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Authors	Lynch, Brenda;Fitzgerald, Anthony P.;Corcoran, Paul;Buckley, Claire M.;Healy, Orla;Browne, John P.
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University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Drivers of Potentially Avoidable Emergency Admissions in Ireland: An Ecological Analysis.

Keywords: Health services research, ambulatory care, emergency department

Drivers of Potentially Avoidable Emergency Admissions in Ireland: An Ecological Analysis.

ABSTRACT

Background: Many emergency admissions are deemed to be potentially avoidable in a well performing health system.

Aim: To measure the impact of population and health system factors on county-level variation in potentially avoidable emergency admissions in Ireland over the period 2014 -2016.

Methods: Admissions data were used to calculate 2014-2016 age-adjusted emergency admission rates for selected conditions by county of residence. Negative binomial regression was used to identify which *a priori* factors were significantly associated with emergency admissions for these conditions and whether these factors were also associated with total/other emergency admissions. Standardised incidence rate ratios (IRRs) associated with a 1 SD change in risk factors were reported.

Results: Nationally, potentially avoidable emergency admissions for the period 2014-2016 (266,395) accounted for 22% of all emergency admissions.

Of the population factors, a 1 SD change in the county level unemployment rate was associated with a 24% higher rate of potentially avoidable emergency admissions (IRR: 1.24; 95% CI 1.04 to 1.41).

Significant health system factors included emergency admissions with length of stay equal to 1 day (IRR: 1.20; 95% CI 1.11 to 1.30), and private health insurance coverage (IRR: 0.92; 95% CI 0.89 to 0.96).

The full model accounted for 50% of unexplained variation in potentially avoidable emergency admissions in each county. Similar results were found across total/other emergency admissions.

Conclusion: Results suggest potentially avoidable emergency admissions and total/other emergency admissions are primarily driven by socioeconomic conditions, hospital admission policy and private health insurance coverage. The distinction between potentially avoidable and all other emergency

admissions may not be as useful as previously believed when attempting to identify the causes of regional variation in emergency admission rates.

Background

Since the early 2000's, countries such as England, Wales and Northern Ireland have experienced increases in emergency admissions to acute hospitals.^{1,2} Over the past 10 years in Ireland, emergency admissions have increased by almost 1,000 per annum from 32,000 in 2005 to 41,500 in 2016.³ As of 2016, emergency admissions accounted for approximately one in four of all hospital admissions.³

Potentially avoidable emergency admissions have been deemed indicative of health system performance.^{4,5,6} These admissions may occur due to an exacerbation from an underlying condition, in which case the admission may have been preventable if the appropriate management of the condition was observed. For example, it has been proposed that the risk of emergency admission due to an exacerbation of asthma may be reduced if the condition is monitored by specialist nurses within the primary care system.⁵ An emergency admission may also be potentially avoidable if the patient could have been treated more appropriately elsewhere, such as in the patient's home or in a community setting.^{4,5} The designation 'potentially avoidable' refers to a subset of total emergency admissions, and focuses on conditions which are assumed to be sensitive to the quality of primary care management and the availability of alternatives to hospitalisations.⁵

To understand the drivers of potentially avoidable emergency admissions, it is important to distinguish between population and health system factors.

At a population level, older demographics^{7, 8, 9}, socioeconomic deprivation^{7,10, 11} and rurality^{10, 12, 13} are major sources of geographical variation in emergency admissions.

At a health system level, continuity of primary care and barriers to accessing primary care^{7,8}, including the number of available general practitioners (GPs), have been identified as reasons for regional disparities of emergency admissions within a country.¹⁴ Certain hospital-level factors such as the availability of acute beds¹⁵ and Emergency Department (ED) admission procedures¹⁶ have also been shown to drive geographical variation in potentially avoidable emergency admissions.

ED practices play an increasing role in admissions for almost all conditions.¹⁶ In Ireland, attendance at an ED can occur as a result of a patient's self-referral, or due to the referral of a GP. In addition to need, the use of such services may be motivated by whether the patient or GP believes viable alternative services exist.¹⁷ Since 2010, a number of EDs have been reconfigured to urgent care centres, which include Medical Assessment Units (MAUs) and Local Injury Units (LIUs). There are now 10 such centres in Ireland.¹⁸ These centres provide an alternative to traditional acute services which are required for serious emergency conditions. In 2016 there were 83,354 attendances at LIUs, representing 6% of all emergency presentations.¹⁸ However, this leaves a large majority of emergency presentations still occurring at EDs.

