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Identifying priorities for primary care investment in Ireland through a population-based analysis of avoidable hospital admissions for ambulatory care sensitive conditions (ACSC)

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ABSTRACT

Background In 2016, the Irish acute hospital system operated well above internationally recommended occupancy targets. Investment in primary care can prevent hospital admissions of ambulatory care sensitive conditions (ACSCs).

Objective To measure the impact of ACSCs on acute hospital capacity in the Irish public system and identify specific care areas for enhanced primary care provision.

Design National Hospital In-patient Enquiry System data were used to calculate 2011–2016 standardised bed day rates for selected ACSC conditions. A prioritisation exercise was undertaken to identify the most significant contributors to bed days within our hospital system. Poisson regression was used to determine change over time using incidence rate ratios (IRR).

Results In 2016 ACSCs accounted for almost 20% of acute public hospital beds (n=871 328 bed days) with adults over 65 representing 69.1% (n=602 392) of these. Vaccine preventable conditions represented 39.1% of ACSCs. Influenza and pneumonia were responsible for 99.8% of these, increasing by 8.2% (IRR: 1.02; 95% CI 1.02 to 1.03) from 2011 to 2016. Pyelonephritis represented 47.6% of acute ACSC bed days, increasing by 46.5% (IRR: 1.07; 95% CI 1.06 to 1.08) over the 5 years examined.

Conclusions Prioritisation for targeted investment in integrated care programmes is enabled through analysis of ACSC's in terms of acute hospital bed days. This analysis demonstrates that primary care investment in integrated care programmes for respiratory ACSC's from prevention to rehabilitation at scale could assist with bed capacity in acute hospitals in Ireland. In adults 65 years and over, including chronic obstructive pulmonary disease patients, the current analysis supports targeting community based pulmonary rehabilitation including pneumococcal and influenza vaccination programmes in order to reduce the burden of infection and hospitalisations. Further exploration of pyelonephritis is necessary in order to ascertain patient profile and appropriateness of admissions.

Strengths and limitations of this study

- The study examines the impact of ambulatory care sensitive conditions (ACSCs) on the acute publicly funded hospital system using national level data extracted from the national Hospital In-patient Enquiry System in the form of bed days and bed day rates.
- National bed day rates are standardised to the European Union population with three age-specific cohorts analysed (children 0–15, adults 15–64 and persons 65 and older) as well as trend analysis over the 5-year period 2011–2016 using Poisson regression techniques.
- All 19 ACSCs identified are included in the prioritisation exercise which identifies the top five contributors to ACSC bed days for the total population as well as for each age cohort examined.
- While the current analysis of capacity and age cohorts remains robust, further in-depth analysis of patient profiles was limited by the episodic nature of Irish National Hospital In-patient Enquiry System data, where admissions are not linked to patient details.
- The generalisability of all ACSC research is limited by poorly defined categorisation of ACSCs internationally, and a refinement of coding would enhance specificity and generalisability of this area of research.

INTRODUCTION

Ambulatory care sensitive conditions (ACSCs) are acute or episodic conditions where appropriate and timely community care can prevent disease and/or hospital admissions.[1] While there is variability in relation to the conditions considered ACSCs, they can be broadly classified into vaccine preventable, acute and chronic conditions. ACSCs are commonly used as an indicator of avoidable hospital admissions as well as quality of and access to primary care.[2 3]

The current Irish acute hospital bed occupancy rate of 94.2% is significantly higher than the internationally recognised target of 85%. Occupancy rates at this level are associated with adverse patient and staff outcomes

