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Which features of primary care affect unscheduled secondary care use? A systematic review

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ABSTRACT

Objectives: To conduct a systematic review to identify studies that describe factors and interventions at primary care practice level that impact on levels of utilisation of unscheduled secondary care.

Setting: Observational studies at primary care practice level.

Participants: Studies included people of any age of either sex living in Organisation for Economic Co-operation and Development (OECD) countries with any health condition.

Primary and secondary outcome measures: The primary outcome measure was unscheduled secondary care as measured by emergency department attendance and emergency hospital admissions.

Results: 48 papers were identified describing potential influencing features on emergency department visits (n=24 studies) and emergency admissions (n=22 studies). Patient factors associated with both outcomes were increased age, reduced socioeconomic status, lower educational attainment, chronic disease and multimorbidity. Features of primary care affecting unscheduled secondary care were more complex. Being able to see the same healthcare professional reduced unscheduled secondary care. Generally, better access was associated with reduced unscheduled care in the USA. Proximity to healthcare provision influenced patterns of use. Evidence relating to quality of care was limited and mixed.

Conclusions: The majority of research was from different healthcare systems and limited in the extent to which it can inform policy. However, there is evidence that continuity of care is associated with reduced emergency department attendance and emergency hospital admissions.

Strengths and limitations of this study

- This review was conducted following rigorous Cochrane methodology.
- We included studies published after 2000 and conducted in Organisation for Economic Co-operation and Development countries to ensure that the results are as relevant as possible to primary healthcare provision in developed countries.
- Seven of the 44 studies had univariable analysis, which limits the interpretation of results.
- Although some studies were countrywide, others were concerned with more discrete populations, making generalisation more difficult.
- Research was carried out in different healthcare systems; findings from one setting may not be generalisable to other settings.

INTRODUCTION

Unscheduled care is defined as any unplanned contact with the health service by a person requiring or seeking help, care or advice.[1] It includes urgent care which comprises conditions that require assessment and planned intervention within 7 days, or which is likely to lead to an emergency within 4 weeks and emergency care which is not always life-threatening but needs prompt assessment and a planned intervention within 24 hours.[2] There are five levels of unscheduled healthcare from self-care (level 1), primary care, minor injury unit, etc (level 2) through to level 3 (emergency department (ED)) and hospital admission (level 4) and specialised hospital support (level 5).[3]

Reducing unscheduled care use in the secondary care sector (ie, ED attendance and emergency hospital admission (EHA)) is a priority for many healthcare systems. For example, in a recent King's Fund report, it was suggested that emergency admissions among people with long-term conditions that could have been managed in primary care cost the National Health Service (NHS) £1.42 billion annually and that this could be reduced by 8–18% through investment in primary and community-based services.[4]

Patterns of attendance at ED vary according to the local healthcare system and population but overall attendances at ED are rising.[5] In the UK, despite the universal provision of primary care for which there is no charge at the point of access, there were

17.6 million ED attendances recorded at major ED departments, single specialty A&E departments, walk-in centres and minor injury units in England in 2011–2012: an increase of 8.5% from 2010 to 2011.[6] In the UK, many patients use ED even when primary care offices or practices are open, with weekday attendances peaking in the mid-morning.

There is considerable variation in emergency admission and ED attendance rates across general practices.[7 8] The reason for this variation in rates across practice is poorly understood. Previous systematic reviews have been limited to looking at access and continuity of care.[9–13] The reviews of primary care access described the effect on ED use and not EHA, and included data in the continuity of care reviews were over 5 years old. This is the first review, to the best of our knowledge, that synthesises the effect of patient features, primary care access, features of primary care practice, continuity of care and quality markers on both ED use and EHA.

Our objective therefore was to conduct a systematic review to identify studies that describe features of primary care services that impact on levels of utilisation of unscheduled secondary healthcare (USC) (see online supplementary data—protocol).

METHODS

A systematic review was conducted to identify studies that describe factors at primary care practice level that impact on levels of utilisation of USC.

Inclusion criteria

Study population

Studies that included people of any age of either sex living in Organisation for Economic Co-operation and Development (OECD) countries.[14]

Types of features of primary healthcare

For both in hours and out of hours services, we selected studies examining the impact of patient features, access to primary healthcare, features of the practice, continuity of care and quality markers.

Types of studies

Observational studies about features of primary care services associated with unscheduled secondary care use. We included studies written in any language.

Outcomes

Any studies concerning any health condition as long as the outcome of interest was utilisation of USC, that is, attendance at an ED or an EHA.

Exclusion criteria

Studies that only reported admission for elective or planned healthcare including planned diagnostic services, admission to a community or non-acute hospital as an outcome and clinical trials primarily about the management of conditions. We excluded pre-2000 studies as primary healthcare provision has changed significantly over time and older studies were less relevant.

Searches and reference management

A search strategy was developed in Medline for the electronic databases according to their specific subject headings or searching structure to search for papers describing both primary studies and systematic reviews (see online supplementary data—search strategy). Other databases searched were EMBASE, CINAHL, PsycINFO and the Cochrane Library. All databases were searched from inception until October 2012. This review was part of a wider group of reviews that also included interventional and qualitative studies; thus, the search strategy and the PRISMA flow chart reflect this (see online supplementary data—search strategy; figure 1).

The search strategy was modified to search internet sites such as the Agency for Healthcare Research and Quality and the King's Fund. Reference lists of included papers were checked for further potentially eligible studies. These references underwent a two-stage process of screening using the inclusion and exclusion criteria by two independent reviewers. The first screen was of titles and abstracts and the second of the full papers. Where there was continued disagreement between reviewers about including or excluding a paper, a third reviewer made the final decision.

Data collection, analysis and reporting

Standardised data extraction forms were developed and then data were abstracted by one reviewer and a second reviewer checked data abstraction against the original paper. During this process, we divided the data into patient features, access to primary healthcare, features of the practice, continuity of care and quality markers. Quality of studies was assessed by two reviewers using a modified CASP appraisal tool for cohort and case control studies as appropriate for all the included studies.[15]

RESULTS

General

We identified 48 papers relevant to the aim of our study; 24 studies of features influencing ED visits and 22 studies of features influencing EHA[16–59] (figure 1). This included one paper describing one study with both outcomes,[16] two sister papers describing ED visits and EHA, respectively, within the same population[7 17] and two papers describing the same study on EHA.[18 19] Thus, the review contained 44 individual studies of which the majority of studies were cross-sectional in design (n=38). The remaining studies were a mixture of designs: longitudinal (n=2), before and after (n=1) and case control (n=2).Generally, the papers described data across two or more features of primary healthcare.

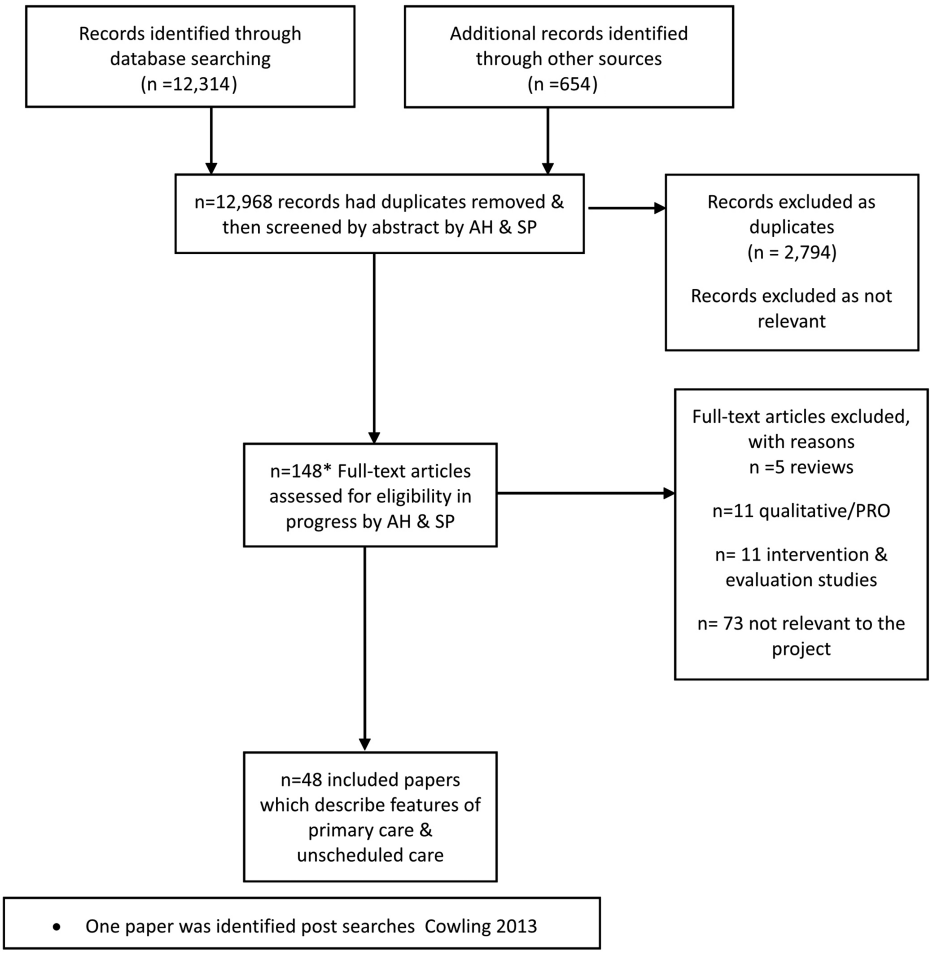

Figure 1 PRISMA flow diagram.

Quality appraisal

Several issues came out of the CASP quality appraisal of the studies (see online supplementary data—CASP). One was the generalisability of the studies; while some studies were country or state-wide for the whole population,[20–22] others analysed much smaller populations, for example, inner city boroughs.[23 24] Equally, some studies involved all patients on GP lists[7 25] while others dealt with specific groups such as patients with diabetes or paediatric patients.[26–28]

The majority of the studies described problems with response rates, bias and confounding factors. For some studies, this imposed serious caveats about the findings from the study, for example, poor response rates[27] or only univariable analysis was performed (seven studies, see online supplementary data—CASP).[7 16 25 27 29–31] The majority of studies performed multivariable analysis and so attempted to adjust for confounding factors. Only four studies described cost data, while the majority of the studies merely stated that the results had cost implications.[20 32–34]

Impact of patient characteristics on unscheduled care (n=21 studies)

The effect of patient characteristics on unscheduled care was described in 22 papers (21 studies), and this was usually in combination with investigation of non-patient factors (see online supplementary data-tables 1ab and 2ab). There were n=8 investigating ED use and n=14 investigating EHA and the 21 studies were spread across the UK (n=11), the USA (n=5), South America (n=1), Canada (n=1), Norway (n=1), Italy (n=1) and Spain (n=1).

Age, gender and ethnicity

All studies show that increased age is associated with increased ED attendance[28 35] and increased EHA.[17 34 36–38] The only exception was Cowling 2013, a study covering 95% of GP practices in England, which showed that an increase in the percentage of patients aged 65 years or older was associated with a small reduction in patients who self-referred to, and were then subsequently discharged from ED (relative rate 0.989 (95% CI 0.984 to 0.994), p<0.001), suggesting that older patients may be less likely to attend with minor illness.[39] However, gender appears to be less important in ED attendance with four studies showing no effect with gender.[7 28 39 40]

The evidence about the impact of gender on EHA is mixed with two studies from the UK and Norway showing that women are more likely to experience EHA[17 34] and three studies from Italy, Spain and the

USA showing that men are more likely to undergo EHA.[37 38 45] It is therefore possible that these effects are country/or culture specific.

The evidence for the effect of ethnicity is also mixed for ED attendance[7 28 30 40] and EHA.[35 37 38 42 45] However, this may be due to the lack of data on ethnicity admissions and dependency on location and ethnic mix of population.

Socioeconomic status

Decreased socioeconomic status is consistently associated with increased ED attendance[7 33 35 39 40 43 44] and increased EHA.[8 16 17 21 22 25 36 45] A similar effect is seen with social isolation and lack of social support for ED attendance[35 40] and EHA.[8 35 41]

One study associated increased education with reduced ED attendance.[26] Increased education is consistently associated with reduced EHA.[34 41 45]

In the USA, insurance status was associated with unscheduled care use. Two studies showed that adult Medicaid patients use the ED more and have more EHA than private insurance patients.[18 38] Another US study showed that parents of children with public health insurance who perceive good family centredness in their primary healthcare provision had reduced ED attendance.[28] In the UK, a study by Harris with multivariable analysis of data from 68 practices from Brent (North London) primary care trust (PCT) suggests that for a population that is older, male, white and living alone, being on a GP register as opposed to having no GP has no effect on ED use.[40] Brent PCT is an inner-London borough characterised by its ethnic diversity and high levels of deprivation.

