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Trends in Emergency Admissions

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Key Words: Rise in emergency admissions, increasing medical admissions, short stay emergency admission, mechanisms for growth, vague diagnoses, signs & symptoms, demography, same (zero) day stay admissions, new infectious immune disease

Key Points

- Seven mechanisms for growth appear to regulate the trends in emergency admissions.
- Demographic change, re-admissions and rising expectations account for less than a 2% per annum increase and fail to explain the more dynamic changes.
- A major part of the gap between the demographic and actual increase is due to short stay (mainly zero day) emergency admissions and it is perhaps better to treat these as an extension of ambulatory care (which includes A&E) rather than emergency admissions *per se*.
- Length of stay (LOS) efficiency for emergency admission should be re-calibrated by excluding zero day stay emergency admissions as should apparent rates of 'admission' for particular diagnoses.
- The seasonal variation in admission to the medical group of specialties is shown to be very high and this refutes claims that emergency admissions are 'predictable'.
- If hospitals and primary care are to allocate scarce resources to minimise costs then supporting tools which forecast health based on the weather and environment are an absolute necessity.

Series Summary

Part one of this series discusses how the more widely recognised factors such as an aging population, re-admissions and increasing expectations of medicine only contribute to a baseline increase in emergency admissions. Seasonal variation is discussed in the context of the predictability or otherwise of emergency admissions in response to changes in the weather and the wider environment. However these are unable to explain the observed cyclical events occurring every four to six years in medicine and even longer cycles in surgical and trauma admissions. These cycles are discussed in part two while part three investigates the implications to bed planning. The current methods for estimating the size of hospitals and bed pools within hospitals are shown to be inappropriate to the real needs of emergency care. Part four investigates financial risk associated with emergency admissions.

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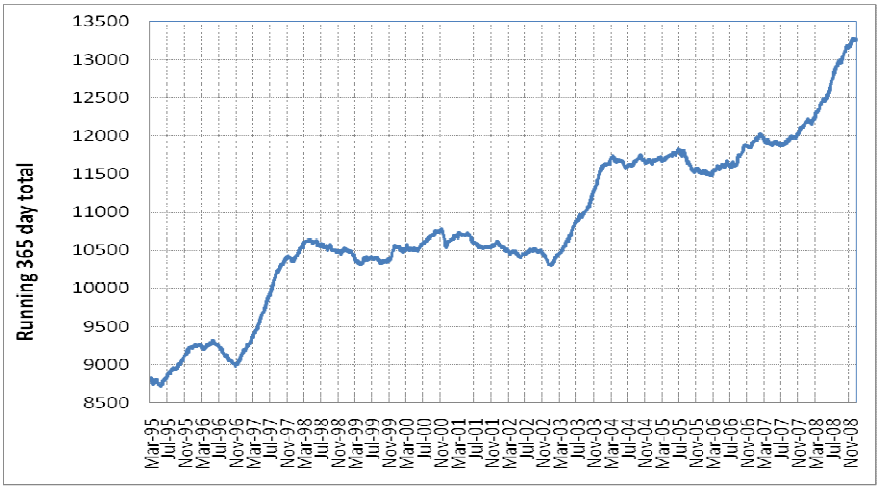
Introduction

Unexpected surges in emergency admissions appear to be a somewhat recurring pattern. The 'problem' seems to go away for several years and then re-emerges upon a seemingly unprepared health service. Indeed we need to ask the fundamental question – are the cycles of NHS surplus and deficit somehow related to patterns in emergency admission? Fig. 1 shows a running 365 day total of emergency admissions to the medical group of specialties seen at a hospital based in Reading, England. The data excludes zero day stay emergency admissions which in England are a confounding artefact of the accident and emergency (A&E) four hour target and this mainly effects data in the 2003/04 financial year onward (Robinson 2007, Jones 2009a, Department of Health 2008a).

Fig. 1: Emergency admissions to the medical group of specialties



This trend is similar to that seen in other hospitals and mirrors that of emergency medical admissions in England as displayed in Hospital Episode Statistics (HES) data (HES online 2009). It appears to exhibit what may be a repeating cycle at an approximate six year interval leading to a step-like change in activity. The fundamental step-like trend, which is contrary to how many believe demand increases, is only revealed by a very long time series and leads to the question, what are the mechanisms by which emergency admissions rise and fall?

Observation of the patterns in emergency admission has led to the conclusion that a number of basic mechanisms are involved (Jones 1996b):

1. Low level and gradual increase driven by population demographic shifts, i.e. the aging population
2. Gradual increase due to rising expectations of what healthcare can do; how society functions and how primary care interfaces with acute care which is partly reflected in increasing levels of emergency re-admission and same day 'admissions'.
3. Decreases in admission rates in particular conditions as care is moved away from an inpatient setting, i.e. as in mental health, diabetes, gynaecology, etc
4. Spike increases induced by events such as abnormal pollen levels, high/low temperature, pollution levels, influenza, etc

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5. Seasonal patterns seen in almost all conditions.
6. Longer term cycles such as those seen for scarlet fever, tonsillitis, etc and which reflect in the trends in emergency admission in the surgical specialties and for Orthopaedic trauma admissions.
7. Trigger events where the number of admissions suddenly shifts to a permanently higher level as observed in the medical specialties (and GP referral).