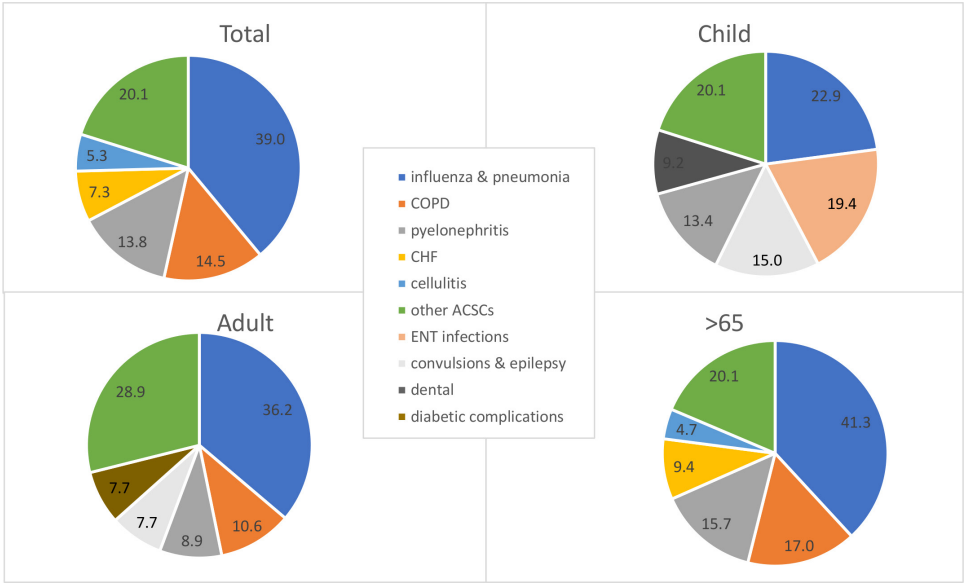

Figure 1 Impact of ACSCs on bed days in public acute hospitals in Ireland in 2016 by age cohort. ACSC, ambulatory care sensitive condition; COPD, chronic obstructive pulmonary disease.

as well as restricting efficiency in terms of patient flow.[4] To achieve international standards of bed occupancy would require the immediate introduction of 1 260 inpatient beds.[5] Ireland is experiencing an ageing demographic shift with an expected annual increase of almost 20 000 in the population 65 years and over. This population cohort currently occupy 54% of total acute bed days.[6] Moreover, the demand for acute hospital beds is projected to increase significantly unless there is a shift in the model of care from acute hospital care to primary care.[6] The hospital centric nature of the Irish system continues to fuel an ever increasing demand for acute hospitals to deliver care and services which would be better provided in the community. However, primary care services in Ireland remain under resourced.[7] As recognised within Slaintecare, the 10-year cross political vision for the future of Irish healthcare services, improvement and sustainability of the Irish Health system is dependent on a shift of care from acute hospitals to primary care.[7]

In the literature, ACSC analyses to date recognises the impact on emergency departments and admissions. Drivers of these admissions have been examined highlighting the association with levels of primary care provision, as well as higher levels of deprivation.[1 8–10] However, the use of ACSC analysis to identify and prioritise areas for improved primary care resources and programmes of care remains unexamined. The purpose of this paper is to examine ACSCs in relation to their overall impact on acute hospital capacity in Ireland in terms of bed days and bed day rates and to assist prioritisation of targeted investment in primary care supporting robust integrated care programmes. This novel approach to the evaluation of ACSCs supports the left shift to primary care called for by Slaintecare and international policy.

METHODS

The international literature in relation to 'definition and coding' of ACSCs was reviewed and a list of 19 commonly cited ACSCs was identified for inclusion (online supplementary appendix 1). Definition notes for International Classification of Disease (ICD) codes including primary and secondary diagnoses were examined and the definition notes most appropriate to the Irish setting and reflective of bed utilisation were chosen. Data for these codes was extracted from the National Hospital In-patient Enquiry System to calculate 2011–2016 age-standardised bed day rates for selected ACSC conditions. Age specific analysis was carried out using the following categories; children (0–14 years), adults (15–64 years) and persons 65 years and over. A prioritisation exercise in which all 19 conditions were ranked in terms of their contribution to total and age specific bed days and bed day rates in 2017 was undertaken to identify the most significant contributors within our hospital system (figure 1). Poisson regression analysis was used to distinguish a genuine change over time. Standardised incidence rate ratios (IRR) with 95% CIs and corresponding p values were reported.[10] Population rates are directly standardised to the European standard population.

Patient and public involvement

Patients were not involved in the concept or design of this study.