Health state

Having a chronic disease or multimorbidity is associated with ED attendance and EHA. One study showed that underlying morbidity in the presence of cardiovascular disease, or digestive disease, is associated with increased ED attendance, as are terminal illness and overall comorbidity.[35] This study also showed that an increased number of days in hospitals is associated with subsequent increased ED attendance.[35]

The presence of chronic diseases coronary artery disease (CHD), angina, asthma and chronic obstructive pulmonary disease (COPD) has been associated with EHA,[22 42 46] as is the combination of smoking with CHD, asthma or COPD.[21 22] However, Cowling 2013 found no effect of the prevalence of asthma, obesity and hypertension in English practice on ED visits.[39] Age-standardised patient increased mortality rates are also associated with increased EHA.[8 35]

There is one study associating worse self-reported health and increased EHA.[37] This same study found a greater number of hospital admissions following lower primary healthcare use in a period of 1 year and that shorter previous hospital stays resulted in increased subsequent EHA.[37]

ED attendance studies and features of primary healthcare provision (n=24)

More than half of these studies (n=16) were conducted in the US A and Canada. The majority of the studies are cross-sectional in design (n=19). These studies are described in detail in online supplementary data-table 1a and the main results are summarised in online supplementary data—table 1b.

Access

Four US studies and one UK study indicate that increased access to primary care in terms of longer opening hours, more appointment slots available and increased nurse triage reduce ED attendance.[27 28 39 43 44 47] The UK study is based on 7885 primary care practices and suggests that general practices providing more timely access to primary care had fewer self-referred discharged ED visits per registered patient.[39] One of the US studies suggests that this is true for both public and private insurance patients.[28]

One study in the Netherlands showed that positioning GP out of hours clinics near EDs reduced ED attendance.[48] However, changes to the delivery of out of hours primary healthcare in the UK since 2004 have transferred responsibility for out of hours care from practices to the local PCT which provides care across a local geographical area. One longitudinal study has shown that this change has increased ED use at a UK district general hospital.[29] Similarly in Denmark, when out of hours care by local GPs was replaced by telephone triage by GPs in a central regional triage centre and geographically larger rota systems, ED visits increased.[49] However, one study conducted in Spain reported that greater access to the primary care continuing care points (out of hours) did not have any effects on ED attendance.[50]

ED attendance is also increased if patients do not have a regular GP[35 51 52] or a specialist practitioner,[52] although there is a UK study based on data from one PCT in an ethnically diverse and deprived area which suggests that being registered with a GP for patients greater than 65 years did not influence ED use.[40] The picture is mixed in terms of higher physician to patient ratio influencing ED attendance as one study[35] showed that high family physician availability was associated with greater ED use, although this study included areas with low specialist availability, which could limit access to more intensive management of ambulatory care sensitive conditions. In two studies, a higher ratio of GPs to registered patients had no effect on certain types of ED usage.[35 39]

Patients' perception of poor primary healthcare access in terms of telephone access, shorter opening hours, no alternative place to seek advice, inability to get appointments and unmet needs was associated with increased ED attendance.[7 19 52]

Practice features

Practice features have an inconsistent association with ED attendance. One UK county-wide study suggests that

a smaller practice size is associated with increased ED attendance.[7] This same study also showed that patient proximity to a primary healthcare practice reduced ED attendance.[7] Another smaller UK study based in a north London district showed that close proximity to primary care practice had no effect on ED attendance.[40] However, a more recent and larger England-wide study by Cowling suggested that the shorter distance to GP practice compared to distance to hospital by foot or public transport reduced ED attendance.[39] A US study focused on the paediatric population showed that proximity to a primary healthcare practice reduced ED attendance, but that proximity to ED increased use.[53] A further US study reported that the shorter time to drive to hospital from home was associated with increased ED use.[47]

While practices lacking nebulisers for children and peak flow meters for adults showed increased ED attendance in one US study, this study also found that practices lacking inhalers reduced ED attendance.[43] The authors suggest that patient behaviour may be affected differently by these devices but could offer no real explanation for these conflicting data. Practices having the same day turnaround of laboratory tests were associated with a reduction in ED attendance.[44]

Practices in the USA with nurse practitioners or physician assistants were associated with increased ED attendance,[43] but a UK study found that if care was provided by either a nurse or a doctor, there was no effect on ED use.[40] Practices in North America in which at least one clinician made hospital rounds, or which had a specialist physician as opposed to a family physician (for older people) were associated with increased ED attendance.[43 52]

Continuity of care

Five studies, three from the USA and two from Canada, consistently showed that continuity of care as measured by seeing the same family or specialist physician reduced ED attendance.[16 29 35 52 54]

Quality of care measures

Overall, there is a paucity of evidence for the relationship between the quality of general practice care and ED attendance; however, one study showed that better quality of care (as measured by use of cholesterol tests, glycated haemoglobin tests, referrals to ophthalmologists and recommendation to stop smoking) for patients with diabetes reduced ED attendance of these patients.[26]

EHA studies and features of primary healthcare provision (n=22)

The majority of these studies (n=12) were conducted in the UK and cross-sectional in design (n=21). These studies are described in detail in online supplementary data-table 2a and the main results are summarised in online supplementary data-table 2b.

Access

One US study showed that poorer access to primary care services increased EHA, but a study in Ireland showed that increasing free primary care to those patients over 70 years of age had no effect on EHA.[55 56]

While there are five studies from different countries, which suggests that an increase in GP supply (availability of GPs in an area) and a higher ratio of practitioners to patients are associated with reduced admissions,[22 37 38 45 57] there are also five studies that looked at similar measures: physician density, GP per 10 000 population, average list per partner, physician supply and percentage of GPs with >2500 patients, which showed no effect on admissions.[8 21 34 36 45]

Practice features

The impact of overall size of a GP practice on EHA is conflicting. Evidence from three studies showed training and course provision within GP practices decreased EHA of patients from those practices.[21 22 41]

Two studies show that an increased distance of primary care practice from the hospital reduces EHA.[17 32] Equally, patient data show that urban dwelling and proximity to hospital increase admissions.[21 22 38] There is evidence that training (n=3 studies) and course provision (n=1 studies) within GP practices decrease EHA of patients from those practices. Features that do not appear to reduce EHA are the numbers of GP partners, the number of partners with formal postgraduate qualifications in general practice or the proportion of salaried GPs.[34 36] However, there is one US study which shows that an increase in specialists in primary care is associated with increased EHA.[38] There is one study that shows that having female GPs in a practice is associated with reduced EHA.[41]

The evidence for practices providing specific services is mixed. One study showed that cervical screening, child health surveillance, emergency contraception and maternity services were associated with increased EHA.[42] One UK study showed that providing prescription services for asthma, diabetes, heart failure, hypertension and COPD, as well as diabetes and asthma specialist services, has no effect on admissions.[8]

However, the amount of certain services does seem to impact on reducing EHA with both health visitor hours per 1000 children under the age of 5, and the number of primary care visits in the last months of life in congestive heart failure and patients with COPD being associated with fewer EHA.[58 59]

Continuity of care

As with ED visits, there is evidence on continuity of care (seeing the same health professional) and EHA. However, the data suggest that the effect may be context and condition-specific. One UK study shows that the easier it is to get an appointment with your own GP, the lower the EHA.[17] A US study shows that reduced continuity of care with paediatric patients on Medicaid or

with asthma was associated with increased EHA, and one study carried out in Manitoba, Canada showed that high continuity of care was associated with a reduction in EHA.[16 23] However, one further US study of diabetes, CHD and depression patients suggests that improved continuity of care with the same physician had no effect on EHA.[32]

Quality of care measures

While two UK studies showed that general performance indicators for primary care practice had no effect on EHA,[17 42] the evidence for quality of care measures for specific conditions is mixed. For patients with diabetes, two studies show that improved quality indicators reduce EHA,[20 25] but one of these studies suggests that this association is only valid when comparing moderate to poor Quality and Outcomes Framework (QoF) indicators, and that when moderate is compared with high indicators there is no effect.[20]

High quality scores for angina were associated with reduced EHA, but condition-specific quality markers for myocardial infarction (MI) had no effect on EHA.[22]

Diagnosis of asthma by spirometry was shown to be associated with reduced EHA, but there was no effect on EHA for asthmatics who received a review.[21] There was also no effect on EHA with increased clinical QoF scores for patients with COPD.[21] Patient satisfaction with primary healthcare services is associated with reduction of EHA.[34 37]

DISCUSSION

Statement of principal findings

This review identified 48 papers which described 24 studies of features influencing ED visits, and 22 studies of features influencing EHA. The patient factors influencing unscheduled care were similar for ED use and EHA and were consistent across countries. The most important of these were increased age, reduced socioeconomic status, lower educational achievement and the presence of chronic disease and multimorbidity, which were all associated with increased unscheduled secondary care. In addition, proximity of patients to healthcare provision strongly influences their use despite the country of residence, that is, if they live near an ED/hospital, they are more likely to use these services than if they live more remotely. Equally, if patients live near a primary care facility, then unscheduled secondary care may be reduced.

The main feature of primary care that is consistently associated with reduced unscheduled care use is continuity of care. Studies from the USA, Canada and the UK suggest that being able to see the same family or specialist practitioner reduces both ED use and EHA. However, the evidence of effect on unscheduled secondary care of increased access to primary healthcare was mixed. In general, better access to primary care was associated with reduced use of ED and EHA in the USA and Canada. However, the relationship in European health systems is less clear with no clear overall patterns emerging from the identified studies.

Organisational features of primary healthcare affecting ED attendance and EHA are more complex to describe with heterogeneity of findings across healthcare systems and within systems. The evidence for quality of care markers is inconclusive.

Strengths and weaknesses of the study

This review was conducted following rigorous Cochrane methodology with a focused search conducted in all the major databases. There was no language restriction on the studies retrieved, but the studies were restricted to OECD countries and to those published from 2000 onwards to ensure that the studies were as relevant as possible to the current primary health provision in developed countries.

The initial search only included studies published up to October 2012. An updated limited search before the analysis of included studies identified one paper which was included in the main results section[39] A final updated search identified a further four relevant papers published up to December 2013. Two studies were found from the USA. One cross-sectional study included further evidence that fewer primary care physicians per capita are associated with higher ED attendance rates.[60] A second paper was a before and after study of the introduction of a patient-centred medical home model across a health system.[61] This study found a reduction in emergency department visits but not emergency admissions in patients using the new model of care. A further cross-sectional study from England suggested that being able to book an appointment with a preferred primary care doctor is associated with fewer admissions.[62] A second English study found that nationally falling rates of admission for heart failure are not associated with characteristics of primary care, including quality of care.[63] None of these studies contradict the findings of the initial review.

Seven of the originally included cross-sectional studies only reported univariable analysis, which limits the identification of factors that significantly influence the measures of unscheduled secondary care, as potential confounding factors will not be incorporated in modelling. Definitions of unscheduled secondary care also differed between studies limiting comparisons and synthesis. While some studies were countrywide, many studies were on relatively discrete populations which have may not be generalisable to all the patient groups within a healthcare system. For example, Cowling *et al*[39] found that having a greater proportion of patients older than 65 years in a practice population was associated with reduced ED attendance. However, the outcome was based on patients who had self-referred and then had been discharged and were therefore likely to be a cohort of patients with minor illness, rather than the

total cohort presenting to ED which would include those with more significant pathology.

Furthermore, as research was carried out in different healthcare systems, findings from one setting may not be generalisable to other settings. The ED attendance studies were predominantly from the USA and Canada while the majority of the EHA studies were UK-based, and therefore this limits the generalisable conclusions. There were very little cost data or analyses, and so the financial case for implementing services cannot be made from the identified studies.

Strengths and weaknesses in relation to other studies/ important differences in the results

There are five systematic reviews that are relevant to this current review.[9–13] Two of the reviews focus on access to primary healthcare and ED use, but there were no data on EHA in either of these reviews.[11 12] Both reviews include worldwide studies and suggest that improved patient access to primary care reduces ED use, but neither review explicitly addressed country-specific health systems and their differing issues.