The Organization for Economic Cooperation and Development (OECD) found that in 2015 Ireland had a high occupancy rate of acute beds; 93.8% in Ireland, compared to an OECD average rate of 84.3%.¹⁹ It argued that this was due to an excess of people seeking care and being treated at a secondary care level.¹⁹ It strongly recommended a focus on reducing avoidable emergency admissions for those cases that could be treated in a primary care setting.¹⁹ Improving primary care services to prevent and manage disease is a key aim of recent government policies and a focus of recent reports.²⁰⁻²²

Service use in Ireland, regardless of condition, may also be driven by eligibility for medical card schemes.⁴ For example, the General Medical Services (GMS) card allows the use of the majority of health services free of charge including doctor visits, all in-patient services to public wards in public hospitals and all out-patient services in public hospitals, as well as use of emergency departments, casualty and out-patient services.^{23, 24} Eligibility for this card is based on income thresholds and consideration of an undue burden of the cost of an illness. In 2016, 68%^{25, 26} of those over 65 years of age were eligible for this scheme.²⁷ The Irish Longitudinal Study on Ageing found that among older adults in poor health, those with a medical card were more likely to have a hospital admission, have a GP visit, and an ED attendance than those not covered by the GMS or those with medical insurance.²⁸

A factor that has not been fully considered in the Irish context is the role of private health insurance. Ireland's public hospital system is financed through a mix of both public and private spending. Older

adults with private health insurance are more likely to have an overnight stay in a public hospital than those without insurance²⁹, possibly because it is financially beneficial for public hospitals to keep such patients within the health system for longer. It is suggested that this may also reflect a general lower threshold for a hospital admission for those patients with private health insurance.²⁹

Given the multitude of factors identified by the literature as potentially influencing the level of emergency admissions, this paper aims to explore the population and health system factors that contribute to the county variation in potentially avoidable emergency admission within Ireland. We also investigate whether the drivers of these emergency admissions differ from those that impact total/other emergency admissions.

Methods

Study Area

Ireland is a country of 70.2 thousand km² on the west of Europe with a population of 4.8 million as of 2016.²⁶ The smallest geographical area level at which emergency admissions, population drivers of admission, and health system factors can be studied is county. There are 26 counties, the populations of which range from 1.3 million in Dublin to 32,000 in Leitrim.²⁶

Admissions data sources

Fourteen conditions derived from consensus work carried out in the UK³⁰ were included in the definition of potentially avoidable emergency admissions. These conditions include non-specific chest pain, Chronic Obstructive Pulmonary Disease (COPD), urinary tract infection, non-specific abdominal pain and falls for those over 74 years of age (see appendix table 1 for full list of conditions). A group of 48 clinicians, researchers and healthcare commissioners identified these conditions as being rich in potentially avoidable emergency admissions, and that such admissions could be reduced by a well performing health system.^{30, 31} Similar consultation work was undertaken by a study in Ireland³² to ensure that these conditions were applicable to the Irish context. Many of these conditions have also

been assessed across a number of international studies of ED attendance and hospital admissions.^{33, 34,}

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The incidence of emergency admissions for the selected conditions is available from the Irish Hospital In-Patient Enquiry (HIPE) admissions system.³ The county population required to determine admission rates was made available from the Central Statistics Office (CSO) 2016 Census.²⁶

A priori factors and data sources

Two principle studies were identified as the most appropriate for considering drivers of potentially avoidable emergency admissions in Ireland, one based in Ireland⁴ and one in the UK.⁵ *A priori* factors were chosen from these studies and other literature, and adapted for the Irish context (see table 1 and appendix 2 for factor construction).

Population factors relating to age, deprivation and rurality were included. Deprivation at a geographical level may be defined as “*an area's potential for health risk from ecological concentration of poverty, unemployment, economic disinvestment, and social disorganisation*”.³⁶ For this study, four measures of deprivation were considered, a measure of unemployment³⁷, the Survey of Income and Living Conditions (SILC) measure of deprivation³⁸, the Pobal HP (HP) deprivation index³⁹ and the Small Areas Health Research Unit (SAHRU) deprivation index⁴⁰ (see appendix 2 for further details).

Also considered were health system factors that related to hospital activity/turnover (the rate of short term lengths of stay for emergency admissions, and conversion rates of emergency presentations to emergency admissions) and a proxy measure for the availability of primary care (the number of GPs per 100,000). The proportion of admissions with a length of stay (LOS) of 1 day and conversion rates were not included in the same model given the possible tautological association between the two factors.

Two factors related to health care funding were considered, eligibility for the GMS scheme and the percentage of the population with private health insurance in each county, by age group. Both of these factors have been shown to be important drivers of service use in Ireland.²⁹

Table 1. A priori factors considered for inclusion in analysis

Population factors:	
<i>Age</i>	
Age stratification	Six age groups (0-19, 20-44, 45-54, 55-64, 65-74 and 75+). Age stratification was constrained by the age specific level of the other independent factors included.
<i>Deprivation</i>	
Unemployment ³⁷	2016: Percentage of population unemployed
SILC Deprivation ³⁸	2014, 2015, 2016: Percentage of population deprived. Based on the Survey of Income and Living Conditions (SILC) deprivation scale regarding ability to buy certain goods and services.
HP Deprivation ³⁹	2016: Percentage of population with greater than average levels of deprivation. Based on the Pobal HP (HP) deprivation index.
SAHRU Deprivation ⁴⁰	2011: Percentage of population living in electoral districts in the lowest quintile of deprivation. Based on the Small Area Research Health Unit (SAHRU) deprivation index.
<i>Geography</i>	
Rurality ⁴¹	2016: Percentage of the population living in rural areas. Areas with a population below 1,500 inhabitants are classified as belonging to the Aggregate Rural Area. ⁴²
Health system factors:	
<i>Hospital</i>	
Conversion rate ^{3, 43}	2014, 2015, 2016: Conversion rate of all emergency presentations to emergency admissions by hospital, weighted by the probability of a person from each county being admitted to that hospital.
LOS of 1 day ³	2014, 2015, 2016: Percentage of all emergency admissions with a length of stay (LOS) of one day, by county of residence.
<i>Primary Care</i>	
GPs ⁴⁴	2011: Number of general practitioners (GPs) per 100,000 population.
<i>Financial factors/ Funding of health care</i>	
GMS ²⁵	2014, 2015, 2016: Percentage of the population eligible for the General Medical Services (GMS) card.
Private health insurance ^{45, 46}	2015: Percentage of the population with private health insurance.