RESULTS

ACSCs represented 18.5% (n=871 328) of publicly funded bed days in Ireland in 2016 with an 18.2% (IRR 1.03; p<0.01) increase over the 5-year time period examined. The most significant contributors to ACSC bed days included influenza and pneumonia, chronic obstructive

Table 1 ACSC contribution to national bed days by age cohort in 2016

	Total			0–14				15–64			65+		
ACSCs	Bed days	% ACSC bed days	% total bed days	Standardised bed day rate*	Bed days	% ACSC bed days	Age-specific bed day rate	Bed days	% ACSC bed days	Age-specific bed day rate	Bed days	% ACSC bed days	Age-specific bed day rate
Vaccine preventable	340461	39.1	7.2	10170	11276	24.1	11141	80775	36.4	2826	248545	41.3	41933
Influenza and pneumonia	339613	39.0	7.2	10155	10704	22.9	930	80518	36.2	2817	248524	41.3	41930
Other vaccine preventable	848	0.1	0.0	14	572	1.2	76	257	0.1	81	21	0.0	3
Acute	252698	29.0	5.4	7002	29822	63.7	2809	73371	32.8	2471	150172	24.9	25431
Pyelonephritis	120285	13.8	2.6	3681	6282	13.4	547	19762	8.9	680	94338	15.7	16145
Cellulitis	46088	5.3	1.0	1307	2512	5.4	182	15403	6.9	5334	28141	4.7	4734
Convulsions and epilepsy	36161	4.2	0.8	857	7026	15.0	707	17426	7.7	5725	11993	2.0	1967
Dehydration and Gastro Intestinal Infection	7594	0.9	0.2	216	149	0.3	27	2713	1.2	911	4740	0.8	794
Dental	8422	1.0	0.2	162	4308	9.2	466	3374	1.5	110	809	0.1	126
Ear Nose & Throat infections	15443	1.8	0.3	282	9090	19.4	881	5401	2.3	1675	1171	0.2	193
Gangrene	11372	1.3	0.2	308	417	0.9	80	5128	2.3	1780	5827	1.0	956
Perforated ulcer	5575	0.6	0.1	153	10	0.0	29	2597	1.2	896	2969	0.5	487
Pelvic Inflammatory Disease	1758	0.2	0.0	37	28	0.1	1	1567	0.7	485	184	0.0	29
Chronic	278169	31.9	5.9	8227	5704	12.2	562	68790	30.9	2448	203675	**33.8**	33631
COPD	126336	14.5	2.7	3831	140	0.3	23	23500	10.6	5928	102659	17.0	16749
Congestive Heart Failure	68469	7.3	1.5	2059	141	0.3	22	6425	3.0	2478	61904	9.4	9735
Diabetic complications	40241	4.6	0.9	1081	1656	3.5	142	17259	7.7	5928	21479	3.6	3457
Angina	15179	1.7	0.3	430	13	0.0	1	5780	2.6	2125	9386	1.6	1499
Asthma	14519	1.7	0.3	318	3703	7.9	327	7889	3.5	2639	3015	0.5	471
Hypertension	5586	0.6	0.1	144	177	0.4	10	3158	1.4	1076	2268	0.4	371
Iron deficiency anaemia	12523	1.4	0.3	357	180	0.4	21	4449	2.0	1514	7915	1.3	1318
Nutritional deficiencies	225	0	0.0	7	5	0.0	0	42	0.0	13	178	0.0	31
ACSC contribution to total bed days in each cohort	**871328**	**100**	**18.5**	**18297**	**46802**		**4650**	**222936**		**7113**	**602392**		**94483**

*Rates are standardised to the European standard population
ACSC, ambulatory care sensitive condition; COPD, chronic obstructive pulmonary disease.

Table 2 Trend analysis of ACSC bed days in Irish acute public hospitals 2011–2016

