health check, or index date for those without health check

	Outcome	Pre-health check		Post health check		Period IRR† (95% CI)	Change in IRR (95% CI) vs. age-sex-practice matched controls‡
		Total Admissions	Annual Rate/1000	Total Admissions	Annual Rate/1000		
ID patients with health check (n=7,487)	All Emergency Admissions	1,673	**145·7**	3,840	**173·2**	**1·22** (1·11-1·34)	**0·96** (0·87-1·07)
	Emergency ACSCs Only^{o}	602	**52.4**	1,314	**59.3**	**1·11** (0·95-1·29)	**0·82** (0·69-0·99)
	All Elective Admissions*	1,328	**115·9**	2,703	**122·4**	**1·11** (1·01-1·21)	**0·96** (0·87-1·06)
ID patients without health check but assigned a random index date(n=6.922)	All Emergency Admissions	1,836	**186·0**	4,263	**212·2**	**1·20** (1·09-1·32)	**1·05** (0·94-1·17)
	Emergency ACSCs Only^{o}	520	**52.7**	1,340	**66.7**	**1·35** (1·14-1·60)	**1·11** (0·92-1·36)
	All Elective Admissions*	1,170	**119·1**	2,567	**128·4**	**1·02** (0·93-1·12)	**0·90** (0·81-1·00)

Mean follow up time was – ID patients with health check: 560 days (pre), 1081 (post). ID patients without health check): 521 days (pre), 1059 (post).

* - Excludes patients with abnormally high elective rates (average > 6/year)

^{o} - For definition of ambulatory care sensitive conditions please refer to E-Table 4

† - This represents the within person change in admission post health check compared to pre health check estimated from conditional Poisson model

‡ - This represents the within person post health check change in admissions between the ID patients and their respective controls (n=46,408 for health check ID patients, n=47,622 for non-health check ID patients) estimated from conditional Poisson model

Table 5: Interaction incidence rate ratios (IRR) comparing the change in emergency hospital admission rates post health check between adults with ID and matched controls, stratified by individual characteristics

Status at time of health check		ID patients with health check	ID patients without health check
		Change in IRR (95% CI) vs. age-sex-practice matched controls‡	Change in IRR (95% CI) vs. age-sex-practice matched controls‡
Gender			
	Women	**1·07** (0·92-1·25)	**1·13** (0·95-1·34)
	Men	**0·88** (0·76-1·01)	**0·98** (0·85-1·13)
Age			
	18-34 years	**1·01** (0·81-1·25)	**0·97** (0·80-1·16)
	35-54 years	**0·95** (0·80-1·13)	**1·12** (0·92-1·34)
	55-84 years	**0·96** (0·81-1·14)	**0·96** (0·78-1·18)
Downs' Syndrome			
	No	**0·91** (0·82-1·02)	**1·01** (0·90-1·14)
	Yes	**1·55** (1·15-2·08)	**1·55** (1·08-2·22)
Autism Spectrum Disorder			
	No	**0·95** (0·85-1·05)	**1·04** (0·93-1·16)
	Yes	**1·18** (0·76-1·82)	**1·25** (0·75-2·08)
High support needs†			
	No	**1·06** (0·93-1·22)	**1·03** (0·90-1·17)
	Yes	**0·80** (0·67-0·95)	**1·07** (0·85-1·35)
Lives in communal establishment			
	-Not recorded	**0·91** (0·80-1·03)	**1·02** (0·90-1·15)
	-Yes	**1·13** (0·92-1·38)	**1·22** (0·92-1·62)

† - Has been classed as having Severe or Profound ID by GP or has 2 or more of the following in addition to an ID diagnosis: epilepsy, cerebral palsy or significant mobility problem (wheelchair use or greater problem), severe visual impairment, severe hearing impairment, a continence problem or use of PEG feeding.

‡ - This represents the within person post health check change in admissions between the ID patients and their respective controls (n=46,408 for health check ID patients, n=47,622 for non-health check ID patients) estimated from conditional Poisson model

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E-Table 1: Read codes used to define intellectual disability

Read Code	Description	Used by QOF's Learning Disability*
13Z3.00	Low I.Q.	
6664.00	Mental handicap problem	
69DB.00	Learnin disability health exam	Health Check
918e.00	On learning disability register	Register
9HB..00	Learning disabilities administration status	
9HB0.00	Learning disabilities health action plan declined	
9HB1.00	Learning disabilities health action plan offered	
9HB2.00	Learning disabilities health action plan reviewed	
9HB3.00	Learning disabilities health assessment	Health Check
9HB4.00	Learning disabilities health action plan completed	
9HB5.00	Learning disabilities annual health assessment	Health Check
9HB6.00	Learning disabilities annual health assessment declined	
9HB6.11	Learning disabilities annual health check declined	
9HB7.00	Did not attend learning disabilities annual health assessmnt	
9HB7.11	Did not attend learning disabilities annual health check	
9hL..00	Exception reporting: learning disability quality indicators	
9hL0.00	Exc learn disability quality indicators: informed dissent	
9hL1.00	Exc learn disability quality indicators: patient unsuitable	
9mA..00	Learning disability annual health check invitation	
9mA0.00	Learning disability annual health check verbal invitation	
9mA1.00	Learning disability annual health check telephone invitation	
9mA2.00	Learning disability annual health check letter invitation	
9mA2000	Learning disability annual health check invtation 1st letter	
9mA2100	Learning disability annual health check invtation 2nd letter	
9mA2200	Learning disability annual health check invtation 3rd letter	
C03..11	Cretinism	
C031.00	Goitrous cretin	
C03z.12	Cretinism	
C372.11	Lesch - Nyhan syndrome	
C372000	Hypoxanthine-guanine-phosphoribosyltransferase deficiency	
C372011	Lesch - Nyhan syndrome	
C372300	Lesch-Nyhan syndrome	
C372z00	Other disorder of purine or pyrimidine metabolism NOS	
E141.00	Disintegrative psychosis	
E141.11	Heller's syndrome	
E141000	Active disintegrative psychoses	
E141100	Residual disintegrative psychoses	
E141z00	Disintegrative psychosis NOS	
E3...00	Mental retardation	Register
E30..00	Mild mental retardation, IQ in range 50-70	Register
E30..11	Educationally subnormal	Register
E30..12	Feeble-minded	Register
E30..13	Moron	Register