Three of the reviews focus on continuity of care and unscheduled secondary care.[9 10 13] The reviews by Cabana and Hsiao looked at continuity of primary healthcare and unscheduled secondary care, but the data are over 5 years old. However, both these reviews reflect the updated findings of our review, namely that continuity of care reduces unscheduled secondary care. The review by Aubin *et al*[9] only focuses on patients with cancer and considered studies across primary and secondary care.

Meaning of the study—possible explanations and implications for clinicians and policymakers

While the expected associations with increased ED use were seen for patient level factors that are associated with greater prevalence of acute illness (increasing age, indices of low socioeconomic status, chronic disease), there were few clear overall associations across the published evidence for primary care practice or healthcare system factors. This is likely to be due to the importance of the background healthcare context such as insurance based systems without universal health coverage or healthcare with free access at the point of use. Therefore, the policy implications of studies will only be relevant to countries that utilise the healthcare model under study.

Given these caveats, there are some interesting findings of relevance to clinicians and policymakers. Looking at healthcare systems, better access to primary care is associated with lower rates of ED use and EHA in the USA, but this effect is not demonstrated in the UK and other European countries. The geographical location of services is important, with proximity to a general practice reducing unscheduled secondary care use and proximity to ED increasing usage. Convenience for patients therefore appears to be important, a finding that supports recent policy guidance in the UK.[64] For practices, the impact of continuity of care with a primary care provider on both ED use and EHA is evident. This is a timely finding in view of the recent proposal in the UK to provide people over 75 years of age with a dedicated GP who is accountable for their care and who will be responsible for ensuring that their patients have good quality out of hours care.[65]

Unanswered Q and future research

The majority of research found was observational and this limits conclusions about how to change systems. While associations exist, such as the impact of increased continuity of care, this would not necessarily translate to reduced utilisation of USC if implemented. The current evidence base does not provide clear support for any particular policy change. It is clear that the decision to attend unscheduled care and the need to be admitted to hospital as an emergency are both the product of a complex interaction between individuals, their context, the organisation of healthcare, the behaviours of healthcare practitioners and the wider context of society. Further research needs to try to unpack in more nuanced detail the operation of these factors and the complex interactions between them.

Contributors AH is the main systematic reviewer involved in all stages of review and write-up. DL contributed to the methodological approach and also added significant input to the results and discussion. LW assisted with double data extraction and commented and advised on the write-up of the review. RM contributed to the methodological approach, advised on the statistical approach of individual papers and commented on the results and discussion. HE advised on the relevance of results to primary care practice and commissioning of care and also commented on the results and discussion. KC contributed to the significance of results to primary care and provided significant input to the results and discussion. CS contributed to the methodological approach and also added relevance to primary care as well as significant input to the written paper. SP is a PI on the original grant application and overall project; she was involved in all stages of the review including screening, data checking and write-up.

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CASP: QUALITY ASSESSMENT OF COHORT & CASE-CONTROL STUDIES

Adapted from http://www.casp-uk.net/wp-content/ Yes No, Can't tell

ED attendance

Author year	Is the study relevant to the needs of the project?	Does the paper address a clearly focussed issue?	Is the choice of study method appropriate ?	Is the population studied appropriate ?	Is confounding and bias considered?	Are tables/ graphs adequately labelled and understandable?	Are you confident with the authors' choice and use of statistical methods, if employed?	Can the results be applied to the local situation?	Were all important outcomes/ results considered?	Is any cost-information provided?	Accept for further use as Type IV evidence?
Baker[7] 2011	YES	YES	YES	YES But only Leicestershire & Rutland	YES Response rate varied median practice response was 47%	YES	Only univariate analysis	YES	YES	NO	YES
Basu[38] 2002	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
Begley[33] 2006	YES	YES	YES	Data from very specific source (safety net hospitals in Houston)	YES Discussion around data source	YES	YES?	YES	YES	YES	YES
Brousseau[27] 2009	YES	YES	YES	YES Children only in Wisconsin area	YES Poor response rate (40%)	YES	YES	YES	YES	NO	YES

Brousseau[28] 2007	YES	YES	YES	YES	YES 96% response rate	YES	YES Univariate analysis	YES	YES	NO	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate ?**	**Is the population studied appropriate ?**	**Is confounding and bias considered?**	**Are tables/ graphs adequately labelled and understandable?**	**Are you confident with the authors' choice and use of statistical methods, if employed?**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-information provided?**	**Accept for further use as Type IV evidence?**
Burge[29] 2003	YES	YES	YES	YES	Don't know	YES	Yes But univariate analysis only	YES	YES	NO	YES
Christakis[16] 2001	YES	YES	YES	YES Children only	YES in analysis & discussion	YES	Yes but univariate analysis only	YES	YES	NO	YES
Cheung[18,19] 2011 & 2012	YES	YES	YES	YES but US only comparing insurance status	YES	NO No graphs	YES	YES to US	YES	NO But was about insurance status	NO
Cowling[39] 2013	YES	YES	YES	YES	Yes in analysis & discussion	YES	YES	YES	YES	NO	NO
De la Fuente[50] 2007	YES	YES	YES	YES	YES	YES	YES Time-series co-integration analysis	YES	YES	NO	YES
Gill[54] 2000	YES	YES	YES	YES but only Medicaid population	YES	YES	YES	YES	YES	NO	YES

Harris[40] 2011	YES	YES	YES	YES but just one inner-London primary care trust	YES	YES	YES	YES	YES	NO	YES
Hull[58] 2000	YES	YES	YES	YES	YES	NO Selective data reported	YES	YES	YES But not all reported	NO	YES
Ionescu[35] 2007	YES	YES	YES	YES But only 65yrs plus patients	YES	YES	YES	YES	YES	NO	YES
Kronman[59] 2008	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate ?**	**Is the population studied appropriate ?**	**Is confoundin g and bias considered?**	**Are tables/ graphs adequate ly labelled and understa ndable?**	**Are you confident with the authors' choice and use of statistical methods, if employed?**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-informati on provided?**	**Accept for further use as Type IV evidence?**
Lowe[43] 2005	YES	YES	YES	YES but only Medicaid enrollees	NO	YES	YES	YES	YES	NO	YES
Lowe[47] 2009	YES	YES	YES	YES but only Medicaid enrollees	YES Described in analysis	YES	YES	YES	YES	NO	YES

Ludwick[53] 2009	YES	YES	YES	YES but only pediatric Medicaid enrollees	YES In analysis & discussion	YES	YES	YES	YES	NO	YES
McCusker [51] 2010	YES	YES	YES	YES but only adults with chronic conditions	YES A overall response rate of 76.4% Bias described in analysis & discussion	YES	YES	YES	YES	NO	YES
McCusker [52] 2012	YES	YES	YES	YES	YES in analysis & discussion	YES	YES	YES	YES	NO	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate ?**	**Is the population studied appropriate ?**	**Is confoundin g and bias considered?**	**Are tables/ graphs adequate ly labelled and understa ndable?**	**Are you confident with the authors' choice and use of statistical methods, if employed?**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-informati on provided?**	**Accept for further use as Type IV evidence?**
Periera[24] 2003	YES	YES	YES	YES for both cases & controls but only adult patients	YES In analysis	YES	YES	YES	YES	NO	YES
Stern[26] 2009	YES	YES	YES	YES for both cases & controls but only diabetes patients	YES Response rate was 54% In analysis & discussion	YES	YES	YES	YES	NO	YES

Sturm[44] 2010	YES	YES	YES	Yes but only pediatrics	YES in analysis & discussion	YES	YES	YES	YES	NO	YES
Thomas[30] 2008	YES	YES	YES	YES but comparing Aboriginal & Torres Strait Islanders with other Australians	YES Briefly in discussion	YES	YES but only univariate	YES	YES	NO	YES
Thompson[31] 2010	YES	YES	YES	YES	YES in the discussion	YES	YES Only univariate	YES	YES	NO	YES
Van uden[48] 2004	YES	YES	YES	YES	YES in the discussion	YES	YES B&A	YES	YES	NO	YES
Vedsted[49] 2001	YES	YES	YES	YES	YES in the discussion	YES	YES	YES	YES	NO	YES

Emergency hospital admissions

Author year	Is the study relevant to the needs of the project?	Does the paper address a clearly focussed issue?	Is the choice of study method appropriate?	Is the population studied appropriate?	Is confounding and bias considered?	Are tables/ graphs adequately labelled and understandable?	Are you confident with the authors' choice and use of statistical methods, if employed?	Can the results be applied to the local situation?	Were all important outcomes/ results considered?	Is any cost-information provided?	Accept for further use as Type IV evidence?
Bankart[17] 2011	YES	YES	YES	YES	Response rate was only 44% & there was response rate variation between practices. Test of validity using model on previous yr data	YES	YES	USE	YES	NO	YES
Bottle[25] 2008	YES	YES	YES	YES	No pilot study or validation described	YES Although some data presented as graphs	YES But only univariate analysis	YES	YES but only diabetes	NO	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate?**	**Is the population studied appropriate?**	**Is confounding and bias considered?**	**Are tables/ graphs adequately labelled and understandable?**	**Are you confident with the authors' choice and use of statistical methods, if employed?**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-information provided?**	**Accept for further use as Type IV evidence?**

Carlsen[34] 2007	YES	YES	YES	YES	The patient response rate varied between counties from 52-70% data was lacking from 4/435 municipalities	YES	YES	YES	YES But no physician data	YES	YES
Christakis [16] 2001	YES	YES	YES	YES	YES Used validated scores for CoC & PCDS	YES	YES	YES	YES	NO	YES
Downing[42] 2007	YES	YES	YES	YES But only 2 PCTs were involved both in the west Midlands, UK	YES In the form of discussion around confounding factors	YES	YES	YES	YES	NO	YES
Dusheiko[20] 2011	YES	YES	YES	YES	Yes But analysis is at practice level not patient level	YES	YES	YES	YES But only diabetes	YES	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate?**	**Is the population studied appropriate?**	**Is confounding and bias considered?**	**Are tables/ graphs adequately labelled and understandable?**	**Are you confident with the authors' choice and use of statistical methods, if employed?**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-information provided?**	**Accept for further use as Type IV evidence?**

Duffy[36] 2012	YES	YES	YES	YES But study performed in Dundee, Scotland only	YES In the form of discussion around confounding factors	YES	YES	YES (most data involved just one hospital)	YES	NO	YES
Guliiford[57] 2002	YES	YES	YES	YES	YES As part of analysis & discussion	YES But only final analysis data given	YES	YES	Selective criteria	NO	YES
Hossain[55] 2009	YES	YES	YES	YES	YES Yes as part of analysis & discussion	YES	spatial structural equation modelling on cross sectional data	YES	YES	NO	YES
Magan[45] 2011	YES	YES	YES	YES	Data provided was often incomplete & imprecise It was not possible to distinguish admission s from readmissions	YES	YES	YES	YES	NO	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate?**	**Is the population studied appropriate?**	**Is confounding and bias considered?**	**Are tables/ graphs adequately labelled**	**Are you confident with the authors' choice and use of**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-information provided?**	**Accept for further use as Type IV evidence?**

						and understandable?	**statistical methods, if employed?**				
Majeed[41] 2000	YES	YES	YES	YES But study performed in London area only	YES Within multivariate analysis	YES	YES	YES	YES	NO	YES
Menec[23] 2006	YES	YES	YES	YES but >67yrs only	YES	YES	YES	YES	YES	NO	YES
Nolan[56] 2011	YES	YES	YES	YES But a very specific population in special situation	YES unique patient identifier not available so could not identify repeat admissions. Used hospital discharge.	YES	YES	YES	NO? Admission related data could also have been correlated e.g. length of stay	NO	YES
Purdy[21] 2011a	YES	YES	YES	YES But only asthma & COPD	YES a priori confounders in analysis	YES	YES	YES	YES	NO	YES
Purdy[22] 2011b	YES	YES	YES	YES But only CHD	YES a priori confounders in analysis	YES	YES	YES	YES	NO	YES
Ricketts[46] 2001	YES	YES	YES	YES	YES As part of analysis	YES	YES	YES	YES	NO	YES
Author year	**Is the study relevant to the needs of the project?**	**Does the paper address a clearly focussed issue?**	**Is the choice of study method appropriate?**	**Is the population studied appropriate?**	**Is confounding and bias considered?**	**Are tables/ graphs adequately labelled**	**Are you confident with the authors' choice and use of**	**Can the results be applied to the local situation?**	**Were all important outcomes/ results considered?**	**Is any cost-information provided?**	**Accept for further use as Type IV evidence?**

						and understandable?	**statistical methods, if employed?**				
Rizza[37] 2007	YES	YES	YES	YES But is a select population	'A random sample of 520 medical records of patients' but 94.6%, response rate. Questionnaire was pretested to improve validity of responses.	YES	YES	YES, but only one hospital	YES	NO	YES
Saxena[8] 2006	YES	YES	YES	YES but only London data	YES Analysis at primary care trusts level Some patient registered in one PCT, lives in another Data quality was not validated	YES	YES	YES, but London area only	YES	NO	YES
Solberg[32] 2004	YES	YES	YES	YES USA data	Don't know	YES	YES	YES To the US population	YES But admission related data could also have been	YES	YES

									correlated e.g. length of stay Only diabetes, CHD & depression		

Systematic review of primary care factors associated with utilisation of unscheduled secondary care

Objective

To conduct a systematic review to identify studies that describe factors and interventions at primary care organisation level that impact on levels of ultilisation of unscheduled care.