ACSC	Absolute change in bed days	% change in standardised bed day rate	Incidence rate ratio for trend	95% CI
Vaccine preventable				
Total	**62395**	**8.2**	**1.02*** **	**1.017 to 1.027**
Influenza and pneumonia	62700	8.2	1.02***	1.018 to 1.027
Other vaccine preventable	−305	−25.4	0.90*	0.791 to 1.014
Acute				
Total	**56773**	**19.7**	**1.03*** **	**1.028 to 1.040**
Pyelonephritis	46554	46.5	1.07***	1.064 to 1.083
Cellulitis	13284	21.5	1.05***	1.035 to 1.063
Convulsions and epilepsy	3829	5.1	1.01	0.9905 to 1.023
Dehydration and Gastro Intestinal Infection	−4,405	−44.9	0.94***	0.913 to 0.967
Dental	393	3.7	1.00	0.963 to 1.036
Ear Nose & Throat infections	250	5.5	1.00	0.973 to 1.029
Gangrene	−538	−22.1	0.98	0.955 to 1.010
Perforated ulcer	−2,280	−38.2	0.93***	0.898 to 0.967
Pelvic Inflammatory Disease	−314	−22.5	0.96	0.893 to 1.038
Chronic				
Total	**−7,442**	**−10.7**	**0.97*** **	**0.969 to 0.979**
COPD	18107	1.1	1.16***	1.157 to 1.171
Congestive Heart Failure	−1,201	−11.4	0.97***	0.961 to 0.980
Diabetic complications	−11,444	−34.1	0.91***	0.902 to 0.924
Angina	−8,163	−43.8	0.90***	0.885 to 0.9195
Asthma	2877	17.6	1.03**	1.007 to 1.063
Hypertension	774	3.0	1.01	0.967 to 1.047
Iron deficiency anaemia	3916	40.5	1.05***	1.026 to 1.083
Nutritional deficiencies	174	633.7	1.08	0.838 to 1.380
ACSC contribution to public bed days	**111726**	**18.2**	**1.03*** **	**1.033 to 1.034**

* p<0.1; **P<0.05; ***p<0.01
ACSC, ambulatory care sensitive condition; COPD, chronic obstructive pulmonary disease.

pulmonary disease (COPD) and pyelonephritis. Influenza and pneumonia accounted for 39.0% of total ACSC bed days (n=339613), with the proportion of ACSC bed days increasing with increasing age across the three age cohorts examined (table 1; figure 1). The bed day rate increased by 8.2% (IRR 1.02; p<0.01) from 2011 to 2016 (table 2). COPD accounted for almost half of chronic ACSC bed days in 2016 and 14.5% of total ACSC bed days (n=126336 bed days; 3831/100 000). The COPD bed day rate increased (2011–2016) by 1.1% (IRR:1.16; p<0.01) on a background of a 10.7% reduction in the chronic ACSC bed day rate over the 5-year period examined.

Pyelonephritis represented almost half (51.2%; n=120285 bed days; 3681/100 000) of acute ACSC bed days in 2016 and 13.8% of total ACSC bed days. The bed day rate for pyelonephritis increased by 46.5% over the 5 years examined.

Examination by age cohort

When age-specific bed day rates were examined significant variation becomes apparent (figure 2). ACSC conditions were concentrated in the older population, with adults 65 and older representing 69.1% of ACSC bed days (n=602392 bed days; 94 483/100 000) in 2016. The impact of ACSCs on total bed days also increased with age, with ACSC bed days representing a quarter of total bed days in this age cohort. Vaccine preventable conditions represented 41.3% of ACSC bed days among this cohort of which 99% (n=248524 bed days; 41 933/100 000) were due to influenza and pneumonia. COPD was the most significant chronic ACSC among this age