Level of data availability

The explanatory factors used in this analysis were available from administrative sources and the majority of the data was available at a county level.

SILC deprivation³⁸ was only available at a larger geographical regional level. The larger regional rates were attributed to each of the counties nested within the areas.

HP deprivation³⁹, SAHRU deprivation⁴⁰, and GMS²⁵ were available at a sub-county level. These factors were weighted by their respective smaller area population and summed to construct the factor at a county level.

Each of the following factors; unemployment³⁷, LOS of one day³, GMS²⁵, and private health insurance^{45, 46} were available at an age specific county level.

All hospital admissions and hospital based factors were reported by the county of residence of the patient. The details of patient's length of stay following admission were available by county of residence from HIPE.³ However, the conversion rate of all emergency presentations to emergency admissions at a county level was constructed by weighting the ratio of emergency admissions to emergency presentations for each hospital by the probability of a patient from each county being admitted to that hospital.

Statistical Analysis

Avoidable admission rates

The age-specific admissions for a three-year period 2014-2016 were calculated for the 26 counties, using six age groups (0-19, 20-44, 45-54, 55-64, 65-74, 75+). Age stratification was constrained by the age specific level of the other independent factors included. The rates were standardised to the national population's age distribution in 2016.

Model selection – negative binomial regression

Initial goodness-of-fit tests indicated significant extra-Poisson variation or over dispersion. Therefore, mean adjusted negative binomial regression models, in which over dispersion is modelled as the impact of unmeasured confounders, were fitted. The yearly, age specific admissions by county for the 14 selected conditions was set as the dependent variable. Analysis was clustered by county to allow for intragroup correlation.

Three multivariable models were run: an age adjusted model (M1), a model with all population level factors (M2) and finally a full model that included age, population level and health system factors (M3). The Pearson chi-square (χ^2) measure of model fit was assessed, with χ^2 values close to 1 deemed to be the better fit. The results from each negative binomial model, M1, M2 and M3 were used to predict the number of potentially avoidable emergency admissions in each county. The observed number of admissions was compared to that expected based on each model. The degree of over-dispersion remaining after each model was also measured by calculating the absolute difference between observed and expected admissions for each model and graphed using lowess smoothing

Additional analysis considered other emergency admissions, defined as total emergency admissions minus the selected 14 conditions, and total emergency admissions. To assess the sensitivity of the results, the analysis was repeated with each of the top five potentially avoidable emergency admission conditions alternatively excluded. Finally, to identify factors associated with the ratio of potentially avoidable to total emergency admissions, a negative binomial model with potentially avoidable

emergency admissions as the outcome and total emergency admissions equal to the population was fitted.