Definition of outcomes
Definitions for the terms use to describe unscheduled secondary care will be developed using the criteria below as a basis and building on existing work by the PI and others.

Eligibility criteria
Inclusion criteria:
Types of studies
Observational studies, randomised controlled trials and other controlled studies (controlled trials, controlled before and after study, analytic cohort) and qualitative studies clearly or potentially primarily about the interventions delivered in primary care to reduce unscheduled secondary care should be included. Only full study reports will be included but authors of studies reported only as abstracts will be contacted to ask if full study reports are available.
Types of factors and interventions
Factors and interventions at the primary care organisation level, to include general/family practice, out-of-hours service concerning organisation of primary care services,access to primary care services (including financial barriers such as co-payments, quality of care), clinician and practice culture factors (including approach to managing risk) and population and socio-demographic factors
Study population
Studies that include people of any age of either sex living in OECD countries as these countries have comparable patterns of health status; health care provision and health spend as a proportion of GDP.
Other criteria
We will include any studies concerning any health condition as long as the outcome of interest is unscheduled secondary care. Studies reporting attendance at an ED or an emergency hospital admission as an outcome will be included. We will include studies written in any language.
Exclusion criteria:
We will exclude studies that only report admission for elective or planned health care, admission to a community or non-acute hospital as an outcome, studies primarily about the clinical management of conditions and studies of hospital or ED visits for planned diagnostic services only. We will exclude case reports, case series, letters, editorials, or expert opinions only

Outcomes of interest
Levels of utilisation of unscheduled care including enumeration of emergency department visits and emergency admissions or readmissions.

Search
Databases and registries
A search strategy will be developed using keywords for the electronic databases according to their specific subject headings or searching structure. The search strategy will be tested for citations from 1985 – 2012 on the OVID databases - Medline®, Excerpta Medica Database (Embase), Cumulative Index to Nursing and Allied Health Literature (CINAHL®), Health Management Information Consortium (HMIC), PsycINFO® and the Social Science Citation Index. For each database, search terms will be adapted according to the search capabilities of that database. The search strategy will be modified to search internet sites such as the Agency for Healthcare Research and Quality (AHRQ) and the King's Fund.

Other sources
All subsets of the ISRCTN Register (International) at www.controlled-trials.com will be searched to identify recently completed trials.The reference lists of all relevant studies will be checked for additional relevant publications. An electronic search in MEDLINE, Centre for Reviews and Dissemination (CRD) databases,York, and the Cochrane Database will be composed to identify any

relevant systematic reviews and their references will be checked. Experts in the field will be contacted to identify additional relevant studies. We will hand search the top 3 journals for the preceding 12 months, defining top journals as those in which identified citations appear most frequently.

Reference management and study selection
A single Reference Manager (RefMan) file will be produced of all references identified through the search process. Duplicates will be removed from this file. These references will undergo a two stage process of screening using the inclusion and exclusion criteria by two reviewers independently. Firstly, a screen of titles and abstracts (if abstract available) and secondly screening of the full paper. For both of these stages, the reviewers will mark them yes, no or unsure. Where there is continued disagreement between reviewers about including or excluding a paper, a third reviewer will make the final decision.

Data collection process
Standardised data extraction forms will be developed using existing guidance.[Higgins et al, 2008, Chapter 7, section 7.5] Data will be abstracted by one reviewer (AH). A second reviewer will check data abstraction against the original paper.

Data items
Participants: setting (primary care/community); eligibility criteria; number of participants (eligible, enrolled, randomised, cases/controls, included in analyses, reasons for withdrawal); reason for being at risk of ED visit or unplanned admission; sociodemographic data and severity of symptoms/casemix. *Interventions:* single intervention or combination, type of intervention(s); care provider(s); duration of intervention or number of sessions.

Comparisons: for the controlled studies, details of the intervention and participants as detailed above. *Outcome measures:* type of outcome measure; scale; timing of outcome assessment. For each outcome measure and for each relevant time point we will extract data on outcome measures per intervention group: mean changes (SD) for continuous outcomes, and numbers (%) for dichotomous outcomes.

Quality Assessment
Quality of studies will be assessed by two reviewers. The risk of bias tool will be used to assess randomised controlled studies and in an adapted form for non-randomised controlled studies.[Higgins et al 2008, chapters 8 &13] Observational studies will be assessed using recognised quality and susceptibility to bias criteria.[Sanderson 2007]. Qualitative studies will be assessed using CASP guidelines [CASP, 2006]. 5

Publication bias across studies

For interventions that have been investigated in multiple RCTs (>10), we will compose funnel plots to assess the potential risk of publication bias. The funnel plots will be inspected for asymmetry. The number of RCTs is likely to be small for most interventions, providing insufficient power for statistical tests of asymmetry.

Summary measures

Dichotomous outcomes will be used to calculate success rates for each study group. The results will be presented individually for each trial. If appropriate, the differences in rates between study groups will then be computed, together with the 95% confidence intervals. The number needed to treat (NNT) will be computed as 1/(Pi – Pc), with Pi expressing the proportion of successes in the intervention group, and Pc the proportion of successes in the control group. The results for each intervention and each outcome will be presented in forest plots.

Additional analysis

There is likely to be considerable heterogeneity in the studies identified. Pooled estimates of outcome will be calculated for trials showing sufficient homogeneity with respect to interventions and outcome measures.[Borenstein at al, 2009]. In case of statistical heterogeneity potential sources of heterogeneity will be explored.[Higgins et al, 2003] If appropriate, we will also perform a analysis using the approach developed by the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) working group, which uses the following factors: study design, risk of bias, consistency of results, generalisability, precision of data, and reporting bias. [GRADE Working Group, 2011]

Reporting of results

For both academic papers and the final report, the details and quality of each included study will be tabulated, excluded studies will be tabulated with reasons for exclusion, the key results of the review will be described and related to the objectives of the review. The strengths and limitations of the review will also be discussed.

Parent search Strategy run in Medline, September 2012:

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1 (Family physician$ or Physician, Family or Pamily Pract$ or Pract$, family).tw. (11252)

2 (Generalist$ or General Pract$ or Pract$, general).tw. (61792)

3 (Primary care physician$ or Physician$, primary care).tw. (12752)

4 (Care, primary health or health care, primary or primary care or care, primary or primary healthcare or healthcare,primary).tw. (63133)

5 family practice.mp. or Family Practice/ (62140)

6 General practice.mp. or General Practice/ (32057)

7 primary care.mp. or Primary Health Care/ (85717)

8 emergencies/ (32805)

9 emergency medicine/ (9094)

10 Emergency treatment/ (7625)

11 emergency service, hospital/td (685)

12 emergency hospital admission*.ti,ab. (196)

13 emergency hospitali#ation.ti,ab. (144)

14 unplanned hospitali#ation.ti,ab. (56)

15 (primary care adj5 admission*).ti,ab. (109)

16 (ambulatory care adj5 admission*).ti,ab. (66)

17 (admission* adj5 emergenc*).ti,ab. (4084)

18 (Emergency Treatment adj5 admission*).ti,ab. (5)

19 ((emergency care adj5 admission*) or readmission*).mp. (11688)

20 (emergency room adj5 admission*).ti,ab. (640)

21 emergency admission*.mp. (1198)

22 emergency medical admission*.mp. (65)

23 emergency referral*.ti,ab. (116)

24 (hospital admission* adj5 emergenc*).mp. (919)

25 ED attendance.mp. (61)

26 emergency department attendance.mp. (53)

27 (accident and emergency attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (19)

28 (A and E attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (8)

29 (emergency department adj5 attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (125)

30 (ED adj5 attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (88)

31 ((accident and emergency) adj5 attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (120)

32 ((a and e) adj5 attendance).mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (79)

33 medical assessment unit.mp. (46)

34 Emergency Medical Services/ (29664)

35 ((unscheduled or unplanned or un-planned or unanticipated or unexpected) adj5 (admission* or readmission* or hospitali#ation or care)).mp. (1424)

36 or/1-7 (178967)

37 or/8-35 (92517)

38 36 and 37 (3386)

39 38 not (case report/ or case study/ or letter/ or editorial/ or expert opinion.mp.) (3018)

40 39 not (Algeria$ or Egypt$ or Liby$ or Morocc$ or Tunisia$ or Western Sahara$ or Angola$ or Benin or Botswana$ or Burkina Faso or Burundi or Cameroon or Cape Verde or Central African Republic or Chad or Comoros or Congo or Djibouti or Eritrea or Ethiopia$ or Gabon or Gambia$ or Ghana or Guinea or Keny$ or Lesotho or Liberia or Madagasca$ or Malawi or Mali or Mauritania or Mauritius or Mayotte or Mozambiq$ or Namibia$ or Niger or Nigeria$ or Reunion or Rwand$ or Saint Helena or Senegal or Seychelles or Sierra Leone or Somalia or South Africa$ or Sudan or Swaziland or Tanzania or Togo or Ugand$ or Zambia$ or Zimbabw$ or China or Chinese or Hong Kong or Macao or Mongolia$ or Taiwan$ or Belarus or Moldov$ or Russia$ or Ukraine or Afghanistan or Armenia$ or Azerbaijan or Bahrain or Cyprus or Cypriot or Georgia$ or Iran$ or Iraq$ or Israel$ or Jordan$ or Kazakhstan or Kuwait or Kyrgyzstan or Leban$ or Oman or Pakistan$ or Palestin$ or Qatar or Saudi Arabia or Syria$ or Tajikistan or Turkmenistan or United Arab Emirates or Uzbekistan or Yemen or Bangladesh$ or Bhutan or British Indian Ocean Territory or Brunei Darussalam or Cambodia$ or India$ or Indonesia$ or Lao or People's Democratic Republic or Malaysia$ or Maldives or Myanmar or Nepal or Philippin$ or Singapore or Sri Lanka or Thai$ or Timor Leste or Vietnam or Albania$ or Andorra or Bosnia$ or Herzegovina$ or Bulgaria$ or Croatia$ or Estonia or Faroe Islands or Greenland or Liechtenstein or Lithuani$ or Macedonia or Malta or maltese or Romania or Serbia$ or Montenegro or Slovenia or Svalbard or

Argentina$ or Belize or Bolivia$ or Brazil$ or chile or Chilean or Colombia$ or Costa Rica$ or Cuba or Ecuador or El Salvador or French Guiana or Guatemala$ or Guyana or Haiti or Honduras or Jamaica$ or Nicaragua$ or Panama or Paraguay or Peru or Puerto Rico or Suriname or Uruguay or Venezuela or developing countr$ or south America$).ti,sh. (2877)

41 limit 40 to yr="1990 -Current" (2347)

42 remove duplicates from 41 (2283)

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Table 1a: Primary care features & ED attendance n=24 studies

+ Positive association i.e. increases ED use -negative associations i.e. decrease ED use # no effect on ED use