Read Code	Description	Used by QOF's Learning Disability*
E31..00	Other specified mental retardation	Register
E310.00	Moderate mental retardation, IQ in range 35-49	Register
E310.11	Imbecile	Register
E311.00	Severe mental retardation, IQ in range 20-34	Register
E312.00	Profound mental retardation with IQ less than 20	Register
E312.11	Idiocy	Register
E31z.00	Other specified mental retardation NOS	Register
E3y..00	Other specified mental retardation	Register
E3z..00	Mental retardation NOS	Register
Eu7..00	[X]Mental retardation	Register
Eu70.00	[X]Mild mental retardation	Register
Eu70.11	[X]Feeble-mindedness	Register
Eu70.12	[X]Mild mental subnormality	Register
Eu70000	[X]Mld mental retard with statement no or min impairm behav	Register
Eu70100	[X]Mld mental retard sig impairment behav req attent/treatmt	Register
Eu70y00	[X]Mild mental retardation, other impairments of behaviour	Register
Eu70z00	[X]Mild mental retardation without mention impairment behav	Register
Eu71.00	[X]Moderate mental retardation	Register
Eu71.11	[X]Moderate mental subnormality	Register
Eu71000	[X]Mod mental retard with statement no or min impairm behav	Register
Eu71100	[X]Mod mental retard sig impairment behav req attent/treatmt	Register
Eu71y00	[X]Mod retard oth behav impair	Register
Eu71z00	[X]Mod mental retardation without mention impairment behav	Register
Eu72.00	[X]Severe mental retardation	Register
Eu72.11	[X]Severe mental subnormality	Register
Eu72000	[X]Sev mental retard with statement no or min impairm behav	Register
Eu72100	[X]Sev mental retard sig impairment behav req attent/treatmt	Register
Eu72y00	[X]Severe mental retardation, other impairments of behaviour	Register
Eu72z00	[X]Sev mental retardation without mention impairment behav	Register
Eu73.00	[X]Profound mental retardation	Register
Eu73.11	[X]Profound mental subnormality	Register
Eu73000	[X]Profound ment retrd wth statement no or min impairm behav	Register
Eu73100	[X]Profound ment retard sig impairmnt behav req attent/treat	Register
Eu73y00	[X]Profound mental retardation, other impairments of behavr	Register
Eu73z00	[X]Prfnd mental retardation without mention impairment behav	Register
Eu7y.00	[X]Other mental retardation	Register
Eu7y000	[X]Oth mental retard with statement no or min impairm behav	Register
Eu7y100	[X]Oth mental retard sig impairment behav req attent/treatmt	Register
Eu7yy00	[X]Other mental retardation, other impairments of behaviour	Register
Eu7yz00	[X]Other mental retardation without mention impairment behav	Register
Eu7z.00	[X]Unspecified mental retardation	Register
Eu7z.11	[X]Mental deficiency NOS	Register
Eu7z.12	[X]Mental subnormality NOS	Register
Eu7z000	[X]Unsp mental retard with statement no or min impairm behav	Register
Eu7z100	[X]Unsp mentl retard sig impairment behav req attent/treatmt	Register

Read Code	Description	Used by QOF's Learning Disability*
Eu7zy00	[X]Unspecified mental retardatn, other impairments of behav	Register
Eu7zz00	[X]Unsp mental retardation without mention impairment behav	Register
Eu81400	[X]Moderate learning disability	Register
Eu81500	[X]Severe learning disability	Register
Eu81600	[X]Mild learning disability	Register
Eu81700	[X]Profound learning disability	Register
Eu81z00	[X]Developmental disorder of scholastic skills, unspecified	Register
Eu81z11	[X]Learning disability NOS	Register
Eu81z12	[X]Learning disorder NOS	Register
Eu81z13	[X]Learn acquisition disab NOS	Register
Eu84112	[X]Mental retardation with autistic features	
Eu84200	[X]Rett's syndrome	
Eu84300	[X]Other childhood disintegrative disorder	
Eu84311	[X]Dementia infantalis	
Eu84312	[X]Disintegrative psychosis	
Eu84313	[X]Heller's syndrome	
Eu84400	[X]Overactive disorder assoc mental retard/stereotype movts	
PJ0..00	Down's syndrome - trisomy 21	
PJ0..11	Mongolism	
PJ0..12	Trisomy 21	
PJ0..13	Trisomy 22	
PJ00.00	Trisomy 21, meiotic nondisjunction	
PJ01.11	Trisomy 21, mitotic nondisjunction	
PJ02.00	Trisomy 21, translocation	
PJ02.11	Partial trisomy 21 in Down's syndrome	
PJ0z.00	Down's syndrome NOS	
PJ0z.11	Trisomy 21 NOS	
PJ1..00	Patau's syndrome - trisomy 13	
PJ10.00	Trisomy 13, meiotic nondisjunction	
PJ11.00	Trisomy 13, mosaicism	
PJ11.11	Trisomy 13, mitotic nondisjunction	
PJ12.00	Trisomy 13, translocation	
PJ12.11	Partial trisomy 13 in Patau's syndrome	
PJ1z.00	Patau's syndrome NOS	
PJ1z.11	Trisomy 13 NOS	
PJ2..00	Edward's syndrome - trisomy 18	
PJ20.00	Trisomy 18, meiotic nondisjunction	
PJ21.00	Trisomy 18, mosaicism	
PJ21.11	Trisomy 18, mitotic nondisjunction	
PJ22.00	Trisomy 18, translocation	
PJ22.11	Partial trisomy 18 in Edward's syndrome	
PJ2z.00	Edward's syndrome NOS	
PJ2z.11	TRISOMY 18 NOS	
PJ30.00	Antimongolism syndrome	
PJ30.11	Deletion of long arm of chromosome 21	