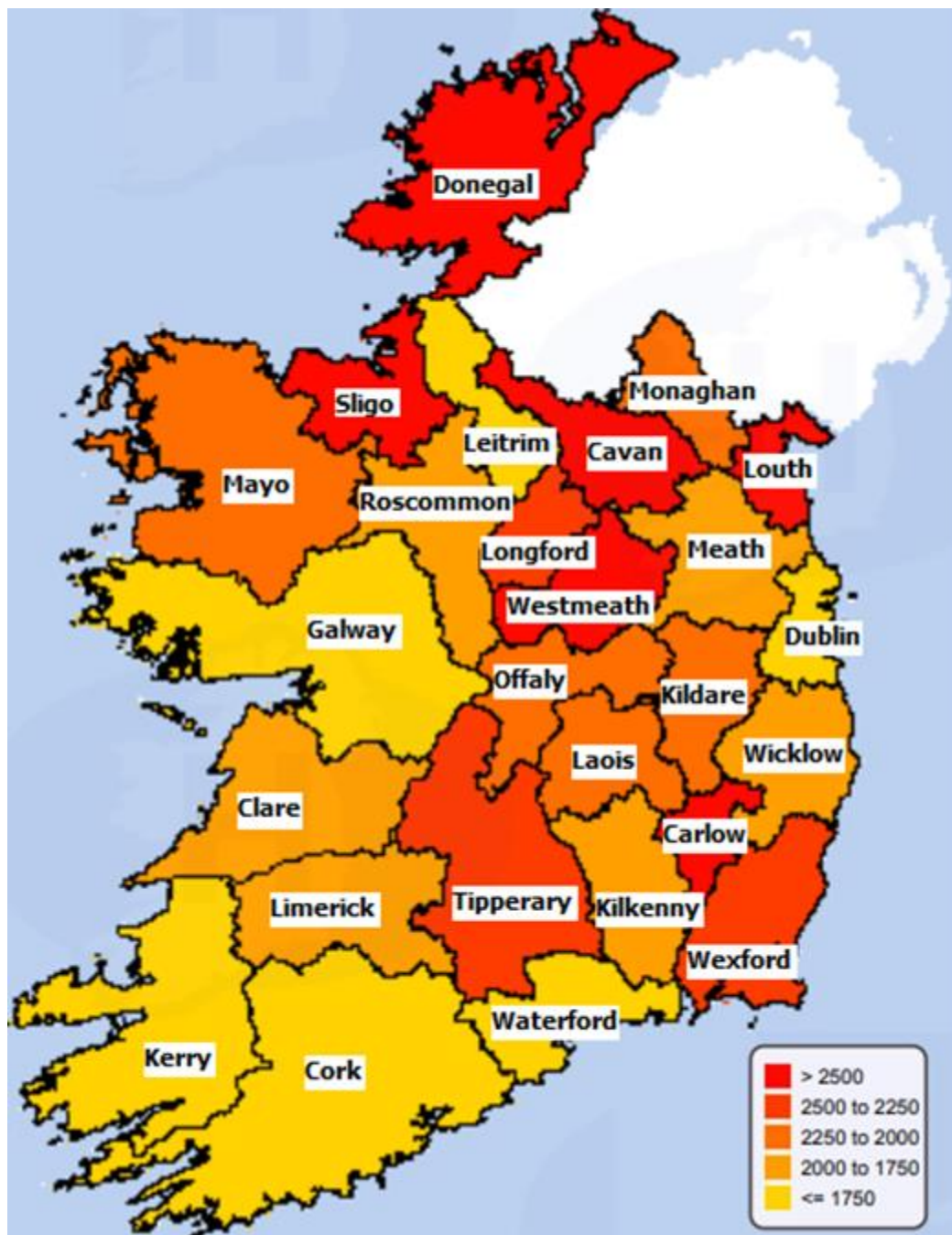
Results were presented as incidence rate ratios (IRR) and 95% confidence intervals. The quoted IRR represents the incident rate ratio associated with a 01 SD change in the risk factor. This allows for different units across the independent factors, making the IRRs comparable. Statistical significance was defined as $p < 0.05$. All analysis was carried out using Stata V.13.

Results

Avoidable admission rates

There were 266,395 emergency admissions for the selected 14 conditions in 2014-2016.³ They accounted for 22% of total emergency admissions over the 3 year period.³ The age-adjusted admission rates for the combined 14 conditions were found to vary across counties over the period of 2014-2016. Six of the 26 counties had age-adjusted rates greater than 2,500 per 100,000 population. Six had age adjusted rates below 1,750 per 100,000 population, including counties with the largest urban centres, Dublin, Cork and Galway, (see figure 1).

Figure 1. Age-adjusted admission rates per 100,000 for potentially avoidable emergency admissions, 2014-2016



Analysis and selection of factors for inclusion in the model

The age-adjusted analyses of individual factors revealed each of the following to be significant: each measure of deprivation, LOS of 1 day, GMS and private health insurance coverage (see table 2 and appendix 3 for results).

Due to the previously outlined concerns regarding the conversion rate and LOS of 1 day, and based on the univariate analysis, conversion rate was not included in the full model.

Of the four measures of deprivation, unemployment and HP Deprivation Index were found to have the lowest, and very similar, akaike information criterion (AIC) values (11.29 and 11.27). Unemployment was included as it most closely matched that of the UK study.⁵

Tests for multicollinearity indicated low levels of multicollinearity (variance inflation factor (VIF)= 3.71 for GMS, VIF = 3.09 for LOS and VIF=1.66 for unemployment).

Potentially Avoidable Emergency Admissions

The results for each of the three models (M1, M2, M3) are given in table 2. The full model (M3) found unemployment, LOS of 1 day and private health insurance were significant.

Higher levels of unemployment were associated with a greater level of potentially avoidable emergency admissions (IRR: 1.24; 95% CI 1.04 to 1.41). Those counties whose patients had a high percentage of short stays following an emergency admission were also more likely to see higher potentially avoidable emergency admissions (IRR: 1.20; 95% CI 1.11 to 1.30). Higher levels of private insurance, were associated with lower rates of potentially avoidable emergency admissions (IRR: 0.92; 95% CI 0.89 to 0.96).