Study Year country Design	**Setting & participants**	**Methods**	**Primary care features which have associations with emergency department attendance**				
			Patient features	Access	Practice features	Continuity of care	Quality of care
Baker [7] 2011 UK sister paper to Bankart Cross-sectional	Attendances at emergency departments data in '06/'07 and '07/'08 in relation to 2 English PCTs, Leicester City & Leicestershire County and Rutland, with 145 general practices	A hierarchical negative binomial regression model was used. Data were expressed as regression coefficient (95% CI, p value)	Deprivation (+) 0.02 (0.01, 0.03, p<0.0001) % of patients 65yrs plus (#) White ethnicity (+) 0.004 (0.001,0.007, p=0.006) Gender (#)	Lower patient satisfaction with practice telephone access (+) -0.004 (-0.008, -0.0004, p=0.03)	Smaller list size (+) -0.0000 (-0.0000, -0.0000, p= 0.0005) Shorter distance from hospital (+) -0.02 (-0.03,-0.01, p<0.0001)		Quality and outcomes framework points (#)
Begley[33] 2006 USA Cross-sectional	ED visit data from 5 safety net hospitals(provi des subsidised	New York University ED algorithm was applied. Data expressed as	Increased IMU (+) -.46 p<.0001 Unit decrease in				

	care for all): two public hospitals operated by district and 3 private non-profit general hospitals that serve substantial no. of uninsured in '02 & '03 in Houston , Texas	Pearson correlation coefficients (p value)& used in regression model.	IMU score is associated with >1.7 per 1,000 in PC-related ED visit rate p<0.0001 Rate of uninsurance (+) .56 (p<0001) 1% increase in un-insured rate associated with >35.2 per 1,000 population in PC-related ED visit rate p<0.0001 Deprivation (+) .85 P=0.001 unit increase in the % below poverty was associated with >4.3 per 1,000 in PC-related ED visit rate p<0.0001				
Brousseau 2009[27] USA	5468 children enrolled	Baseline parent-reported quality	Older children vs. younger (<17yrs)	High-quality realized PC	Nurse or doctor care (#)		Parent's perception of

Cross-sectional	in Wisconsin Medicaid whose parents had completed the Consumer Assessment of Healthcare Providers and Systems surveys during fall '02 and fall '04	of PC was assessed & negative binomial regression used to determine association between domains of care and urgent ED utilization. (non-urgent not reported here Data expressed as IRR (95% CI, p value)	(+) 1.70 (1.35,2.14 P<0.05) Female vs male (#) Health status excellent/ v.good vs. good/fair/ poor (#) increased education (beyond high school) (-) 0.80 (0.67,0.96, P<0.05) Spanish vs. English (#) Ethnicity (#)	access (-) 0.67 (0.52,0.86, P<0.05) High-quality timeliness (-) 0.82 (0.67,0.99, P<0.05)			high-quality family centeredness (#)
Brousseau 2007[28] USA Cross-sectional	8823 children (≤17 yrs)from '00–'01 & '01–'02 Medical Expenditure Panel Survey panels- a	Parent-reported quality of PC was assessed using Consumer Assessment of Healthcare Providers and		Greater realized PC access for publicly and privately insured (-)			Parent's perception of high-quality family-centeredness for publicly insured children &

	subsample of the US National Health Interview Survey	Systems survey & related to the primary outcomes of no. of subsequent (non-urgent- not reported here) & urgent ED visits per child. Data expressed as IRR (95% CI)		0.97 (0.70,1.34) 0.96 (0.68,1.34) respectively Timeliness of care (#)			children ≤ 2yrs (-) 0.95 (0.69,1.29) Quality-of-care domains (#)
Burge[29] 2003 USA Cross-sectional	Hospital admissions & separation data from 8702 adults with a recorded date of cancer diagnosis who died of cancer & who made ≥3 visits to FP in last 6ths of life on the Nova Scotia Cancer Registry, and Physician Services **(**1992 to 1997)	The relationship was made between total ED visits & continuity of care, developed using Modified Continuity Index using negative binomial regression with adjustments for demographic factors & health status. Data expressed as Rate R (95% CI)				Lower FP continuity of care (+) Low vs. high RR -3.93 -3.57,-4.34 Moderate vs. high 2.28 (2.15 ,2.42)	
Cheung	2005 data	Statistical	Adults with				

2011 & 2012 [18,19] USA Cross-sectional	from 317, 497 adults (age,≥18 years)from the National Health Interview Survey (NHIS), a cross-sectional household interview survey that approximates non-institutionalized US civilian population. ('99 – '09)	analyses using Stata 10.1 Survey commands were used to create nationally representative estimates. Multivariable analyses adjusted for demographic, socioeconomic status, health conditions, & access to care variables. Barriers were 1) "Couldn't get through on the telephone"; (2) "Couldn't get an appointment soon enough"; (3) "Once you got there, you have to wait too long to see the doctor"; (4) "The (clinic/doctor's) office wasn't open when you could get there"; and (5) "Didn't have	higher number of barriers to PC were more likely to visit ED (+) OR 1.37 [95% CI1.31,1.43] for 1 barrier OR 1.68 [95% CI, 1.60,1.78] for≥2 barriers Medicaid vs. private insurance patients (+) OR 1.48; 95% CI 1.41 , 1.56 Medicaid beneficiaries with 1 barrier or ≥2 barriers compared with that for individuals with private insurance and same barriers. (+) OR 1.66; 95% CI 1.44, 1.92) OR 2.01; 95% CI 1.72 , 2.35 respectively				

		transportation." These barriers were used to predict self-reported ED visits during the past 12 months. Data expressed as % of patients with barriers and ODs					
Christakis [16] 2001 USA Cross- sectional	46 097 paediatric patients at Group Health Cooperative, between 01/01/93-31/12/98	A continuity of care index that quantifies the degree to which a patient has experienced continuous care with a provider. Data expressed as HR (95% CI)				Higher continuity of care [-] High vs medium HR 1.28 (1.20,1.36) High vs. low HR 1.58 (1.49,1.66)	
Cowling[39] 2013 UK Cross-sectional	Patients registered with 7,856 general practices in England (April '10- March '11	Main outcome was the number of type 1 ED visits recorded as a self-referral & discharged either without need for	≥65yrs (-) RR 0.989 (95% CI 0.984,0.994) P<0.001 % of males (#)	GP practices providing for timely access (seeing GP within 2 days(-)	Increased travel time to hospital relative to GP practice by public transport/on		

	with a total registered population of 54,225,700 (~95% of practices in England)	follow up or follow up with GP related to measures of primary care access Negative bionominal regression model was used Analysis controlled for age, sex, ethnicity, socioeconomic health & urban/rural profiles, supply of GPs and relative travel to nearest hospital Data presented as RR (95% CI)	% White (#) Deprivation (IMD) (highest to lowest) (+) RR 1.417 (95% CI 1.330,1.509) P,0.001 Prevalence (%) of asthma, hypertension, obesity (#)	RR=0.898 (95% CI 0.853,0.945) p<0.001 No. of GPs per 1,000 registered patients (#)	foot (-) RR 0.974 (95% CI 0.963,0.984) P<0.001 Rural vs. urban (-) RR 0.85 (95% CI 0.811,0.890) P<0.001		
De la fuente[50] 2007 Spain Cross-sectional	All emergency visits (n=6.454.034) made to ED & PC continuing care points (CCP's~ out of hours service) in Asturias &	The time series were constructed with monthly frequencies for Asturias & each one of the districts, a co-integration analysis having		Greater accessibility to the PC CCP's (#)			

	of each one of the healthcare districts ('94-'01)	been made to assess whether the two series are inter replaceable. Data expressed as annual % increase					
Gill[54] 2000 USA Cross-sectional	100% sample (n= 11 474). of Delaware Medicaid claims for 1 year '93-94	Continuity with single provider during year was calculated for each participant. These data were related to ED attendance in a multivariate analysis Data were expressed as ORs with 95% CI				Continuity with a single provider (-) for a single ED visit 0.82 (0.70,0.95) & for multiple ED visits 0.65 (0.56,0.76)	
Harris[40] 2011 UK Cross-sectional	68 general practices in Brent Primary Care Trust, north London, UK. (2007-2009)	Routinely collected data from GP practices, HES, and census data across three broad domains: GP access characteristics, population characteristics, and health status aggregated to the level of the GP	Increase in IMD score (+) 60.13 (40.56,70.70, P<0.05) Standardised mortality Ratio (+) 20.16 (10.07,30.25,	Total opening hours (#) Total whole-time equivalents (#) Satisfied with the GP practice (#) Able to get	Registered population that live within 1 km from GP practice (#)		

		practice. Multiple linear regression was used. Data expressed as Beta coefficient (95% CI, p value) for 2007-2009 period	P<0.05) % registered population receiving incapacity benefits (+) 230.89 (160.81,300.98,P< 0.05) % Registered lone-parent households (+) 160.74 (120.19,210.29,p <0.05) %Male (#) On GP register and aged >65 years (#) On GP register and white (#) On GP register and in a lone-pensioner household (#)	through to GP practice on telephone(#) Able to speak to GP(#) Able to get appointment fairly quickly(#) Able to book ahead(#) Satisfied with the opening hours(#) Desired more opening hours(#) Felt out-of-hours care took a long time(#) Felt that the out-of-hours			

				GP service was good(#) Able to see a preferred GP(#) Had to wait a long time at GP practice(#)			
Ionescu [35] 2007 Canada Cross-sectional	A random sample of 95, 173 people aged ≥65 yrs drawn from provincial administrative databases in Quebec for '00 & '01.	Data were collected on rate of ED use, use of hospital & ambulatory physician services, residence (urban v. rural), socioeconomic status, access and continuity of primary care. Data were adjusting for age, sex and comorbidity & expressed as Rate R (95% CI, p value)	Living in a rural area (+) Intermediate vs. urban 1.22 (1.20,1.23, p< 0.001) Rural vs. urban 1.51 (1.48,1.54, p< 0.001) low socio-economic status (+) high vs. low 1.50 (1.46,1.54, p< 0.001) high overall comorbidity (+)	Lack of a primary physician (+) 1.45 (1.41,1.49) Residence in a region with a higher physician :population ratio (+) Mixed vs. low 1.23 (1.21,1.26) High vs. low 1.10 (1.08,1.11) Both p<0.001	Living near ED department (+) 1.21 (1.19,1.22, p< 0.001)	Higher continuity of care [-] (Stronger protective effect in urban than rural area) High vs. low 0.46 (1.44,1.48, p < 0.001) High vs. medium RR 1.27 (1.25,1.29, p< 0.001)	

			(Charlson comorbidity score & medication-based chronic disease score) 1.07 (1.07,1.07) & 1.04 (1.04,1.05) p< 0.001 for both presence of cardio-vascular or digestive disease (+) 1.41 (1.39,1.44) 1.66 (1.64,1.68) P<0.001 for both increased no. of days in hospital (+) 1.05 (1.05, 1.05, P< 0.001) terminal illness (or deteriorating				

			health) (+) 2.01 (1.98,2.05, p< 0.001) Greater age (+) 1.18 (1.17,1.18, p< 0.001)				
Lowe[43] 2005 USA Cross-sectional	57,850 patients assigned to 353 primary care practices affiliated with a Medicaid HMO (Aug 1st-, '98-July 31'99)	A survey instrument was used to measure practice characteristics that might reflect access or quality of care. Analyses was adjusted for patient characteristics Data were expressed as RR (95%, p value)		Higher ratio of no. of active patients per clinician-hour of practice time (+) 1.05 (1.01,1.11, p=0.01) No. of week day daytime office hours per week (#- but near significance) Greater no.	% of Medicaid patients in a practice (+) 1.04 (1.001,1.08 p= 0.04) Practices with nurse practitioners or physician assistants (+) 1.11 (1.0002,1.22p =0.049) Practices where at least 1 clinician made hospital		

				of week day evening office hours per week (-) greater effect for adults compared with children No hours vs.≥12hrs for all patients 0.80 (0.67,0.95, p=0.01)	rounds (+) 1.09(1.004, 1.19, p=0.04) Practices lacking nebulizers for bronchodilators (+ for children) 1.13 (1.02,1.24,p= 0.02) Practices lacking peak flow meters (+ for adults overall and for adults with respiratory conditions) 1.15 (1.07,1.2,p<0. 001) 1.20 (1.05,1.37) Practices lacking inhalers (-) 0.78 (0.68,0.90 p= 0.001)		