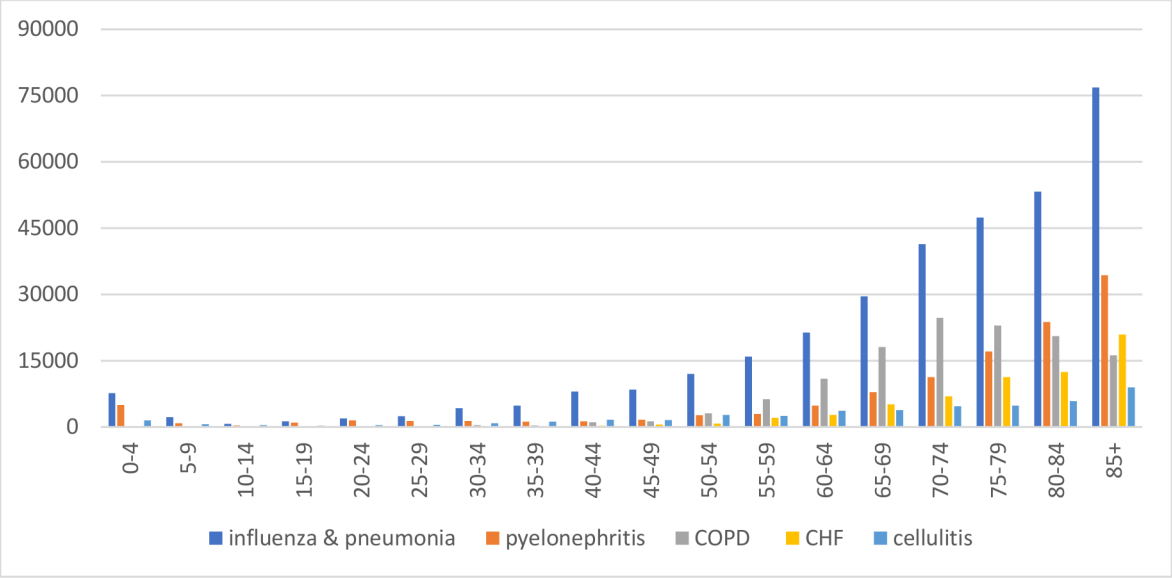

Figure 2 Bed day rate by 5-year age bands for top three ACSCs among total population. ACSC, ambulatory care sensitive condition; COPD, chronic obstructive pulmonary disease.

cohort accounting for more than 100 000 bed days (16 749/100 000). In 2016, pyelonephritis was the most significant acute ACSC in this cohort with 94 338 bed days (16 145/100 000). The bed day rate due to pyelonephritis increased by 46.5% over the 5 years examined (IRR 1.07; p<0.01) (table 2).

In the child cohort (0–14 years), 13.8% of total acute hospital bed days were attributable to ACSCs, representing 46 802 bed days in 2016 (table 2). Acute ACSCs represented 63.4% (n=29 822 bed days; 2089/100 000), with ENT infections the leading acute condition, representing 19.4% (n=9090 bed days; 881/100 000) of ACSC bed days in 2016. Vaccine preventable ACSCs represented almost a quarter (24.1%) of ACSC bed days, with influenza and pneumonia being responsible for the majority of these.

Within the adult cohort (15–64 years), 11.0% (n=222 936 bed days; 7113/100 000) of total bed days were attributable to ACSCs (table 1). The most significant ACSC condition among this age cohort was the vaccine preventable category influenza and pneumonia. Acute and chronic ACSCs contributed similar proportions to bed days at approximately one-third each.

DISCUSSION

The 19 ACSCs identified for inclusion in this analysis accounted for almost 20% of the total publicly funded acute hospital bed days in 2016 or 871 328 bed days. When examined in relation to age specific cohorts, adults 65 years and over represented 69.1% of all ACSC bed days. Just over half of ACSC bed days in 2016 were among respiratory conditions; influenza and pneumonia and COPD. Influenza and pneumonia was the single most important contributor to ACSC bed days across all age cohorts, increasing by 8.2% over the 5 years examined. The majority of these bed days (73.2%; n=248 524 bed days) were among adults 65 years and over. COPD represented 14.5% (n=126 336) of ACSC bed days in 2016, with 81.3% of these in adults 65 years and over. Pyelonephritis was the next biggest contributor to bed days, representing 13.8% of ACSC bed days. Again, the relative contribution to bed days increased with age, with adults 65 years and over representing 78.4%. Over the 5-year period examined bed days due to pyelonephritis increased significantly (46.5%).

Evidence-based models of care for influenza and pneumonia include integrated care programmes which include prevention. Seasonal influenza and pneumococcal vaccination remain the mainstay of preventing mortality and morbidity associated with influenza and pneumonia in Ireland and internationally. Seasonal influenza vaccination is recommended for disease specific risk groups including those with COPD, adults 65 years and over and healthcare workers (HCWs). Pneumococcal vaccination is recommended for those 65 and over and those with COPD. While the absolute impact of seasonal influenza and pneumococcal vaccination remains difficult to quantify, recent studies confirm their effectiveness at reducing the risk of pneumococcal pneumonia as well as hospitalisation from respiratory illness among adults 65 and over.[11 12] Despite this, uptake of seasonal influenza vaccine in Ireland consistently lags behind our closest neighbour the UK, while rates of uptake of pneumococcal vaccination are not routinely collected. In Ireland, uptake of seasonal influenza vaccine among adults 65 and over was 56.9% for the 2012/2013 season, with uptake among HCWs at just 17.6%. Pneumococcal vaccine uptake was estimated at 36%.[13–15] Comparatively, in the UK, seasonal influenza vaccination rates consistently approach or exceed 70% among adults over 65, with HCW vaccination