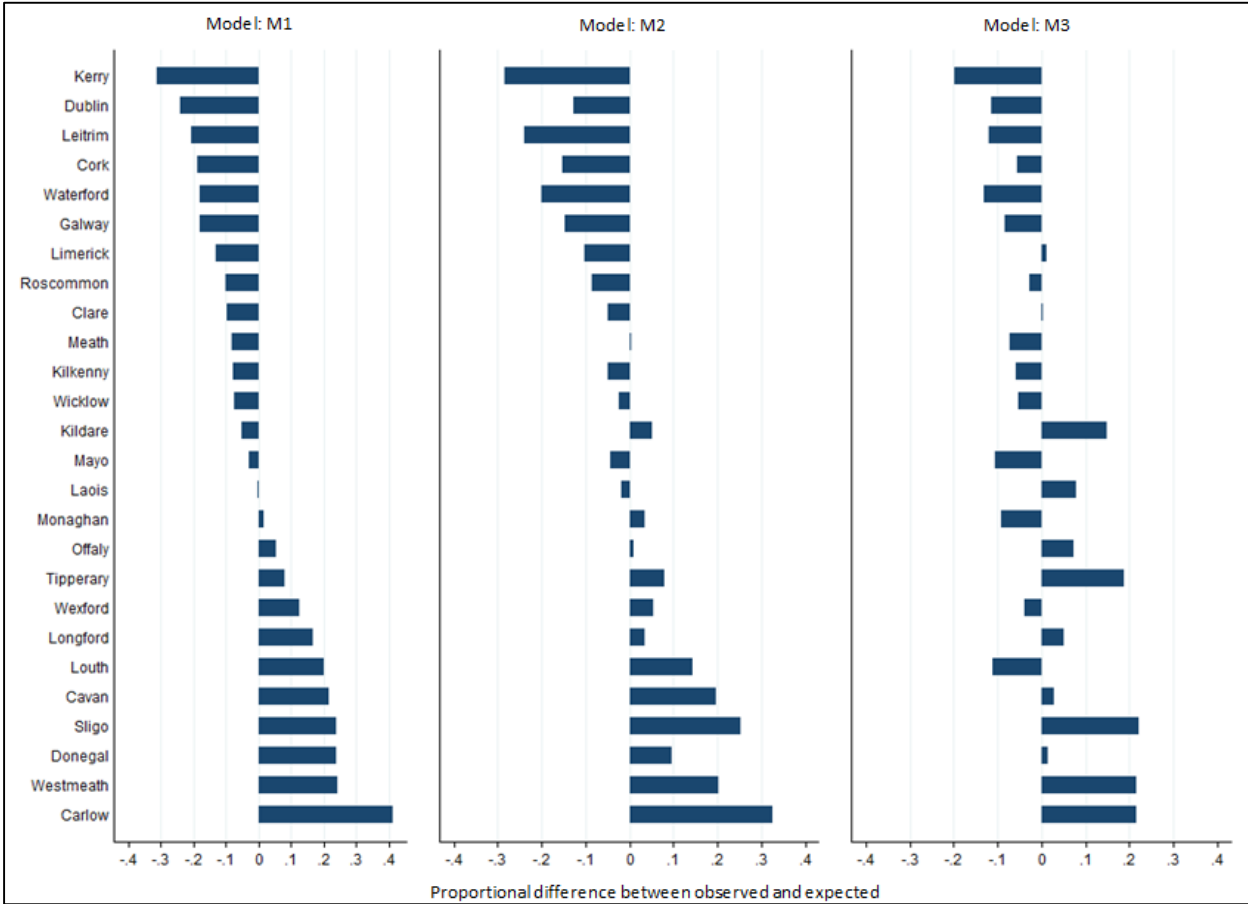
Table 2. Negative binomial regression results for models 1-3, (n=468, 26 counties, 6 age-groups, 3 years)

Factor (standardised)	Model 1 (M1)/univariate ¹		Model 2 (M2):		Model 3 (M3)	
	Pearson $\chi^2 = 1.039$ $\alpha = 0.05$		Pearson $\chi^2 = 1.005$ $\alpha = 0.04$		Pearson $\chi^2 = 1.029$ $\alpha = 0.027$	
	IRR [95% CI]	P	IRR [95% CI]	P	IRR [95% CI]	P
Age 1 (0-19)	1.00	<0.001	<0.001	<0.001	<0.001	<0.001
Age 2 (20-44)	1.35 [1.23 to 1.48]		0.52 [0.31 to 0.89]		0.86 [0.54 to 1.37]	
Age 3 (45-54)	2.10 [1.89 to 2.33]		1.11 [0.77 to 1.62]		1.79 [1.31 to 2.45]	
Age 4 (55-64)	3.03 [2.78 to 3.30]		1.33 [0.83 to 2.14]		2.63 [1.78 to 3.87]	
Age 5 (65-74)	5.22 [4.79 to 5.69]		3.98 [3.27 to 4.84]		5.26 [4.07 to 6.79]	
Age 6 (75+)	15.21 [13.94 to 16.59]		15.22 [13.95 to 16.59]		14.79 [7.94 to 27.54]	
Percentage of population unemployed	1.50 [1.26 to 1.78]	<0.001	1.47 [1.20 to 1.81]	0.003	1.24 [1.04 to 1.41]	0.018
Percentage of the population living in rural areas	1.04 [0.96 to 1.12]	0.348	1.02 [0.95 to 1.09]	0.597	0.97 [0.91 to 1.03]	0.295
Conversion rate of emergency department presentations to admissions	0.98 [0.93 to 1.04]	0.471				
Percentage of emergency admissions with length of stay equal to 1	1.19 [1.08 to 1.30]	<0.001			1.20 [1.11 to 1.30]	<0.001
Number of GPs per 100,000	0.97 [0.91 to 1.04]	0.430			1.01 [0.96 to 1.05]	0.801
Percentage of the population eligible for the GMS card	1.40 [1.13 to 1.74]	0.002			1.24 [0.98 to 1.57]	0.07
Percentage of population with private health insurance	0.902 [0.87 to 0.93]	<0.001			0.92 [0.89 to 0.96]	<0.001

1. All models are age-adjusted. Results for age, model χ^2 and α based on age only model (M1)
2. The quoted IRR represents the incident rate ratio associated with a one standard deviation change in the risk factor

The degree of over-dispersion fell from $\alpha = 0.05$ following age-adjustment, to $\alpha = 0.04$ after adjusting for the population level factors of unemployment and rurality. This represents a decrease of 20%. This fell by a further 30%, to $\alpha = 0.027$, having allowed for health system factors (see table 2). The inclusion of all factors, population level and health system level reduced the absolute difference between the observed and expected admissions by approximately 50% (see appendix 4).