Lowe[47] 2009 USA Cross-sectional	Admin data from July 1, '03-Dec 31, '04. Residence ZIP codes were used to assign all 555,219 Medicaid enrollees to 130 primary care service areas (PCSAs).	Andersen's model of access to care, which includes predisposing characteristics enabling resources, perceived & objective needs; & health care system characteristics Data expressed as ED (95% CI,p value)		Great PC capacity (estimated provider visits available/ visits needed) (-) 0-1 vs.2.0 visits -0.10 (-0.20, -0.026, p= 0.044) 0-1 vs.1-2 visits -0.12 (-0.20, -0.044, p=0.002)	Driving time to hospital (+) ≤10 vs. >30 mins -0.26 (-0.38, -0.13, p<0.001)		
Ludwick[53] 2009 USA Cross-sectional	26,038 children ≤ 18 yrs in 332 PC practices affiliated with a Medicaid HMO in South eastern Pennsylvania. (Aug 1 '98- July 31, '99).	Secondary analysis of cohort study data that examined association between PC practice characteristics & ED use. Data expressed as RR (95% CI, p values)		Distance from PC practice (-) 0-0.7 vs. .3.13miles 1.10 (0.99,1.21, p=0.06) (p=0.06 overall) Distance from nearest ED department			

				(+) 0-0.58 vs.1.19 miles 0.89 (0.81–0.99, p=0.03) (p=0.01 overall) Distance from nearest children's hospital (#)			

McCusker [51] 2010 Canada Cross-sectional	33,491 Québec residents aged ≥18yrs who reported at least one GP contact during previous 12 mths & were not hospitalized.	Multiple logistic regression of data from 2 cycles (2003 & 2005) of the Canadian Community Health Survey carried out in 2003 & 2005. Data expressed as OR (95% CI) .	Perception of unmet needs (+) 1.28 (1.01, 1.63) Presence of chronic conditi*o*ns (#)	No regular GP(+) 4.23, (3.43, 5.21)			
McCusker [52] 2012 Canada Cross-sectional	Cohort of 367, 315 adults ≥18 yrs resident in urban areas of Quebec. (Apr. '03- Mar '06).	Multivariable negative binomial regression to investigate relationships between measures of care & ED use in 12mth period IRR (95% CI)		No registered FP or specialist for those <65yrs (+) 1.11 (1.05, 1.16) & 1.10 (1.04, 1.17) respectively. Specialist physician as opposed to fam. physician for those >65yrs (+) 1.13 (1.09,1.17)		Greater CoC with FP with participants ≥ 25 visits to a physician during the 2 yr baseline period. (-) 1.17 (1.07,1.28) Greater CoC with specialist physician (-) Low v. high 1.17 (1.07,1.28)	

						Medium v. high 1.10 (1.01,1.18)	
Pereira[24] 2003 USA Case-control	3,931 adults whose PCP who left a large multi-specialist practice (Jul '94- Jun '96) compared with those adults (8,009) in the same practice who still had their PCP for the study period.	Comparison of measures of quality of care & use of urgent care & the ED department Data expressed as mean numbers of ED visits.				PCP departure (#)	
Stern[26] 2009 Israel Case control	919 type 2 diabetes mellitus patients within a large HMO who were admitted to one of West Jerusalem's ERs (May – June '04 & were compared with	Study covariates were retrieved from the HMO's database & a study subset of the study population was interviewed. Logistic regressions were conducted to estimate ODs (95% CI, p					Quality of care for diabetes patients as measured by Cholesterol testing (-) 0.23 (0.19, 0.29, p< 0.001) Glycated haemoglobin test (-) 0.26 (0.24,0.29,

	1952 control subjects not admitted.	value) of being admitted according to measures of quality of care.					p < 0.001) Visiting an ophthalmologist (-) 0.47 (0.32,0.68, p =0.001) Recommendations to stop smoking (-) 0.10 (0.05,0.21 p < 0.001)
Sturm[44] 2010 USA Cross-sectional	127 017 patient visits to the 2 tertiary care PEDs (Nov '06, -Oct '07) were reviewed with PC practice characteristics prospectively collected from 33 practices.	Discriminant analysis classification model used to identify practice characteristics associated with Non-urgent versus urgent utilization of the PED. Data presented as discriminatory patterns.	% patients with Medicaid (+) closer distance to the PED (+) Ability of practice to have same-day turnaround of laboratory tests (-)	Greater total available sick slots to see patients per physician (-) Office policy to have after-hours nurse triage line call on-call physician prior to disposition to PED (-) Office policy to accept all walk in sick visits (-)			
Thomas[30] 2008	2004–05 data from the	Data used to assess	Indigeous people (+)				

Australia Cross-sectional	National Non-admitted Patient Emergency Department Care database from Northern Territory &Western Australia	equity in the accessibility and quality of care received in EDs by Aboriginal and Torres Strait Islander people compared with other Australians. Data presented as ratio.	1.7:1 ratio of presentation at ED with non-indigenous people				
Thompson[31] 2010 UK longitudinal	Routinely collected data before, during & after the delivery of out-of-hours primary medical care in the UK were changed in 2004. (Sep & Oct '99- '06 were included)	The data were analysed by using a simple linear regression model to analyse the yearly trend for 1999–2003 and plotting subsequent observed monthly attendances against predicted numbers. Data presented in graph form only.		Change in the delivery of OoH primary medical care in UK since 2004 (+) Increase in % non-trauma vs. trauma patients, at all times 1999-2006 Slope=0.015, SE=0.00081, x2 (df=1) for trend=363.1, p<0.001			
Van uden[48] 2004 The Netherlands Before & after	Until Sep '01, OoH PC was organised in 24 small practice rotas.	Before & after (4wks) reorganisation of primary care all patient		Presence of GP OoH cooperatives near EDs (-) Absolute change			

	OoH was reorganised & 3 large GP cooperatives were created, located near but independent of the only 3 hospital EDs in the province of Limburg	contacts with GPs & hospital EDs were analysed using GP cooperatives' & hospital computer system. Data presented as total numbers & %.		-2292 (8.9%)			
Vedsted[49] 2001 Denmark Longitudinal	A reorganisation of the OoH GP service in Denmark in 1992 including a mandatory telephone triage staffed by GPs & the replacement of small rota systems with county-based health centres. in the County of Aarhus.	Calculation of the number of annual contacts per inhabitant from 1988 to 1997. Linear regression Data presented as correlation coefficient (95% CI, p value)		A mandatory telephone triage staffed by GPs & replacing small rota systems (+) 0.0026 (0.0017, 0.0036, P=0.0002)			

Table 1b: Summary of features of primary care that influence ED attendance.

Features which **REDUCE** unplanned ED attendance (author, country)

Patient factors	Access	Practice factors	Continuity of care	Quality of care
Increased education {Brousseau 2009 , USA} **Parent's perception of high-quality family-centeredness PC for publicly insured children & children ≤ 2yrs {Brousseau 2007, USA}** **% of patients ≥65yrs of age (Cowling , UK)**	**Greater realized PC access {Brousseau 2007,2009, USA}** **Greater realized PC access for publicly and privately insured {Brousseau 2007,USA}** **High-quality timeliness /timely access (2 days) {Brosseau 2009, USA, Cowling , UK}** **Greater no. of week day evening office hours per week -greater effect for adults compared with children {Lowe, USA}** **Great PC capacity (estimated provider visits available/ visits needed){Lowe, USA}**	**Short distance from PC practice {Ludwick, USA, Cowling UK}** **Practices lacking inhalers {Lowe, USA}** **Ability of practice to have same-day turnaround of laboratory tests {Sturm, USA}** **Rural vs. urban practices (Cowling , UK)**	**Higher continuity of care {Christakis,USA; Gill USA Ionescu, USA; McCusker, Canada}**	**Quality of care for diabetes patients as measured by:** **Cholesterol testing** **Glycated haemoglobin test** **Visiting an ophthalmologist** **Stopping smoking {Stern, Israel}**

	Greater total available sick slots to see patients per physician {Sturm, USA} **Office policy to have after-hours nurse triage line call on-call physician prior to disposition to PED {Sturm, USA}** **Office policy to accept all walk in sick visits {Sturm, USA}** **Presence of GP OoH cooperatives near EDs {van Uden, The Netherlands}** **Availability of a Transitions Clinic {Wang, USA}**			

Features which INCREASE ED attendance

Patient factors	Access	Practice factors	Continuity of care	Quality of care
Deprivation (Cowling ,UK) Older children vs. younger (in practice) {Brosseau 2009, USA} Greater age {Carret, S. America; Ionescu, Canada} Being female (15-49yrs) [Carret, S. America} Number of barriers to PC (Cheung 2011, USA) Medicaid patients vs. private insurance patients (Cheung 2012, USA)	No primary physician {Ionescu, Canada} No registered FP or specialist for those <65yrs {McCusker, Canada} Absence of a regular GP {McCusker, Canada} Higher physician :population ratio {Ionescu, Canada}	Practices with nurse practitioners or physician assistants {Lowe, USA} Practices where at least 1 clinician made hospital rounds {Lowe, USA} Specialist physician as opposed to fam. physician for those >65yrs {McCusker, Canada}	Lower continuity of care {Burge.USA}	
White ethnicity {Baker, UK} Indigeous people [Thomas, Australia}	Change in the delivery of OoH primary medical care in UK since 2004 {Thompson,UK} A mandatory telephone	Smaller list size {Baker, UK} Shorter distance from hospital {Baker, UK}		

	triage staffed by GPs & replacing small rota systems {Vedsted, Denmark}			
Amongst older (50+) patients, more education {Carret, S.America}	**Lower patient satisfaction with practice telephone access {Baker, UK}** **Patients who reported that the PHC clinic which they use is open for shorter periods during the day {Carret, S.America}** **Patients who reported there was no other place to go {Carret, S. America}** **Patients reporting that doctor at regular place of care refused them without a prior appointment {Carret, S.America}** **Perception of unmet needs {McCusker, Canada}**	**Practices lacking nebulizers for bronchodilators (+ for children) {Lowe, USA}** **Practices lacking peak flow meters (+ for adults overall and for adults with respiratory conditions) {Lowe, USA}**		

Increased IMU {Begley, USA} **Deprivation {Baker,UK;Begley, USA}** **Rate of uninsurance {Begley, USA}** **low socio-economic status {Ionescu, Canada}** **Increase in IMD score {Harris, UK}** **% registered population receiving incapacity benefits {Harris, UK}** **% of Medicaid patients in a practice {Lowe, USA; Sturm, USA}**				
Lack of social support {Carret, S.America} **% Registered lone-parent households {Harris, UK}**				

Living in a rural area {Ionescu, Canada}				
Longer duration of symptoms until consultation {Carret, S.America} **Absence of self-reported chronic diseases {Carret, S.America}** **high overall comorbidity {Ionescu, Canada}** **Standardised Mortality Ratio {Harris, UK}** **for both presence of cardio-vascular or digestive disease {Ionescu, Canada}** **terminal illness (or deteriorating health) {Ionescu, Canada}**				

increased no. of days in hospital {Ionescu, Canada}				

Features which have NO EFFCT on ED attendance

Patient factors	Access	Practice factors	Continuity of care	Quality of care
On GP register and aged >65 years {Harris, UK} **Female vs male {Brousseau, USA, Cowling UK}** **% Male {Harris, UK, Cowling UK}**	**Timeliness of care {Brousseau, USA}** **Greater accessibility to the PC CCP's { De la fuente, Spain}** **Total opening hours {Harris, UK}** **No. of week day daytime office hours per week (- but near significance) {Lowe, USA}**	**Nurse or doctor care {Brosseau, USA}** **Total whole-time equivalents {Harris, UK}** **No of GPs per 1,000 registered patients (Cowling UK)** **PCP departure { Pereira, USA}**		**Quality and outcomes framework points {Baker, UK;Brousseau 2007,USA}**
Parent's perception of high-quality family centeredness	**Had to wait a long time at GP practice {Harris, UK}**	**Distance from nearest children's hospital {Ludwick, USA}**		

{Brosseau,2009, USA}	**Able to see a preferred GP{Harris, UK}** **Felt that the out-of-hours GP service was good {Harris, UK}** **Felt out-of-hours care took a long time {Harris, UK}** **Desired more opening hours {Harris, UK}** **Satisfied with the opening hours {Harris, UK}** **Able to book ahead {Harris, UK}** **Able to get appointment fairly quickly {Harris, UK}** **Able to speak to GP {Harris, UK}** **Able to get through to GP practice on telephone {Harris, UK}**			