Read Code	Description	Used by QOF's Learning Disability*
PJ31.00	Cri-du-chat syndrome	
PJ31.11	Deletion of short arm of chromosome 5	
PJ32.00	Deletion of short arm of chromosome 4	
PJ32.11	Wolff - Hirschorn syndrome	
PJ33100	Deletion of long arm of chromosome 18	
PJ33111	18p- syndrome	
PJ33200	Deletion of short arm of chromosome 18	
PJ33211	18q- syndrome	
PJ33300	Smith-Magenis syndrome	
PJ33400	Jacobsen syndrome	
PJ33500	Greig cephalopolysyndactyly syndrome	
PJ33700	3p deletion syndrome	
PJ33800	Chromosome 4q deletion syndrome	
PJ33900	Langer-Giedion syndrome	
PJ33A00	Kleefstra syndrome	
PJ3z.00	Monosomies and deletions from the autosomes NOS	
PJ50.00	Whole chromosome trisomy syndromes	
PJ50000	Trisomy 6	
PJ50100	Trisomy 7	
PJ50200	Trisomy 8	
PJ50300	Trisomy 9	
PJ50400	Trisomy 10	
PJ50500	Trisomy 11	
PJ50600	Trisomy 12	
PJ50700	Other trisomy C syndromes	
PJ50800	Trisomy 22	
PJ50w00	Whole chromosome trisomy, meitotic nondisjunction	
PJ50x00	Whole chromosome trisomy, mosaicism	
PJ50x11	Whole chromosome trisomy, mitotic nondisjunction	
PJ50y00	Other specified whole chromosome trisomy syndrome	
PJ50z00	Whole chromosome trisomy syndrome NOS	
PJ51.00	Partial trisomy syndromes	
PJ51000	Major partial trisomy	
PJ51100	Minor partial trisomy	
PJ51200	10q partial trisomy syndrome	
PJ51300	Trisomy 4p syndrome	
PJ51400	Trisomy 9p syndrome	
PJ51500	15q partial trisomy syndrome	
PJ51z00	Partial trisomy syndrome NOS	
PJ52.00	Trisomies of autosomes NEC	
PJ52z00	Trisomy of autosomes NEC NOS	
PJ9..00	Mowat-Wilson syndrome	
PJyy200	Fragile X chromosome	
PJyy400	Fragile X syndrome	
PKy0.11	Prader-Willi Syndrome	

Read Code	Description	Used by QOF's Learning Disability*
PKy0.12	Prader-Willi syndrome	
PKy4.00	William syndrome	
PKy9300	Prader - Willi syndrome	
Pyu0200	[X]Other reduction deformities of brain	
PyuA000	[X]Oth specif trisomies & partial trisomies of autosomes	
R034y11	[D]Global retardation	
ZS34.00	Developmental disorder of scholastic skill	
ZS34.11	Learning disability	

*** -** This column indicates whether the Read code was used by the Quality and Outcomes Framework (version 26 of the business rules from 2013) to identify patients on its Learning Disability register ("Register"), or used to indicate a health check ("Health Check"). The Read code **Eu818** "[X]Specific learning disability" was subsequently introduced into QOF in 2014-5 and therefore not counted in our study.

E-Table 2: Read codes used to define severe health needs

Read Code	Description	Sub-Group*
13C5.00	Confined to chair	Mobility severe
13C5.11	Chairbound	Mobility severe
13C6.00	Bed-ridden	Mobility severe
13C6.11	Bedbound	Mobility severe
13CC.00	Immobile	Mobility severe
13CD.00	Mobility very poor	Mobility severe
13CE.00	Mobility poor	Mobility severe
14U5.00	H/O: gastrostomy	PEG Feeding
1593.00	H/O: stress incontinence	Continence
16F..00	Double incontinence	Continence
19E2.00	Soiling - encopresis	Continence
19E2.11	Encopresis symptom	Continence
19E2.12	Soiling symptom	Continence
19E3.00	Incontinent of faeces	Continence
19E3.11	Incontinent of faeces symptom	Continence
1A22.00	Enuresis	Continence
1A22000	Nocturnal enuresis	Continence
1A22011	Bedwetting	Continence
1A22100	Daytime enuresis	Continence
1A23.00	Incontinence of urine	Continence
1A24.00	Stress incontinence	Continence
1A24.11	Stress incontinence - symptom	Continence
1A26.00	Urge incontinence of urine	Continence
1B75.00	Loss of vision	Severe Visual Loss
1B77.00	Deteriorating vision	Severe Visual Loss
1C13.00	Deafness	Severe Hearing impairment
1C13300	Bilateral deafness	Severe Hearing impairment
1C17.00	Hearing aid problem	Severe Hearing impairment
2836.00	O/E - quadriplegia	Mobility severe
2BL..11	O/E - deaf	Severe Hearing impairment
2BL3.00	O/E - significantly deaf	Severe Hearing impairment
2BL4.00	O/E - very deaf	Severe Hearing impairment
2BL5.00	O/E - completely deaf	Severe Hearing impairment
2DG..00	Hearing aid worn	Severe Hearing impairment
2DH0.00	Uses hearing loop	Severe Hearing impairment
3930.00	Bowels: incontinent	Continence
3931.00	Bowels: occasional accident	Continence
3940.00	Bladder: incontinent	Continence
3941.00	Bladder: occasional accident	Continence
3960.00	Dependent: chair/bed transfer	Mobility severe
3980.00	Immobile	Mobility severe
3981.00	Independent in wheelchair	Mobility severe
3982.00	Minimal help in wheelchair	Mobility severe
398A.00	Dependent on helper pushing wheelchair	Mobility severe