Figure 2: Proportional differences between observed and expected potentially avoidable emergency admissions



The proportional differences between the observed and expected admissions are given in figure 2. For model M1, the values range from 40% above for Carlow and 30% below for Kerry, with 10 of the 26 counties within 10% of a difference.

The number of counties within 10% increases to 62% (16 of the 26 counties) based on model M3. The range also decreases to 20% below for Kerry and 20% above for Sligo (see figure 2).

An analysis of total emergency admissions and other emergency admissions, defined as total emergency admissions minus the selected 14 conditions, revealed that for most factors the effect size was similar whether looking at potentially avoidable, total, or other emergency admissions (see table 3). The results for the selected 14 conditions combined were not sensitive to the exclusion of individual conditions (see appendix 5).

Table 3. Negative binomial regression results for Other Emergency admissions and Total Emergency Admissions, (n=468, 26 counties, 6 age-groups, 3 years)

Factor (standardised)	Other Emergency Admissions: Univariate results Pearson $\chi^2 = 1.04$ $\alpha=0.04$		Other Emergency Admissions: Model 3 (M3) Pearson $\chi^2 = 1.05$ $\alpha = 0.02$		Total Emergency Admissions: Univariate results Pearson $\chi^2 = 1.04$ $\alpha=0.04$		Total Emergency Admissions: Model 3 (M3) Pearson $\chi^2 = 1.04$ $\alpha = 0.02$	
	IRR [95% CI]	P	IRR [95% CI]	P	IRR [95% CI]	P	IRR [95% CI]	P
Age 1 (0-19)	1.00	<0.001	1.00	<0.001	1.00	<0.001	1.00	<0.001
Age 2 (20-44)	0.78 [0.72 to 0.85]		0.66 [0.49 to 0.90]		0.86 [0.79 to 0.93]		0.68 [0.50 to 0.93]	
Age 3 (45-54)	1.01 [0.93 to 1.10]		1.05 [0.84 to 1.31]		1.15 [1.05 to 1.26]		1.15 [0.92 to 1.44]	
Age 4 (55-64)	1.52 [1.39 to 1.65]		1.71 [1.27 to 2.28]		1.71 [1.57 to 1.86]		1.83 [1.37 to 2.46]	
Age 5 (65-74)	2.67 [2.45 to 2.90]		3.13 [2.61 to 3.76]		2.99 [2.76 to 3.25]		3.42 [2.81 to 4.16]	
Age 6 (75+)	5.46 [5.00 to 5.95]		6.19 [4.36 to 8.80]		6.70 [6.16 to 7.30]		7.37 [4.92 to 11.09]	
Percentage of population unemployed	1.33 [1.16 to 1.53]	<0.001	1.12 [0.98 to 1.27]	0.093	1.37 [1.19 to 1.57]	<0.001	1.14 [0.99 to 1.31]	0.052
Percentage of the population living in rural areas	1.06 [0.99 to 1.13]	0.088	1.00 [0.96 to 1.04]	0.856	1.05 [0.98 to 1.13]	0.139	1.00 [0.95 to 1.04]	0.824
Percentage of emergency admissions with length of stay equal to one	1.19 [1.10 to 1.28]	<0.001	1.19 [1.14 to 1.26]	<0.001	1.19 [1.10 to 1.28]	<0.001	1.20 [1.13 to 1.26]	<0.001
Number of GPs per 100,000	0.98 [0.93 to 1.04]	0.578	1.02 [0.98 to 1.06]	0.358	0.98 [0.93 to 1.04]	0.534	1.02 [0.98 to 1.06]	0.435
Percentage of the population eligible for the GMS card	1.33 [1.09 to 1.61]	0.004	1.17 [1.01 to 1.34]	0.035	1.34 [1.10 to 1.63]	0.003	1.18 [1.00 to 1.38]	0.042

Percentage of population with private health insurance	0.912 [0.88 to 0.94]	<0.001	0.93 [0.89 to 0.97]	<0.001	0.91 [0.88 to 0.94]	<0.001	0.93 [0.89 to 0.96]	<0.001
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1. All models are age-adjusted. Results for age, model χ^2 and α based on age only model (M1)
2. The quoted IRR represents the incident rate ratio associated with a 1 SD change in the risk factor

For both total and other emergency admissions, 25% of the over-dispersion was explained by population factors. An $\alpha = 0.04$ following age-adjustment fell to $\alpha = 0.03$ after adjusting for the population level factors of unemployment and rurality. The inclusion of both population and health system factors reduced the unexplained variation by a total of 50%, $\alpha = 0.02$, (see table 3) . This reduction was similar to that found by the models run for potentially avoidable emergency admissions (see table 2).