	Satisfied with the GP practice {Harris, UK}			

Table 2a: Primary care features & emergency hospital admissions n=22 studies

+ Positive association i.e. increases EA -negative associations i.e. decrease EA # no effect on EA

Study Year country Design	**Setting & participants**	**Methods**	**Primary care features which have associations with emergency admissions**				
			Patient features	Access	Practice features	Continuity of care	Quality of care
Bankart[17] 2011 UK Cross-sectional	145 general practices over two PCTs	Practice & patient characteristics were used as predictors of EA use in a two-level hierarchical model with 2007/8 data and evaluated against 2006/7data	Older age (+) 1.03 (1.02, 1.04) p=<0.0001 Male (-) 0.98 (0.96, 0.99) p=0.004	Patient satisfaction with telephone access (#) Patient being able to get an appointment within 48hrs (#) Patient being	Shorter distance from hospital (+) 0.99 (0.985,0.995) p<0.0001 Larger practice size (+)	Being able to get appointment with particular GP (-) 0.995 (0.991,0.998) p=0.0006	Practice performance: QoF, clinical & organisational points (#)

		Data reported as IRR (95% CI, p value) 2007/8 data	White (+) 1.003 (1.001,1.005) p=<0.0001 Increased deprivation (+) 1.016 (1.012,1.02) p<0.0001	able to book an appointment in advance (#)	0.9999 (0.9998,0.9999) p=0.0001		
Basu [38] 2002 USA Cross-sectional	New York residents in the age group 20–64 hospitalized either in New York or in three contiguous states: New Jersey, Pennsylvania, or Connecticut using 1995 statewide discharge files from the Health care Cost and Utilization Project (HCUP)	The association of primary care availability, HMO enrollment, & other person and location variables with potentially ambulatory care sensitive (ACS) hospitalisation for adults in New York State, compared with other types of hospitalisation. A multinomial	Increased age (+) e.g. 50-64 age bracket OR 1.34 (1.24,1.45) p=0.01 Being male (-) OR 0.69(0.65, 0.75)p=0.01 Being black (+) OR 2.2		Higher primary care density compared with marker admissions as measured by Primary care phys. per 1000 pop & (-) OR 0.2		

		logit model was used with individual discharge as the unit of analysis. ACS admissions are compared with (urgent but non-ACS admissions & referral sensitive surgeries controlling for severity of illness. Data expressed as OR with 95% CI	(1.95,2.52) p=0.01 Being Hispanic (+) OR 1.33 (1.12,1.57) p=0.01 Private vs. Medicaid insured patients (-) HMO OR 0.75 (0.69,0.81) Medicaid FFS 1.99 (1.78,2.22), Medicaid HMO 1.84 (1.55,2.18) Increasing urbanity (-) Urban(metro area) OR 0.75 (0.62,0.91) p=0.01 New York		(0.07,057), p=0.01 Specialists per 1000 pop (+) OR 1.41 (1.11, 1.80) p=0.01		

			City OR 1.21 (1.04,1.4) p=0.05 Increased Severity score (RDSCALE) (-) OR 0.61 (0.56, 0.66) p=0.01				
Bottle [25] 2008 UK Cross-sectional	303 PCTs in England participating in performance – linked reimbursement with a focus on diabetes care (1,760,898 diabetic patients registered with GP)	Hospital admission rates were compared with quality of care scores, diabetic prevalence & deprivation Data reported as DSR (r=) & p values	Lower socio-economic status (+) 25-29yr grp 0.58 p<0.001 60yrs+ 0.45 p<0.001				PC quality scores of higher glycaemic control in patients over 60yrs (-) Correlation co-efficient of -0.21 p<0.001
Carlsen[34] 2007 Norway Cross-	Norwegian Patient Register data set with number of	Municipalities were unit of observation a) inhabitants'	high proportion of women (+)	Patient satisfaction with the physician	Physician density (#)		

sectional	acute (and planned admissions) to somatic hospitals in 1998 10.5 per 100 admissions were unplanned but rates varied between municipalities	need for treatment, b)supply of specialized health services c) supply of primary physician services were used to explain use of hospital admissions Data reported as coefficients relating no of emergency admissions per 100 inhabitants affected by unit change in variables (t values in brackets)	0.308 (3.26) A higher proportion children & adolescents (-) –0.127 (–2.38) high proportion of elderly people (+) 0.101 (2.95) high age-standardised mortality (+) 0.189 (2.38) Higher education (-) –0.086 (–	(-) –0.515 (–2.86)	Share of salaried physicians (#) greater distance from hospital (-) –0.189 (–7.29)		

			6.63) away from coastline (+) 0.353 (2.78)				
Christakis[16] 2001 USA Cross-sectional	46 097 paediatric patients at Group Health Cooperative, between 01/01/93-31/12/98	A continuity of care index that quantifies the degree to which a patient has experienced continuous care with a provider. Data were expressed as HR (95% CI)	Children on Medicaid or with asthma & with reduced CoC (+) 1.22 (1.09,1.38) between high & medium CoC 1.54 (1.33,1.75) For children with the lowest CoC				
Downing[42] 2007	Two neighbouring	QoF data for the period April	Higher clinical		Higher scores in		

UK Cross-sectional	PCTs with ~360,000(PCT1) & 157,000 (PCT2) individuals respectively with a GP in same PCT.	2004 to March 2005 linked to data for emergency hospital admissions for 6+ chronic conditions for the period September 2004 to August 2005. Multilevel logistic regression models were used. Data were as expressed OR (95% CI)	domain (-) significant for cancer 0.86 (0.79,0.93) and other conditions 0.94 (0.92,0.97) in PCT 2 Being female & having cancer OR CHD (-) PCT 1 0.68 (0.57,0.8) & 0.56 (0.48,0.64) Respectively PCT 2 0.74 (0.57,0.94) 0.54 (0.43-0.68) Deprivation with all conditions		the additional services (+) Signif. for Asthma 1.04 (1.01,1.08) CHD 1.03 (1.01,1.07) stroke 1.05 (1.01,1.11) other conditions 1.03 (1.01,1.04) in PCT 1 & cancer 1.03 (1.01,1.05) in PCT2 organisational		

			(+) PCT 1 1.10 (1.06,1.14) PCT 2 1.11, (1.06,1.17) per quartile increase in income domain score.		domain scores e.g. education for patient, information, clinical management (#)		
Dusheiko[20] 2011 UK Cross-sectional	8,223 English family practices from 2001/2002 to 2006/2007	Data from the QOF incentive scheme related to diabetes care i.e QOF quality indicators for monitoring & controlling HbA1c levels were related to 4 types of diabetes EA. Data were expressed as IRR (95% CI)					Moderate compared to poor QOF quality indicators for diabetes with EAs (-) 1.9% (1.1–2.6%) Moderate compared to good QoF quality indicators for diabetes with EAs (#) Moderate compared with

							good QoF indicators with hypoglycaemic admissions (#)
Duffy [36] 2012 UK Cross-sectional	An acute hospital trust serving Dundee, Scotland between 1996 & 1997	Scottish Morbidity Record 1 data which provides EA data related to general practice and patient variables. The three variables of high & low deprivation & age were expressed as t-ratios and used for modelling	High rate of deprivation (+) 2.00 Low rate of deprivation (-) 2.90 Greater age (+) 2.29 R2 of 42.1% t-statistic of overall model (*F* [3,29] = 7.04; *P* = 0.001).		No. of partners with MRCGP (#) List size (#) No. of partners (#) Average list per partner (#)		

Guliiford [57] 2002 UK Cross-sectional	99 health authorities in England in 1999	Health outcomes including hospital admissions for acute conditions. These were related to number of GPs per 10,000 population with confounders of deprivation, ethnic origin, social class & long term illness Data expressed as mean changes (95% CI)		Increase in GP supply (-) -14.4, (-21.4,-7.4)			
Hossain[55] 2009 USA Cross-sectional	Health care data from south Carolina ages 18+	To explore the related latent constructs associated with 12 ambulatory care sensitive conditions using cluster detection tools to identify counties that have a higher probability of hospitalization		Less access to PHC (+)			

		for each adult condition.					
Hull[58] **2000** UK Cross-sectional	Paediatric data in East London & City Health authority, including all 164 practices in the inner-city boroughs of Hackney, Newham, Tower Hamlets, and the City of London for the year to 31 March 1996.	The effect of practice variations on Paediatric acute admissions, & A&E attendances, for discrete age and sex bands The practice was the unit of analysis. Preliminary uni-variate analysis followed by for each outcome variable two linear multiple regression models one including all of the explanatory variables & the second a stepwise method with backward elimination of variables using a significance level of 0.05. Data expressed	Children ≤1yr Health visitor hours/1000 children aged under 5 years (-) Separate data given by gender (male/female) & age (≤1yrs, >1-≤2yrs, >2-≤5yrs) -0.006 (-0.008, -0.003) p<0.001 -0.008 (-0.012,-0.005) p<0.001 -0.006 (-0.009 ,-0.003) p<0.001 No data				

		as regression coefficients (95% CI)	presume NS -0.007 (-0.009, -0.005) p<0.001 No data presume NS Other demographic data but not consistent across ages				
Kronman[59] 2008 USA Cross-sectional	National random sample of 78,356 Medicare beneficiaries aged 66+ who died in 2001. Non-whites were over-sampled. All subjects with complete Medicare data for 18months prior to death were	To explore associations between primary care & hospital utilization at the end of life. Retrospective analysis of Medicare data related hospital use during the final 6 mths of life & the number of primary care physician visits in	Greater number of primary care visits for end of life congestive heart failure & COPD patients (-) OR=0.82, p<0.001 OR=0.81, P=0.02				

	retained.	the 12 preceding months. Multivariate cluster analysis adjusted for the effects of demographics, comorbidities, & geography in end-of-life healthcare use. Data expressed as adjusted OR (95% CI)	respectively				
Magan[45] 2011 Spain Cross-sectional	Individuals aged 65yrs plus in 34 health districts in the region of Madrid, Spain between 2001-2003	Used hospital discharge data to obtain hospitalisations for ambulatory care sensitive conditions (ACSH) and compare to population socioeconomic factors PHC characteristics Data expressed as age- and sex-adjusted Rate-R were calculated (95% CI, pvalue)	Being male vs female (+) *65-74yrs* 21.95 vs. 10.26 *75-84yrs* 46.29 vs.22.33 *≥85yrs* 74.77 vs.52.27 p<0.05 for all University education (-) 0.961	High versus low physician supply (#)	Increased physician workload (+) 1.066 (1.041,1.091 P<0.001)		

			(0.951,0.971, p<0.001) Higher mean income (-) 0.349 (0.243, 0.503 p<0.05) for >$12,700 mean available income Accessibility & type of heating indicator (-) 0.979 (0.964,0.994, P<0.05)				
Majeed[41] 2000 UK Cross-sectional	66 primary care groups in London with a total list of 8.0 million	Data from NHS Executive and DoH: population estimates, hospital admissions,	Unable to work due to health (+) 0.46 p<0.01		Increased % female GP principals (-)		

		mortality, census data, benefits data and practice characteristics. Univariate correlation was determined between admission rates (emergency data presented separately) & possible explanatory factors. Data expressed as Pearson's correlation coefficient & p value	Unemployed (+) 0.38 p<0.01 Household headed by someone in unskilled socioeconomic grp (+) 0.51 p<0.01 Household with no car or with no heating (+) 0.25 Overcrowded households (+) 0.21 Pensioners		-0.41 p<0.05 Increased % of GPs who were approved trainers or course organisers (-) -0.25 & -0.21 respectively p<0.05 These associations were weaker than the patient factors		

			living alone (+) 0.05 Single parent households (+) 0.23 People over 18 or with education above A levels (-) -0.41 Working age people who are students (-) -0.26 Receiving benefits (+) 0.25 to 0.68 depending				

			on benefit type				
Menec[23] 2006 Canada Cross-sectional	Survey of older adults aged 67 or over living in the province of Manitoba (n=1863)	Data linked between survey (aging in Manitoba) & health care use database from 1971, 1976 & 1983 Data expressed as OR 95% CI				High continuity of care (-) OR 0.67 (0.51,0.9)	
Nolan[56] 2011 Ireland Cross-sectional	58 (2 private) acute hospital in Ireland with a coverage rate of 95%	Hospital In-patient Enquiry (HIPE) discharge data for 1999-2004 to relate it to enhanced access to GP services for the over 70s after July 2001		Enhanced access to free GP services for the over 70s (#)			
Purdy[21] 2011a UK Cross-sectional	8169 general practices in England during 2005-6	Univariate analysis & multiple regression of HES routine population data for asthma & COPD patients and primary care	Deprivation (+) 1.723 (1.536,1.932,) 1.631 (1.536–1.733)		Smaller practice size (+) 0.992 (0.987,0.997, p<0.001) NS for		Increased clinical QOF score for COPD (#) NS for asthma 0.976 (0.960–0.992 p= 0.004) for COPD

		data. Data expressed as Rel.rate (95% CI, p value) asthma followed by COPD data.	Between least & most deprived p<0.001 for both Increased asthma/COPD prevalence (+) 1.049 (1.031,1.066,) 1.234 (1.203–1.267) p<0.001 for both Higher smoking rates in asthma/COPD patients (+) 1.007 (1.000,1.013,p=0.03		COPD Single-handed practices (+) 1.079 (1.010,1.154 p= 0.025) NS for COPD FTE GP per 10000 population (#) Training practice (-) NS for asthma 0.977 (0.955, 1.000 p=0.005) for COPD		Diagnosis of asthma by spirometry (-) 0.997 (0.995, 0.999) p=0.009 Asthmatics who received a review (#)