Read Code	Description	Sub-Group*
6688.00	Registered partially sighted	Severe Visual Loss
6688.11	Registered partially blind	Severe Visual Loss
6689.00	Registered blind	Severe Visual Loss
6689.11	Registered severely sight impaired	Severe Visual Loss
668C.00	Certificate of vision impairment	Severe Visual Loss
668D.00	Registered sight impaired	Severe Visual Loss
7007300	Insertion of auditory implant to brainstem	Severe Hearing impairment
7308400	Placement of hearing implant in external ear	Severe Hearing impairment
7308500	Attention to hearing implant in external ear	Severe Hearing impairment
7308600	Removal of hearing implant from external ear	Severe Hearing impairment
7311A00	Insertn bone anchors subcutaneous bone anchored hearing aid	Severe Hearing impairment
7317C00	Placement of hearing implant in middle ear	Severe Hearing impairment
7317D00	Attention to hearing implant in middle ear	Severe Hearing impairment
7317E00	Removal of hearing implant from middle ear	Severe Hearing impairment
7319.00	Attachment of bone anchored hearing prosthesis	Severe Hearing impairment
7319000	Insertion fixtures bone anchored hearing prosthesis Stage 1	Severe Hearing impairment
7319100	Insertion fixtures bone anchored hearing prosthesis Stage 2	Severe Hearing impairment
7319200	Reduction soft tissue for bone anchored hearing prosthesis	Severe Hearing impairment
7319300	Attention to fixtures for bone anchored hearing prosthesis	Severe Hearing impairment
7319400	One stage insert fixtures bone anchored hearing prosthesis	Severe Hearing impairment
7319500	Fitting external hearing prosthesis bone anchored fixtures	Severe Hearing impairment
7319y00	Other specified attachment bone anchored hearing prosthesis	Severe Hearing impairment
7319z00	Attachment of bone anchored hearing prosthesis NOS	Severe Hearing impairment
7617.00	Gastrostomy operations	PEG Feeding
7617.12	Creation of gastrostomy	PEG Feeding
7617000	Creation of permanent gastrostomy	PEG Feeding
7617100	Creation of temporary gastrostomy	PEG Feeding
7617400	Attention to gastrostomy tube	PEG Feeding
7617500	Removal of gastrostomy tube	PEG Feeding
7617600	Change of gastrostomy tube	PEG Feeding
7617700	Maintenance of percutaneous endoscopic gastrostomy tube	PEG Feeding
7617z00	Gastrostomy operation NOS	PEG Feeding
7619.11	Gastrotomy NEC	PEG Feeding
761E300	Temporary percutaneous endoscopic gastrostomy	PEG Feeding
761E400	Permanent percutaneous endoscopic gastrostomy	PEG Feeding
761E600	Fibreoptic endoscopic percutaneous insert gastrostomy (PEG)	PEG Feeding
761E900	Fibreoptic endoscopic removal of gastrostomy tube	PEG Feeding
761EA00	Fibreoptic endoscopic percutaneous insertion of gastrostomy	PEG Feeding
8CJ2.00	Percutaneous endoscopic gastrostomy feeding	PEG Feeding
8D2..00	Auditory aid	Severe Hearing impairment
8D2..11	Auditory aid provision	Severe Hearing impairment
8D2..12	Hearing aid provision	Severe Hearing impairment
8D21.00	Provide head worn hearing aid	Severe Hearing impairment
8D22.00	Provide body worn hearing aid	Severe Hearing impairment
8D23.00	Ear fitting hearing aid	Severe Hearing impairment

Read Code	Description	Sub-Group*
8D24.00	Replace hearing aid battery	Severe Hearing impairment
8D25.00	Physiolog. hearing assistance	Severe Hearing impairment
8D2Z.00	Auditory aid NOS	Severe Hearing impairment
8D3..00	Visual aid	Severe Visual Loss
8D3..13	Visual aid provision	Severe Visual Loss
8D31.00	Physiolog. visual assistance	Severe Visual Loss
8D3Z.00	Visual aid NOS	Severe Visual Loss
8D73.00	Nocturnal bladder warning syst	Continence
8D73.11	Enuretic alarm	Continence
8D73.12	Enuresis alarm	Continence
8D9..13	Wheel chair	Mobility severe
8D92.00	Self propelled wheel chair	Mobility severe
8D93.00	Pedal powered wheel chair	Mobility severe
8D94.00	Powered wheel chair	Mobility severe
8D95.00	Wheel chair unspecified	Mobility severe
8D9A.00	Attendant powered wheel chair	Mobility severe
8D9B.00	Wheel chair seating	Mobility severe
8E3..00	Deafness remedial therapy	Severe Hearing impairment
8E3Z.00	Deafness remedial therapy NOS	Severe Hearing impairment
8F6..11	Blind rehabilitation	Severe Visual Loss
8F61.00	Blind rehabilitation	Severe Visual Loss
8F62.00	Blind lead dog rehabilitation	Severe Visual Loss
8HHC.00	Referred for wheelchair assessment	Mobility severe
8HlE.00	Referral to visual impairment multidisciplinary team	Severe Visual Loss
8M41.00	Hearing aid requested	Severe Hearing impairment
9m08.00	Excluded from diabetic retinopathy screening as blind	Severe Visual Loss
9N0b.00	Seen in hearing aid clinic	Severe Hearing impairment
9NfB.00	Requires deafblind communicator guide	Severe Hearing impairment
9NfB.00	Requires deafblind communicator guide	Severe Visual Loss
9NlD.00	Seen by visual impairment teacher	Severe Visual Loss
9R43.00	Wheelchair in need of repair	Mobility severe
9R44.00	Wheelchair in good repair	Mobility severe
9RA..00	Wheelchair applied for	Mobility severe
A560200	Rubella deafness	Severe Hearing impairment
E276.00	Non-organic enuresis	Continence
E276000	Non-organic primary enuresis	Continence
E276100	Non-organic secondary enuresis	Continence
E276z00	Non-organic enuresis NOS	Continence
E277.00	Non-organic encopresis	Continence
E277000	Non-organic continuous encopresis	Continence
E277100	Non-organic discontinuous encopresis	Continence
E277z00	Non-organic encopresis NOS	Continence
E311.00	Severe mental retardation, IQ in range 20-34	Severe/Profound
E312.00	Profound mental retardation with IQ less than 20	Severe/Profound
E312.11	Idiocy	Severe/Profound
Eu72.00	[X]Severe mental retardation	Severe/Profound

