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}**