Table 3 Comparative vaccination uptake figures 2012/2013 and 2017/2018

	2012/2013				2017/2018		
	Seasonal Influenza vaccine uptake 65	Seasonal influenza vaccine uptake HCW	Invasive Pneumococcal Vaccine uptake 65	Pneumonia (% ACSC admissions)	Seasonal influenza vaccine uptake 65	Seasonal influenza vaccine uptake HCW	IPV uptake 65
Ireland	56.9%	17.6%	38.0%	29.0%–35.0%	68.0%	44.8%	38.0%
UK	74.0%	45.6%	69.1%	15.0%	70.5%	68.7%	69.5%

ACSC, ambulatory care sensitive condition; HCW, healthcare worker.

rates consistently above Irish estimates (table 3).[16 17] For the 2012/2013 season, for which comparative data is available, pneumonia represented approximately 10% of ACSC admissions in the UK compared with approximately 30% in the Irish setting.[1] These estimates support the continued emphasis on seasonal influenza and pneumococcal vaccination for HCWs and adults 65 and over, as well as the regular monitoring of pneumococcal vaccination uptake rates in Ireland.

Ireland consistently has one of the highest admission and re-admission rates for COPD in the Organization for Economic Co-operation and Development (OECD).[18 19] COPD is also one of the most resource intensive Dagnosis Related Groups in acute hospitals in Ireland.[6] Mortality rates in Ireland due to chronic lower respiratory diseases are 42% higher than the EU average.[6] Pulmonary rehabilitation is one of the most cost-effective treatments available.[20] At a cost of 2,000–8,000 per Quality Adjusted Life Year, it is known to be effective at improving quality of life and reducing hospital admissions. Despite being recognised as the standard of care, this programme is not routinely available in Ireland.[21] While COPD patients are identified as a risk group for both influenza and pneumococcal vaccination in Ireland, vaccination uptake among this group is not routinely measured or reported.[18] This paper provides evidence to support implementation of an integrated care programme for COPD focusing on primary care investment to reduce pressure on acute hospitals and improve the quality of care for patients delivered closer to home.

The impact and increase observed for pyelonephritis is surprising, though a similar trend has been observed in the UK.[10] Further exploration of this phenomenon is necessary in order to ascertain patient profile and appropriateness of admissions. Available evidence demonstrates that with appropriate primary care support in the form of diagnostics, treatment guidelines and preventive approaches, admissions can be reduced and care provided closer to home.[22]

CONCLUSION

ACSCs are a high-level indicator of potentially avoidable hospitalisation with admissions known to be correlated with primary care provision as well as with deprivation.[1 8 10] The impact of ACSCs on acute hospital capacity is best measured using bed day rates. This analysis can be used to identify conditions that would benefit from investment in primary and community care. Identifying specific conditions by their impact on acute hospital capacity supports closer examination of integrated models of care for these conditions.[7 20] This analysis not only supports the left shift to provision of care within the community called for in Slaintecare, but enables prioritisation of resources to primary care.[6]

ACSCs were responsible for almost one-fifth of all acute hospital bed day usage in 2016 in Ireland. While the proportion of these admissions that represent truly avoidable admissions will require further exploration, an examination of the impact of these conditions in terms of bed days make a compelling argument for prioritising the development of integrated models of care with primary and community services, enabling the 'left shift' of care closer to home envisioned within government policy.[6 23]

Collaborators Planning for Health Group, Department of Public Health, HSE West.

Contributors BS: consultant in Public Health Medicine developed the study protocol and provided ongoing support to data analysis and interpreted. GM: specialist registrar in Public Health Medicine, performed data extraction and analysis. Both authors have given final approval for publication and are accountable for all aspects of the work. This work was conducted within the work programme of the Planning for Health Group.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval As the analysis represents a secondary analysis of an anonymised data set, ethical approval was not required.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES

1 Billings J, Zeitel L, Lukomnik J, *et al*. Impact of socioeconomic status on hospital use in New York City. *Health Aff (Millwood)* 1993;12:162–73.
2 Purdy S, Griffin T, Salisbury C, *et al*. Ambulatory care sensitive conditions: terminology and disease coding need to be more specific to aid policy makers and clinicians. *Public Health* 2009;123:169–73.