Analysis of the ratio of potentially avoidable emergency admissions to total emergency admissions identified age, unemployment and rurality as significant factors (see appendix 6). As expected the ratio of potentially avoidable emergency admissions to total emergency admissions increased with age. Although rurality was not associated with either potentially avoidable or other emergency admissions, it was associated with the proportion of potentially avoidable emergency admissions among all emergency admissions (see appendix 6).

Discussion

Summary of findings

This study found that variation exists in potentially avoidable emergency admission rates between counties in the Ireland.

The model which included both population and health system factors identified unemployment, a hospital LOS of 1 day and the rate of private health insurance as being significantly associated with potentially avoidable emergency admissions. The full model accounted for almost 50% of the degree of unexplained variation in emergency admissions in each county.

The results also suggest that the identified associations apply equally to potentially avoidable and total/other emergency admissions.

Interpretation

Deprivation

Deprivation has been found to play a significant role in explaining the variation in standardised illness ratios¹³ and hospital admission rates.^{4, 5, 47} In the UK study, employment deprivation was found to account for 72% of the variation in potentially avoidable emergency admissions.⁵

Attendance at emergency departments is also higher amongst deprived populations.⁴⁸ Higher levels of unemployment can be associated with higher rates of ill health.⁴⁹ Therefore, it is more likely that those counties with high unemployment will experience high emergency admissions for the 14 selected conditions.⁵⁰ As it currently stands, those who are unemployed and with low incomes may be supported in accessing health services through the GMS card scheme, thereby reducing the negative impact of deprivation.⁴ However, other aspects of health may suffer such as quality of diet, levels of physical activity etc.⁵¹ The result of these changes may have long-term consequences on health, particularly with regard to chronic conditions,⁵² and health service use.⁵

Addressing health inequalities, and reducing the impact of the inverse care law,⁵³ i.e. the tendency for medical care to be available to those in the population that need it the least, has been a significant theme of recent government policy documents.²⁰⁻²² These policy documents acknowledge the need to tackle the broader determinants of health, including increased education, which may help to increase job opportunities in deprived areas, and promote the early identification of disease and secondary prevention of complications.

Our findings underline the importance of risk adjustment for differences in deprivation levels when comparing health system performances at a geographical level. Ireland, in common with many countries covered by the OECD, uses region-level hospitalisation rates for a select group of chronic conditions (asthma, diabetes, COPD and heart failure) to detect variation in the quality of primary

care.⁵⁴ These comparisons are age-sex standardised but do not adjust for county-level variation in deprivation. Our findings suggest that these unadjusted comparisons may reveal little about primary care performance, particularly for conditions such as COPD where most hospitalisations occur on an emergency basis.⁵⁵

Short term lengths of hospital stay

Short stay emergency admissions were associated with a higher rate of emergency admissions for both potentially avoidable and total/other emergency admissions, which may point to limited capacity to cater for longer LOS¹⁵, resulting in a revolving door readmission pattern.⁵⁶ It may also reflect the hospital policy or the availability of more senior emergency doctors or consultants.⁵⁷ For example, smaller hospitals tend to have more junior staff and a culture of admitting patients overnight for observation may exist.^{32, 58} It could also be argued that short LOS may be a consequence, rather than a cause, of a high volume of potentially avoidable emergency admissions, perhaps driven by the need to meet certain waiting time targets for emergency presentations.⁵⁹

The availability of clear frameworks and local protocols for the management of patients with the selected 14 conditions could help to reduce the impact of this factor. Ideally, each ED should have frameworks/ protocols based on national guidelines and staff should be familiar with these documents and how to implement them. Further analysis of this finding is required to understand whether a consistent inference can be applied. Therefore, this result should be interpreted with caution.

Private health insurance

This study's analysis shows private health insurance is associated with lower potentially avoidable emergency admissions and total/other emergency admissions to public hospitals. This may reflect the engagement with other services such as outpatient services, GP visits or admissions to private hospitals or better access to care. The Irish Longitudinal Study on Ageing reports there is "*suggestive evidence that insured people are likely to use slightly more outpatient services*".²⁹ In addition, the

study found that those with private health insurance are more likely to have a GP visit and to have an overnight stay in hospital. It is suggested that this may reflect lower thresholds for hospital admissions for patients using private services.²⁹ While a longer length of stay once admitted may be more likely for private patients, it has been found that there is equity of access among public and private patients with regard to emergency services.⁶⁰ A study of the characteristics of ED admissions at four Irish hospitals found that *“privately insured patients and individuals with no additional cover are significantly less likely to be admitted relative to medical card holders”*.⁶¹ This report also found that unemployed individuals and medical card holders were both more likely to be admitted and that this may be in line with assumptions of higher deprivation and poorer health among this group.⁶¹

Strengths and limitations

A strength of this study is the investigation of both population and health system factors as drivers of potentially avoidable emergency admissions, extending the traditional methods used by previous studies.^{4,5} In addition to a previous Irish study, which focused on primary care resources and deprivation⁴, this study widens the number of potential drivers to include hospital factors and the role of private health insurance.