Read Code	Description	Sub-Group*
Eu72.11	[X]Severe mental subnormality	Severe/Profound
Eu72000	[X]Sev mental retard with statement no or min impairm behav	Severe/Profound
Eu72100	[X]Sev mental retard sig impairment behav req attent/treatmt	Severe/Profound
Eu72y00	[X]Severe mental retardation, other impairments of behaviour	Severe/Profound
Eu72z00	[X]Sev mental retardation without mention impairment behav	Severe/Profound
Eu73.00	[X]Profound mental retardation	Severe/Profound
Eu73.11	[X]Profound mental subnormality	Severe/Profound
Eu73000	[X]Profound ment retrd wth statement no or min impairm behav	Severe/Profound
Eu73100	[X]Profound ment retard sig impairmnt behav req attent/treat	Severe/Profound
Eu73y00	[X]Profound mental retardation, other impairments of behavr	Severe/Profound
Eu73z00	[X]Prfnd mental retardation without mention impairment behav	Severe/Profound
Eu81500	[X]Severe learning disability	Severe/Profound
Eu81700	[X]Profound learning disability	Severe/Profound
Eu9y000	[X]Nonorganic enuresis	Continence
Eu9y100	[X]Nonorganic encopresis	Continence
F132100	Progressive myoclonic epilepsy	Epilepsy
F132111	Unverricht - Lundborg disease	Epilepsy
F137.00	Symptomatic torsion dystonia	Cerebral Palsy
F137.11	Athetoid cerebral palsy	Cerebral Palsy
F137.12	Athetosis - congenital	Cerebral Palsy
F137.13	Vogt's disease	Cerebral Palsy
F137000	Athetoid cerebral palsy	Cerebral Palsy
F137011	Vogt's disease	Cerebral Palsy
F137100	Double athetosis	Cerebral Palsy
F137111	Congenital athetosis	Cerebral Palsy
F137y00	Other specified symptomatic torsion dystonia	Cerebral Palsy
F137z00	Symptomatic torsion dystonia NOS	Cerebral Palsy
F23..00	Congenital cerebral palsy	Cerebral Palsy
F23..11	Congenital spastic cerebral palsy	Cerebral Palsy
F23..12	Infantile cerebral palsy	Cerebral Palsy
F23..13	Littles disease	Cerebral Palsy
F23..14	Cerebral atonia	Cerebral Palsy
F230.00	Congenital diplegia	Cerebral Palsy
F230.11	Paraplegia - congenital	Cerebral Palsy
F230000	Congenital paraplegia	Cerebral Palsy
F230100	Cerebral palsy with spastic diplegia	Cerebral Palsy
F230z00	Congenital diplegia NOS	Cerebral Palsy
F231.00	Congenital hemiplegia	Cerebral Palsy
F232.00	Congenital quadriplegia	Cerebral Palsy
F232.11	Tetraplegia - congenital	Cerebral Palsy
F233.00	Congenital monoplegia	Cerebral Palsy
F233.11	Congenital spastic foot	Cerebral Palsy
F234.00	Infantile hemiplegia NOS	Cerebral Palsy
F23y.00	Other congenital cerebral palsy	Cerebral Palsy
F23y000	Ataxic infantile cerebral palsy	Cerebral Palsy

Read Code	Description	Sub-Group*
F23y100	Flaccid infantile cerebral palsy	Cerebral Palsy
F23y200	Spastic cerebral palsy	Cerebral Palsy
F23y300	Dyskinetic cerebral palsy	Cerebral Palsy
F23y400	Ataxic diplegic cerebral palsy	Cerebral Palsy
F23y500	Worster-Drought syndrome	Cerebral Palsy
F23y511	Congenital suprabulbar paresis	Cerebral Palsy
F23yz00	Other infantile cerebral palsy NOS	Cerebral Palsy
F23z.00	Congenital cerebral palsy NOS	Cerebral Palsy
F240.00	Quadriplegia	Mobility severe
F240.11	Tetraplegia	Mobility severe
F240100	Spastic tetraplegia	Mobility severe
F241.00	Paraplegia	Mobility severe
F241100	Spastic paraplegia	Mobility severe
F242.00	Diplegia of upper limbs	Mobility severe
F243.00	Monoplegia of lower limb	Mobility severe
F244.00	Monoplegia of upper limb	Mobility severe
F25..00	Epilepsy	Epilepsy
F250.00	Generalised nonconvulsive epilepsy	Epilepsy
F250200	Epileptic seizures - atonic	Epilepsy
F250300	Epileptic seizures - akinetic	Epilepsy
F250500	Lennox-Gastaut syndrome	Epilepsy
F250y00	Other specified generalised nonconvulsive epilepsy	Epilepsy
F250z00	Generalised nonconvulsive epilepsy NOS	Epilepsy
F251.00	Generalised convulsive epilepsy	Epilepsy
F251000	Grand mal (major) epilepsy	Epilepsy
F251011	Tonic-clonic epilepsy	Epilepsy
F251200	Epileptic seizures - clonic	Epilepsy
F251300	Epileptic seizures - myoclonic	Epilepsy
F251400	Epileptic seizures - tonic	Epilepsy
F251500	Tonic-clonic epilepsy	Epilepsy
F251y00	Other specified generalised convulsive epilepsy	Epilepsy
F251z00	Generalised convulsive epilepsy NOS	Epilepsy
F253.00	Grand mal status	Epilepsy
F253.11	Status epilepticus	Epilepsy
F254.00	Partial epilepsy with impairment of consciousness	Epilepsy
F254000	Temporal lobe epilepsy	Epilepsy
F254100	Psychomotor epilepsy	Epilepsy
F254200	Psychosensory epilepsy	Epilepsy
F254300	Limbic system epilepsy	Epilepsy
F254400	Epileptic automatism	Epilepsy
F254500	Complex partial epileptic seizure	Epilepsy
F254z00	Partial epilepsy with impairment of consciousness NOS	Epilepsy
F255.00	Partial epilepsy without impairment of consciousness	Epilepsy
F255000	Jacksonian, focal or motor epilepsy	Epilepsy
F255011	Focal epilepsy	Epilepsy
F255012	Motor epilepsy	Epilepsy