3 Page A, Ambrose S, Glover J, *et al*. *Atlas of avoidable hospitalisations in Australia: ambulatory care-sensitive conditiobns*. Australian Institute of Health and Welfare and the University of Adelaide, 2007.
4 Department of Health. *Health service capacity review 2018: review of health demand and capacity requirements in Ireland to 2031-findings and recommendations*. Dublin, Ireland: Department of Health, 2018.
5 Smyth BM, Donohue P, Kavanagh F, *et al*. *Planning for health: trends and priorities to inform health service planning 2017*. Dublin, Ireland: Health Service Executive, 2016.
6 The Houses of the Oireachtas DoH. *Oireachtas Committee on the future of healthcare. Slaintecare report*. Dublin: Oireachtas, DOH, 2017.
7 Tian Y, Dixon A, Gao H. *Emergency hospital admissions for ambulatory care-sensitive conditions: identifying the potential for reductions*. The King's Fund, 2012.
8 Sheridan A, Howell F, Bedford D. Hospitalisations and costs relating to ambulatory care sensitive conditions in Ireland. *Ir J Med Sci* 2012;181:527–33.
9 Lynch B, Fitzgerald AP, Corcoran P, *et al*. Drivers of potentially avoidable emergency admissions in Ireland: an ecological analysis. *BMJ Qual Saf* 2019;28.
10 Blunt I. *Focus on preventable admissions. trends in emergency admissions for ambulatory care sensitive conditions 2001 to 2013*. UK: The Health Foundation & Nuffield Trust, 2013.
11 Trucchi C, Paganino C, Orsi A, *et al*. Influenza vaccination in the elderly: why are the overall benefits still hotly debated? *J Prev Med Hyg* 2015;56:E37–43.
12 Falkenhorst G, Remschmidt C, Harder T, *et al*. Effectiveness of the 23-valent pneumococcal polysaccharide vaccine (PPV23) against pneumococcal disease in the elderly: systematic review and meta-analysis. *PLoS One* 2017;12:e0169368.
13 HSE Health Protection Surveillance Centre. *Uptake of seasonal influenza vaccine in acute hospitals and long term care facilities in Ireland in 2017-2018*. Dublin: HSE HPSC, 2018.
14 Mereckiene J, Domegan L, O'Lorcain P. *Seasonal influenza vaccination trends for at risk groups, the importance of data collection and reporting. fighting the flu together*. Sligo, Ireland, 2018.
15 Giese C, Mereckiene J, Danis K, *et al*. Low vaccination coverage for seasonal influenza and pneumococcal disease among adults at-risk and health care workers in Ireland, 2013: the key role of GPs in recommending vaccination. *Vaccine* 2016;34:3657–62.
16 Public Health England. Seasonal flu vaccine uptake (GP) 2012/13-Data on GP registered patients, 2013. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/676221/SeasonalFluData_GPs_Jan13_acc.pdf
17 Public Health England. Seasonal influenza vaccine uptake amongst frontline healthcare workers (HCWs) in England. Winter season 2012/13, 2013. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/245605/Seasonal_Influenza_Vaccine_Uptake_HCWs_2012_13.pdf
18 Crinion S, Cotter O, Kennedy B, *et al*. Copd exacerbations-a comparison of Irish data with European data from the ERC COPD audit. *Ir Med J* 2013;106:268:270–2.
19 OECD. *Health at a glance 2017: OECD indicators*. Paris: OECD, 2017.
20 Vogiatzis I, Rochester CL, Spruit MA, *et al*. Increasing implementation and delivery of pulmonary rehabilitation: key messages from the new ATS/ERS policy statement. *Eur Respir J* 2016;47:1336–41.
21 Petty-Saphon N, O'Reilly O, O'Connor M. National needs assessment for pulmonary rehabilitation services-report to the integrated care programme for the prevention and management of chronic disease 2016 Clinical Strategies and Programmes; 2016.
22 Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. *Aging health* 2013;9:519–28.
23 Health Service Executive. National service plan 2018. Dublin HSE; 2017.