			3) 1.012 (1.010–1.014, p<0.001)		Proximity to ED (+) 0.988 (0.983, 0.993) 0.992 (0.989–0.995) p<0.001 for both Urban dwelling (vs. rural) (+) 0.840 (0.765 2 0.922) 0.825 (0.776–0.887) p<0.001 for both		
Purdy[22] 2011b UK Cross-sectional	80,377 EAs for angina & 62,373 EAs for MI for individuals aged ≥45 yrs. from all general	HES provided EA data in England adjusted for age & gender. IRR (95%, p value)for general practices	Deprivation (+) 1.018(1.009,1.028) (MI) & 1.084		Increased proximity to ED department for angina (+)		Higher overall clinical QOF score for angina (-) 0.984(0.969,0.999) P=0.039

	practices England for 12mth (Apr '05 to Mar '06	were calculated & adjusted for confounding variables in a multiple regression Poisson model.	(1.052,1.117) p<0.001 for both Practice prevalence of CHD and smoking (+) 1.083(1.060,1.106) (MI) & 1.074(1.048,1.101) (angina) P<0.001 for both Urban dwelling (+) For angina patients p<0.001 NS for MI patients Presence of Pneumonia, CHF,		0.972 (0.958,0.986) p<0.001 NS for MI Training practices for MI (-) 0.954 (0.930,0.980) p<0.001 NS for angina Higher numbers of general practitioners per registered population for MI (-) 0.981(0.965,0.998) p=0.021 NS for		Condition-specific quality markers for MI (#)

			COPD, asthma, and angina (+)		angina Practice Size effect on CHD admissions (#)		
Ricketts[46] 2001 USA Cross-sectional	Primary care market areas in North Carolina Data were reported by North Carolina Medical Database Commission for all discharges from North Carolina hospitals (Oct '93-Sep '94) 117,444 (16.87%) were for ACSCs.	Rates of ACSCs admissions were age-sex adjusted The adjustments included age-limited diagnoses. Cluster rates were calculated for two groups: < and >65yrs of age.	per greater capita income (-) -0.000403, p>0.003 non-white (+) 0.045278 p>0.008 the latter two in the <65yrs grp only	Health insurance coverage (-) is postulated but not proven by model. Authors state that almost complete Medicare insurance coverage in the over 65yrs protects against access issues of the <65yrs.	PC physician supply (#) Presence of subsidised community clinic (#)		
Rizza[37] 2007 Italy Cross-sectional	520 patients admitted to medical wards (Cardiology, Internal Medicine, Pneumology,	Data from reviewing patient charts and by interviewing patients. A multivariate	Greater age (+) 1.03 (1.01,1.05, p=0.027) Being male		Greater no. of patients for each PC physician (+)		

	Geriatrics) of a non-teaching acute care hospital in Catanzaro April-July 2005 (492 patients agreed to participate)	logistic regression analysis was performed to identify characteristics independently associated with preventable hospitalization Data expressed as OR (95% CI, p value)	(+) 0.52 (0.31–0.87, p=0.013) No. of hospital admissions in previous year (+) 1.76 (1.06,2.93 p= 0.03) With a lower no. of PCP accesses & medical visits in previous year (+) 0.52 (0.3,0.93, p=0.027) less satisfactio n with PCP health services		2.25 (1.62,3.13 , p < 0.001)		

			(+) 0.34 (0.2,0.58,p<0.001) worse self-reported health status (+) 0.53 (0.31,0.89, p=0.017) shorter length of hospital stay (+) 0.95 (0.91,0.99, p=0.011) these outcomes were consistent across heart, respiratory & diabetic disease				
Saxena[8] 2006	All 31 primary care trusts in	Cross sectional analysis at	Underlying mortality		Total number		

UK Cross sectional	London with a (7 million patients) in 2001 focusing on Age-standardized AEs for asthma, diabetes, HF, hypertension and COPD.	primary care trusts level using routine data from multiple sources the census, Department for Environment, Transport & the region's Index of Multiple Deprivation, Office for National Statistics, DOH, PCTs & HES. Data expressed as regression coefficients (95% CI, p values)	for COPD patients (+) 4.74 (2.27,7.21 p≤0.05) Deprivation (+) signif. for asthma & COPD 1.32 (0.57,2.08) & 4.00 (2.25,5.75) p≤0.05 for both Lone parenthood with diabetes (+) 26.95 (5.52,48.87) Percentage of elderly living alone with		of GPs in practice (#) Practices with higher list sizes (#) % GP with >2,500 patients (#) Specialist services for diabetes (#) Specialist services for asthma (#) Prescription services for all conditions studied		

			asthma, hypertension,COPD. (+) -36.90 (51.94,21.84) -9.63 (-17.77,1.49) -53.30 (91.11,15.48) respectively		(#)		
Solberg[32] 2004 USA Cross-sectional	~7000 patients with diabetes, 3800 with CHD & 6000 with depression who received all of their care in 500-physician multi-specialty medical group between 1999 and 2001	Multilevel regression analysis of health plan administrative data to determine rates of inpatient admissions and various types of outpatient encounters. Data expressed as numbers & %.		Implementation of open access primary care (#)		Improved continuity of primary health care (#)	

Table 2b: Summary of features of primary care that influence unplanned hospital admissions.

Features which **REDUCE** unplanned hospital admissions (author, country)

Patient factors	Access	Practice factors	Continuity of care	Quality of care
Higher % of children & adolescents { Carlsen, Norway} **Being male {Rizza, Italy}** **Being female with cancer or CHD {Downing, UK}** **Higher education {Carlsen, Norway}** **University education {Magan, Spain}** **People >18yrs & >A levels education {Majeed, UK}** **Working age people who are students {Majeed, UK}**	**Increase in GP supply {Guliiford, UK}** **Higher practitioner/ patient ratio (MI patients) {Purdy 2011b,UK, Basu,USA}**	**Female GP principals {Majeed, UK}** **GP trainers within practice {Majeed,UK}{Purdy2011a,UK} {Purdy 2011b UK}** **Course provision within practice {Purdy 2011a,UK}** **Greater distance from hospital {Carlsen, Norway}** **Health visitor hours /100 children under 5 {Hull, UK}** **No. of PC visits at the end of life for COPD & congestive heart failure {Kronman, USA}**	**Getting appointment with own GP {Bankart ,UK}** **High continuity of care {Menec, Canada}**	**Primary care quality score of high glycaemic control (>60yrs){Bottle, UK}** **Moderate compared to poor QoL indicators for diabetes {Dusheiko, UK}** **High quality scores for angina (Purdy 2011b, UK)** **Diagnosis of asthma by spirometry {Purdy 2011a, UK}**

Higher income {Magan, Spain} **Greater income in the 60yrs old {Magan, Spain}** **Accessibility & type of heating in home {Magan, Spain}** **Low rate of deprivation {Duffy, UK}** **Higher clinical domains for cancer {Downing, UK}** **Patient satisfaction with Physician {Carlsen, Norway}** **Private vs. Medicaid insurance {Basu,USA}**				

Features which **INCREASE** unplanned hospital admissions

Patient factors	Access	Practice factors	Continuity of care	Quality of care
Greater age {Bankart, UK; Duffy UK; Rizza, Italy, Basu, USA} **Greater age & educated {Magan, Spain}**	**Less primary care access {Hossain, USA}**	**Large practice size {Bankart, UK}** **Smaller practice size {Purdy 2011a, UK}**		
Being female {Carlsen,Norway} **Being male {Magan, Spain; Rizza, Italy, Basu, USA}**	**Increased primary care practitioner workload {Magan, Spain}** **Greater % of patients to physicians {Rizza, Italy}**	**Shorter distance from hospital {Bankart,UK} {Carlsen, Norway}**		
Not white & <65yrs {Ricketts, USA} **Black or Hispanic {Basu, USA}** **White ethnicity {Bankart, UK}**		**Higher scores in additional services {Downing, UK}**		
Deprivation (5) {Bankart, UK; Downing UK; Duffy, UK;Purdy2011a, UK;Purdy 2011b, UK;Saxena, UK;				

Deprivation & the prevalence of asthma/COPD {Saxena, UK} **Lower socioeconomic status {Bottle 2008} Children on Medicaid & low CoC { Christakis, USA}** **Unable to work due to health or unemployed {Majeed, UK}** **Household headed by someone in unskilled socioeconomic grp {Majeed, UK}** **No car {Majeed, UK}** **No heating {Majeed, UK}** **Overcrowded households {Majeed, UK}**				
Away from coastline				

{Carlsen, Norway} **Older & alone {Majeed, UK} Percentage of elderly living alone with asthma, hypertension,COPD {Saxena 2006}** **Single parent households {Majeed, UK}** **Urban dwelling Purdy 2011 a&b, UK}**				
CHD {Downing, UK} **CHD & smoking {Purdy 2011b,UK}** **Angina {Ricketts, USA}** **Presence of Pneumonia, CHF, COPD, asthma, and angina {Purdy 2011b, UK}** **Prevalence of**				

asthma & COPD {Ricketts, USA} **Smoking rates with asthma & COPD {Purdy2011a, UK}** **Pneumonia {Ricketts, USA}** **Underlying mortality {Carlsen, Norway}** **Underlying mortality in COPD patients {Saxena, UK}**				
Less satisfaction with service {Rizza, Italy} **Worse self-reported health {Rizza, Italy}**				
No. of hosp ádmission last yr {Rizza, Italy} **Lower primary care use in last yr {Rizza, Italy}** **Shorter length of**				

hospital stay {Rizza, Italy}				

Features which NO EFFECT on unplanned hospital admissions

Patient factors	Access	Practice factors	Continuity of care	Quality of care
Patient's satisfaction with telephone access, being able to get appointment within 48hrs, booking appointment in advance {Bankart, UK}	**Physician density {Carlsen, Norway}** **FTE GP per 10,000 pop {Purdy 2011a, UK}** **Average list per partner {Duffy,UK}** **% GPs with >2500 patients {Saxena,UK}** **Enhanced access to free GP services for the over 70s {Nolan, IRE}** **Implementation of open access primary care {Solberg, USA}** **Presence of subsidised community clinic {Ricketts, USA}**	**No. of partners with MRCGP {Duffy, UK}** **Share of salaried physicians {Carlsen, Norway}** **No. of partners {Duffy,UK}** **PC physician supply {Magan, Spain}** **Total no of Gps in practice {Saxena, UK}** **Practice size effect on CHD admissions {Ricketts, USA}** **Practices with higher list sizes {Saxena, UK}** **Prescription services for all conditions studied**	**Improved continuity of care {Solberg,USA}**	**Practice performance (QOF, clinical & organisational points) {Bankart, UK}** **Organisational domain scores e.g. education for patients, clinical management (Downing,UK)** **Moderate vs. good QoF indicators for diabetes {Dusheiko, UK}** **Moderate vs. good QoF indicators with hypoglycaemic admissions {Dusheiko,UK}** **Increased clinical QoF score for COPD {Purdy 2011a,UK}** **Asthmatics who have**

		{Saxena, UK} **Diabetes/asthma specialist services for {Saxena, UK}**		**received a review {Purdy 2011a,UK}** **Condition specific quality markers for CHD {Purdy 2011b,UK}**