Read Code	Description	Sub-Group*
F255100	Sensory induced epilepsy	Epilepsy
F255200	Somatosensory epilepsy	Epilepsy
F255300	Visceral reflex epilepsy	Epilepsy
F255311	Partial epilepsy with autonomic symptoms	Epilepsy
F255400	Visual reflex epilepsy	Epilepsy
F255500	Unilateral epilepsy	Epilepsy
F255600	Simple partial epileptic seizure	Epilepsy
F255y00	Partial epilepsy without impairment of consciousness OS	Epilepsy
F255z00	Partial epilepsy without impairment of consciousness NOS	Epilepsy
F257.00	Kojevnikov's epilepsy	Epilepsy
F25B.00	Alcohol-induced epilepsy	Epilepsy
F25C.00	Drug-induced epilepsy	Epilepsy
F25D.00	Menstrual epilepsy	Epilepsy
F25E.00	Stress-induced epilepsy	Epilepsy
F25F.00	Photosensitive epilepsy	Epilepsy
F25X.00	Status epilepticus, unspecified	Epilepsy
F25y.00	Other forms of epilepsy	Epilepsy
F25y000	Cursive (running) epilepsy	Epilepsy
F25y100	Gelastic epilepsy	Epilepsy
F25y200	Locl-rlt(foc)(part)idiop epilep&epilptic syn seiz locl onset	Epilepsy
F25y300	Complex partial status epilepticus	Epilepsy
F25y500	Panayiotopoulos syndrome	Epilepsy
F25yz00	Other forms of epilepsy NOS	Epilepsy
F25z.00	Epilepsy NOS	Epilepsy
F25z.11	Fit (in known epileptic) NOS	Epilepsy
F2B..00	Cerebral palsy	Cerebral Palsy
F2B0.00	Spastic quadriplegic cerebral palsy	Cerebral Palsy
F2B1.00	Spastic hemiplegic cerebral palsy	Cerebral Palsy
F2By.00	Other cerebral palsy	Cerebral Palsy
F2Bz.00	Cerebral palsy NOS	Cerebral Palsy
F49..00	Blindness and low vision	Severe Visual Loss
F49..11	Impaired vision	Severe Visual Loss
F49..12	Low vision	Severe Visual Loss
F49..13	Partial sight	Severe Visual Loss
F49..14	Sight impaired	Severe Visual Loss
F490.00	Blindness, both eyes	Severe Visual Loss
F490000	Unspecified blindness both eyes	Severe Visual Loss
F490100	Both eyes total visual impairment	Severe Visual Loss
F490400	Better eye: near total VI, Lesser eye: near total VI	Severe Visual Loss
F490600	Better eye: profound VI, Lesser eye: total VI	Severe Visual Loss
F490900	Acquired blindness, both eyes	Severe Visual Loss
F490z00	Blindness both eyes NOS	Severe Visual Loss
F491.00	Better eye: low vision, Lesser eye: profound VI	Severe Visual Loss
F491000	One eye blind, one eye low vision	Severe Visual Loss
F491100	Better eye: severe VI, Lesser eye: blind, unspecified	Severe Visual Loss
F491300	Better eye: severe VI, Lesser eye: near total VI	Severe Visual Loss

Read Code	Description	Sub-Group*
F491400	Better eye: severe VI, Lesser eye: profound VI	Severe Visual Loss
F491500	Better eye: moderate VI, Lesser eye: blind, unspecified	Severe Visual Loss
F491700	Better eye: moderate VI, Lesser eye: near total VI	Severe Visual Loss
F491z00	One eye blind, one eye low vision NOS	Severe Visual Loss
F492.00	Low vision, both eyes	Severe Visual Loss
F492000	Low vision, both eyes unspecified	Severe Visual Loss
F492200	Better eye: severe VI, Lesser eye: severe VI	Severe Visual Loss
F492300	Better eye: moderate VI, Lesser eye: low vision unspecified	Severe Visual Loss
F492400	Better eye: moderate VI, Lesser eye: severe VI	Severe Visual Loss
F492500	Better eye: moderate VI, Lesser eye: moderate VI	Severe Visual Loss
F492z00	Low vision, both eyes NOS	Severe Visual Loss
F493.00	Visual loss, both eyes unqualified	Severe Visual Loss
F494.00	Legal blindness USA	Severe Visual Loss
F497.00	Severe visual impairment, binocular	Severe Visual Loss
F498.00	Moderate visual impairment, binocular	Severe Visual Loss
F49z.00	Visual loss NOS	Severe Visual Loss
F49z.11	Acquired blindness	Severe Visual Loss
F4H7300	Cortical blindness	Severe Visual Loss
F581211	Noise induced deafness	Severe Hearing impairment
F59..11	Deafness	Severe Hearing impairment
F590.11	Conductive deafness	Severe Hearing impairment
F591.13	Perceptive deafness	Severe Hearing impairment
F591211	Nerve deafness	Severe Hearing impairment
F591400	Congenital sensorineural deafness	Severe Hearing impairment
F591500	Ototoxicity - deafness	Severe Hearing impairment
F591511	Drug ototoxicity - deafness	Severe Hearing impairment
F591800	Congenital prelingual deafness	Severe Hearing impairment
F592.00	Mixed conductive and sensorineural deafness	Severe Hearing impairment
F593.00	Deaf mutism, NEC	Severe Hearing impairment
F594.00	High frequency deafness	Severe Hearing impairment
F595.00	Low frequency deafness	Severe Hearing impairment
F596.00	Maternally inherited deafness	Severe Hearing impairment
F598.00	Moderate acquired hearing loss	Severe Hearing impairment
F599.00	Severe acquired hearing loss	Severe Hearing impairment
F59A.00	Profound acquired hearing loss	Severe Hearing impairment
F59A.11	Deafened	Severe Hearing impairment
F59z.00	Deafness NOS	Severe Hearing impairment
F59z.11	Chronic deafness	Severe Hearing impairment
Fyu9.00	[X]Cerebral palsy and other paralytic syndromes	Cerebral Palsy
Fyu9000	[X]Other infantile cerebral palsy	Cerebral Palsy
Fyu9100	[X]Other specified paralytic syndromes	Cerebral Palsy
FyuU000	[X]Deaf mutism, not elsewhere classified	Severe Hearing impairment
K198.00	Stress incontinence	Continence
K586.00	Stress incontinence - female	Continence
Kyu5A00	[X]Other specified urinary incontinence	Continence
P40z.11	Deafness due to congenital anomaly NEC	Severe Hearing impairment