Although potentially avoidable emergency admissions were the initial focus of this study, the associations with total emergency admissions were also examined. This allowed the identification of factors associated with total emergency admissions, while also highlighting those factors that have a differential effect on potentially avoidable and other emergency admissions. The robustness of results to the inclusion of particular conditions in the definition of potentially avoidable emergency admissions was also considered.

There are a number of limitations to this study. Firstly, this study is an ecological study and therefore may be subject to ecological fallacy i.e. the assumption that county level associations apply at an individual level.

Data was collected from administrative sources. As the majority of this data was only available at a county level, the ability to capture all existing variability within a large geographical level is limited. It is possible that small area associations between variables such as primary care resources and emergency admissions may not be detected when data is aggregated to county level. For example, the study results suggest that higher rates of unemployment at a county level are associated with higher potentially avoidable emergency admissions. Although smaller area deprivation details are available, the study was limited by the fact that there are only 26 counties and data on many of the predictor variables, such as primary care resources, is unavailable at a smaller level than county, or at an age-specific level.

A further limitation of the study is our inability to directly measure quality of care factors at primary and secondary level, factors that might be expected to drive emergency admission rates. This information is not available at present in Ireland and we have had to rely on proxy variables instead.

Emergency admissions to private hospitals were not included in this analysis as private hospitals are not required to submit data to HIPE. Therefore, results for counties with a high level of private hospital usage may be higher than reported here.

The prevalence rates of each individual of the 14 conditions are also not available at a county level. This data would further the understanding of causal mechanisms in the pattern of emergency admissions.

The ability to assess appropriateness of service use based on final diagnosis also has its limitations.

The diagnosis of patients may lead to the conclusion that the hospital was an inappropriate setting to receive care. However, that determination may only be possible in hindsight; investigations and tests may have been necessary to exclude a more serious diagnosis.⁶²

Policy Implications

Previous research in Ireland has highlighted deprivation and primary care provision (GP supply and general medical services coverage) as important factors in partially explaining the variation of

emergency admissions.^{4, 47} In Ireland,^{20, 22} and elsewhere⁶³, GPs and primary care are increasingly expected to relieve hospitals of patient care.⁶⁴ As more pressures are placed on GPs, the risk of growing inequality of access is also a concern, particularly among more vulnerable and disadvantaged patients.⁶⁴ The level of resources available to primary care has a significant role in ensuring quality where such services are most needed.^{65, 66} Therefore, as Ireland continues to move towards providing care at the safest, lowest level of complexity, a consistent and agreed upon measure of monitoring quality in primary care is necessary.²² An information system for primary care services in Ireland, similar to the hospital system of HIPE³, may help support this monitoring. Our findings suggest that unless this data is available, it will not be possible to determine how large a role primary care quality has in light of our findings regarding the impact of deprivation and hospital policy.

Continued investment in the management of chronic conditions should also be considered. There is also a good evidence base on management approaches that minimise the risk of admission for specific conditions. A recent Cochrane review found that self-management interventions for COPD that include an exacerbation plan are associated with a lower probability of a respiratory-related hospital admission.⁶⁷ Of the 'potentially avoidable' conditions included in this study, COPD had the second highest share of emergency admissions at 15%. However, if other services in the wider care system were available such as a 'hospital at home'⁶⁸ or 'care outreach' model⁶⁹ which can respond to the patients need, it may be possible to avoid such admissions.^{5, 70}

At a county level, our findings show that the emergency admissions we designated as 'potentially avoidable' seem to be driven by the same factors as total emergency admissions, and are influenced strongly by regional deprivation and hospital-level policies. This implies that the main drivers of regional variation in emergency admission rates may not be at the primary care level, although this finding is tentative as we have not directly measured primary care quality and have used resource levels as a proxy. These findings have two important policy implications. First, the 'potentially avoidable' designation may not be as useful as previously believed when attempting to identify the causes of regional variation in emergency admission rates. Secondly, potentially avoidable emergency

admission rates may not be a useful quality indicator for regional (e.g. county-level) primary care systems.⁵⁹

This study has also revealed the need to consider the role that hospital factors have to play in the patterns of total emergency admissions, specifically the role of short term lengths of stay. Continued monitoring of hospitals which experience a high number of short term lengths of stay should be studied closer to determine the causes for these patterns. As previously suggested, the availability of clear frameworks and local protocols for the management of patients with the selected 14 conditions could help to reduce the impact of this factor.

Conclusion

Potentially avoidable emergency admission rates have been proposed as a method to detect variation in the performance of regional healthcare systems, particularly the primary care services that manage conditions where the risk of exacerbation-related hospital admission is high.⁷¹

However, this study shows that at a regional level much of the variability in emergency admission rates can be explained by socioeconomic deprivation, hospital policies and private insurance coverage. Whilst deprivation may be associated with lower resources for primary care (a manifestation of the inverse care law), it is likely that much of the variation in county level potentially avoidable emergency admissions does not relate to the quality of primary care. At present, the relevant data does not exist to categorically confirm the role that the quality of primary care plays in reducing potentially avoidable emergency admissions. This study does show that reductions across all emergency admissions, including potentially avoidable emergency admissions, may be achieved by targeting deprived regional populations, the drivers of short term lengths of stay and the way in which patients with private health insurance are managed.

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