Read Code	Description	Sub-Group*
R00A.00	[D] Poor mobility	Mobility severe
R00C.00	[D]Immobility	Mobility severe
R076.00	[D]Incontinence of faeces	Continence
R076000	[D]Encopresis NOS	Continence
R076100	[D]Sphincter ani incontinence	Continence
R076z00	[D]Incontinence of faeces NOS	Continence
R083.00	[D]Incontinence of urine	Continence
R083000	[D]Enuresis NOS	Continence
R083100	[D]Urethral sphincter incontinence	Continence
R083200	[D] Urge incontinence	Continence
R083z00	[D]Incontinence of urine NOS	Continence
SJ15.12	Deafness - traumatic - NOS	Severe Hearing impairment
Z1J..00	Procedures to aid continence	Continence
Z6R3.00	Wheelchair dancing therapy	Mobility severe
Z6R8100	Wheelchair sport	Mobility severe
Z6X1.00	Wheelchair transfer practice	Mobility severe
Z6Z..00	Wheelchair education	Mobility severe
Z6Z1.00	Wheelchair use training	Mobility severe
Z6Z1200	Propelling wheelchair training	Mobility severe
Z6Z1300	Controlling electric wheelchair training	Mobility severe
Z8B5.00	Ability to use hearing aid	Severe Hearing impairment
Z8B5100	Able to use hearing aid	Severe Hearing impairment
Z8B5200	Unable to use hearing aid	Severe Hearing impairment
Z8B5300	Does use hearing aid	Severe Hearing impairment
Z8B5311	Uses hearing aid	Severe Hearing impairment
Z8B5400	Does not use hearing aid	Severe Hearing impairment
Z8B5500	Difficulty using hearing aid	Severe Hearing impairment
Z911.00	Hearing aid procedure	Severe Hearing impairment
Z911100	Fit hearing aid	Severe Hearing impairment
Z911300	Adjust hearing aid settings	Severe Hearing impairment
Z911400	Changing hearing aid battery	Severe Hearing impairment
Z911500	Checking hearing aid	Severe Hearing impairment
Z911700	Switching on hearing aid	Severe Hearing impairment
Z911800	Turning off hearing aid	Severe Hearing impairment
Z911900	Putting on hearing aid	Severe Hearing impairment
Z911A00	Listening for feedback whistle of hearing aid	Severe Hearing impairment
Z911B00	Attention to hearing aid	Severe Hearing impairment
Z911E00	Fit ear mould for existing hearing aid	Severe Hearing impairment
Z96..00	Provision for visual and hearing impairment	Severe Visual Loss
Z961.00	Provision of guide help for visual and hearing impairment	Severe Visual Loss
Z9E2.00	Optical low vision aid provision	Severe Visual Loss
Z9E3.00	Provision of optical low vision aid - near	Severe Visual Loss
Z9E3100	Provision of magnifier low vision aid - near	Severe Visual Loss
Z9E3200	Provision of low vision hand magnifier	Severe Visual Loss
Z9E3300	Provision of low vision stand magnifier	Severe Visual Loss
Z9E3500	Provision of spectacle low vision aid - near	Severe Visual Loss

Read Code	Description	Sub-Group*
Z9E3600	Provision of telescopic spectacles	Severe Visual Loss
Z9E3700	Provision of spectacle magnifier	Severe Visual Loss
Z9E3900	Near low vision aid - clip-on spectacle magnifier	Severe Visual Loss
Z9E3A00	Provision of spectacle telescope	Severe Visual Loss
Z9E3B00	Near low vision aid - integral spectacle telescope	Severe Visual Loss
Z9E3C00	Near low vision aid - clip-on spectacle telescope	Severe Visual Loss
Z9E3D00	Near low vision aid - extra cap for telescope	Severe Visual Loss
Z9E3E00	Provision of headband telescope	Severe Visual Loss
Z9E4.00	Provision of optical low vision aid - distance	Severe Visual Loss
Z9E5.00	Provision of non-optical low vision aid	Severe Visual Loss
Z9E5200	Provision of closed circuit television	Severe Visual Loss
Z9E5300	Provision of image intensifier	Severe Visual Loss
Z9E5400	Provision of ancillary low vision aid	Severe Visual Loss
Z9E5700	Provision of work board	Severe Visual Loss
Z9E6.00	Provision of visual appliance	Severe Visual Loss
Z9E6500	Provision of audiotaped services	Severe Visual Loss
Z9E6600	Provision of talking book	Severe Visual Loss
Z9E8100	Hearing aid provision	Severe Hearing impairment
Z9E8111	Auditory aid provision	Severe Hearing impairment
Z9EA.00	Provision of incontinence appliance	Continence
Z9EA100	Provision of nocturnal bladder warning system	Continence
Z9EA111	Provision of enuresis alarm	Continence
Z9EA112	Provision of enuretic alarm	Continence
Z9EH400	Provision of wheelchair	Mobility severe
Z9MO.00	Enuresis support	Continence
ZC65200	Gastrostomy feeding	PEG Feeding
ZC65300	Percutaneous endoscopic gastrostomy feeding	PEG Feeding
ZC65311	PEG - Percutaneous endoscopic gastrostomy feeding	PEG Feeding
ZC65400	Button gastrostomy feeding	PEG Feeding
ZC65500	Jejunostomy feeding	PEG Feeding
ZE83200	Hearing for loud voice impaired	Severe Hearing impairment
ZE84200	Hearing for voice impaired	Severe Hearing impairment
ZE87.00	Hearing loss	Severe Hearing impairment
ZE87.11	Deafness	Severe Hearing impairment
ZE87.13	Hard of hearing	Severe Hearing impairment
ZE87.16	HL - Hearing loss	Severe Hearing impairment
ZE87.17	HOH - Hard of hearing	Severe Hearing impairment
ZL22400	Under care of continence nurse	Continence
ZN56800	Blind telephone user	Severe Visual Loss
ZN56900	Deaf telephone user	Severe Hearing impairment
ZO2..00	Unable to mobilise	Mobility severe
ZO4..00	Does not mobilise	Mobility severe
ZO72.00	Unable to mobilise indoors	Mobility severe
ZO74.00	Does not mobilise indoors	Mobility severe
ZO75.00	Difficulty mobilising indoors	Mobility severe
ZO92.00	Unable to mobilise using mobility aids	Mobility severe

Read Code	Description	Sub-Group*
ZO93.00	Does mobilise using aids	Mobility severe
ZO94.00	Does not mobilise using mobility aids	Mobility severe
ZO96.00	Ability to mobilise using wheelchair	Mobility severe
ZO96.11	Wheelchair mobility	Mobility severe
ZO96100	Able to mobilise using wheelchair	Mobility severe
ZO96200	Unable to mobilise using wheelchair	Mobility severe
ZO96300	Does mobilise using wheelchair	Mobility severe
ZO96311	Mobilises using wheelchair	Mobility severe
ZO96400	Does not mobilise using wheelchair	Mobility severe
ZO96500	Difficulty mobilising using wheelchair	Mobility severe
ZOC6200	Unable to get in and out of a chair	Mobility severe
ZOC6400	Does not get in and out of a chair	Mobility severe
ZOC8200	Unable to get out of a chair	Mobility severe
ZOC8400	Does not get out of a chair	Mobility severe
ZOC9200	Unable to get on and off a bed	Mobility severe
ZOC9400	Does not get on and off a bed	Mobility severe
ZOCA200	Unable to get on a bed	Mobility severe
ZOCB200	Unable to get off a bed	Mobility severe
ZOCB400	Does not get off a bed	Mobility severe
ZOD2.00	Unable to move in bed	Mobility severe
ZOD4.00	Does not move in bed	Mobility severe
ZOD6200	Unable to roll over in bed	Mobility severe
ZOD6211	Unable to turn over in bed	Mobility severe
ZOD7500	Difficulty turning onto side in bed	Mobility severe
ZOD8200	Unable to move up and down bed	Mobility severe
ZT12711	Voice associated with hearing loss	Severe Hearing impairment
ZV44100	[V]Has gastrostomy	PEG Feeding
ZV45G00	[V]Presence of external hearing-aid	Severe Hearing impairment
ZV45N00	[V]Bone anchored hearing aid in situ	Severe Hearing impairment
ZV46200	[V]Dependence on wheelchair	Mobility severe
ZV4L011	[V] Poor mobility	Mobility severe
ZV53200	[V]Fitting or adjustment of hearing aid	Severe Hearing impairment
ZV53800	[V]Fitting or adjustment of wheelchair	Mobility severe
ZV53D00	[V]Adjustment and management of implanted hearing device	Severe Hearing impairment
ZV55100	[V]Attention to gastrostomy	PEG Feeding

* - To be classed as having severe health needs, must be “Severe/Profound” or have 2 or more of the following in addition to an ID diagnosis: epilepsy, cerebral palsy or significant mobility problem, severe visual impairment, severe hearing impairment, a continence problem or use of PEG feeding.

E-Table 3: Read codes used to identify communal or shared living accommodation

Read Code	Description
13F4.00	Warden attended
13F4.11	Lives in warden controlled accommodation
13F4000	Resident in sheltered accommodation
13F5.00	Part III accommodation
13F5.11	Part 3 accommodation
13F5100	Part III accommodation arranged
13F5111	Part 3 accommodation arranged
13F5200	Resident in part III accommodation
13F6.00	Nursing/other home
13F6100	Lives in a nursing home
13F7.00	Residential institution
13F7100	Lives in a welfare home
13F7200	Lives in an old peoples home
13F7300	Lives in a childrens home
13F7400	Admitted to a children's home
13F8100	Long stay hospital inpatient
13F9.00	Living in hostel
13F9.11	Living in sheltered accomodatn
13FK.00	Lives in a residential home
13FS.00	Long stay hospital inpatient
13FT.00	Lives in an old peoples home
13FV.00	Lives in a welfare home
13FX.00	Lives in care home
13FY.00	Lives in a children's unit
Z177100	24 hour care
Z177500	Custodial care
Z177C00	Residential care
Z177D00	Local authority residential care
Z177D11	LA - local authority residential care
ZU37.00	Lives in a community
ZU37100	Lives in a school community
ZU37200	Lives in boarding school
ZV60600	[V]Institution resident
ZV60611	[V]Boarding school resident
ZV60700	[V]Sheltered housing
ZU37100	Lives in a school community

E-Table 4: Ambulatory care sensitive conditions (ACSCs) and ICD-10 codes used to define them

Conditions	ICD-10 Code
Angina	I20, I24.0, I24.8-I24.9
Aspiration	J69.0, J69.8
Asthma	J45-J46
Cellulitis	L03-L04, L08, L88, L98.0, L98.3
Congestive heart failure	I11.0, I50, J81
Constipation	K59.0
Convulsions/epilepsy	G40-G41, R56, O15
Chronic obstructive pulmonary disease (COPD)	J41-J44, J47
Dehydration & gastroenteritis	E86, K52.2, K52.8, K52.9
Dental conditions	A69.0, K02-K06, K08, K09.8, K09.9, K12-K13
Diabetes complications	E10.0-E10.8, E11.0-E11.8, E12.0-E12.8, E13.0-E13.8, E14.0-E14.8
Ear, nose and throat infections	H66-H67, J02-J03, J06, J31.2
Gangrene	R02
Gastro-oesophageal reflux disease	K21
Hypertension	I10, I11.9
Iron deficiency anaemia	D50.1, D50.8-D50.9
Influenza	J10-J11
Nutritional deficiencies	E40-E43, E55, E64.3
Pelvic inflammatory disease	N70, N73-N74
Perforated/bleeding ulcers	K25.0-K25.2, K25.4-K25.6, K26.0-K26.2, K26.4-K26.6, K27.0-K27.2, K27.4-K27.6, K28.0-K28.2, K28.4-K28.6
Pneumonia & other acute lower respiratory tract infection (LRTI)	J13-J14, J15.3-J15.4, J15.7, J15.9, J16.8, J18.1, J18.8, J20-J20.2, J20.8, J20.9, J22
Tuberculosis & other vaccine preventable	A15-A16, A19, A35-A37, A80, B05-B06, B16.1, B16.9, B18.0-B18.1, B26, G00.0, M01.4
Urinary tract infection (UTI)/pyelonephritis	N10-N12, N13.6, N39.0