It is the cumulative effect of these seven mechanisms that leads to the erratic nature of long-term trends in emergency admissions. Factors 1- 5 (which are more widely recognised and accepted) will now be discussed while factors 6 & 7 will be discussed in the following article of the series.

Demographics

The ageing population does lead to higher demand for all healthcare services, however, a number of comprehensive international reviews have concluded that this is only a minor part of the overall trend (NZHTA 1998, NSW Health 2007, Kendrick & Conway 2003, Kendrick & Vise 2007). For most specialties a combination of admission rates and forecast population growth will yield a forecast for future admissions which shows roughly linear growth over a ten year interval. This demographic growth typically ranges from less than 0.5% per annum for ENT, oral surgery, gynaecology, etc through to 1.0 to 1.5% per annum for rheumatology, urology, thoracic medicine, cardiology and general & elderly medicine. The all specialty average in England is less than 1% per annum. End of life itself is a major factor in the number of healthcare interventions and there is a 10-fold increase from five years prior to decease to the last year of life (Seshamani 2003). A study in Scotland found that demographic change could only account for one-tenth of the observed increase in admissions for all ages and around one-third of the observed increase for ages over 65 (Kendrick & Conway 2003). Another study covering the population of the former Avon health authority found a real rise of 1.4% p.a. over the period 1989/90 to 1997/98 of which only 0.6% p.a. could be explained by demography (Morgan et al 1999). Hence demographic change only sets a minimum baseline increase and does little to explain the highly erratic nature of the long-term time series or the extent of the increase.

Other Factors

Admission rates for each age band have been increasing over time, i.e. estimated future admissions always undershoot the actual value. Indeed the rate of admission per head shows an almost linear increase over time and the slope of this increase rises with age. For example, in Scotland there were two emergency admissions per ten head of population for those over the age of 85 in 1981 and this had risen in a straight line manner to 4.2 admissions per ten head in 2001 (Kendrick & Conway 2003). Rising expectations, more conservative GP behaviour and how society and the whole healthcare system functions are often considered to be the factors explaining the gap between demography and the observed long term increase (NZHTA 1998, NSW Health 2007, Kendrick & Conway 2003, Kendrick & Vise 2007).

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As a rule-of-thumb for the more medical conditions the underlying demographic growth can be multiplied by a factor of two to three to get an approximation to longer term growth; while that of the more surgical interventions tends to be closer to the demographic trend. For example, a range of medical diagnoses showing higher than 2% per annum growth account for 4% of total admissions. In Scotland the fastest growing diagnosis among the elderly is for the ill-defined diagnosis 'signs & symptoms' (Kendrick & Conway 2003). In a similar vein the highest increase in surgical admissions in Exeter (UK) was for non-specific abdominal pain followed by constipation (Campbell et al 2002). Another study investigating admission rates in England showed that the rates for ill-defined conditions had doubled for age groups over 65 years during the nine year period 1995/96 to 2003/04 (Walsh et al 2008). These are non-specific 'admit to diagnose' type conditions. The wider implications of the rise in ill-defined conditions will be discussed further in part two.

Emergency admissions for certain specific conditions can show a large increase. For example, admission for children with Type 1 diabetes increased 8% from 2005/06 to 2006/07 (Juvenile Diabetes Research Foundation 2008). However while particular diseases may be showing a high increase they account for a very small proportion of the overall total.

One particular long term trend seems to be that related to urinary problems (urinary retention, urinary calculus, urinary tract infection) which was noted in Exeter where rates increased somewhere between 15- to 40-times in a 15 year period between1974 to 1998 (Campbell et al 2002). A similar increase has also been noted in Slough for the HRG describing urinary tract infection where total admissions have increased by 4-times over an eight year period (2001/02 to 2008/09). This was the fastest growing diagnosis for this hospital in terms of additional admissions per annum. However before accepting the seeming ubiquitous nature of growth we need to probe a little deeper.

Emergency re-admission seems to account for a part of the general increase; however, this appears to be mainly related to long term conditions (re-admission rate is in brackets) such as COPD (24%), angina pectoris (13%), acute myocardial infarction (12%), atrial fibrillation & flutter (11%), etc. Although the re-admission rates are highest among the most deprived the rate of increase over time appears to be independent of high or low deprivation groups (DH 2008b). Re-admission rates have increased year on year since 1981 and it is the oldest age groups that have experienced the highest (non-linear) increase. The highest rate of increase in re-admission for those aged over 80 is for 'signs and symptoms', while the incidence of re-admission for heart disease has been declining and that for respiratory infections has remained a simple linear increase (Kendrick & Conway 2003). Is this increase in re-admission really attributable to more conservative GP behaviour or is it a natural consequence of the increase in life expectancy and the change in the way society functions?

Declining Admissions

A study of emergency admissions in the south central part of England gives the following insights. For a limited number of diagnoses the number of emergency admissions has been declining. This has been most notable in the area of mental health where a focus on care in

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the community has led to a substantial shift away from inpatient emergency care for specific diagnoses such as affective disorders, schizophrenia and related disorders and anxiety, somatoform, dissociative and personality disorders.

In the area of acute admissions there has also been a decline in admissions for hypertension complicating pregnancy, non-hypertensive congestive heart failure, menstrual and other female reproductive disorders, admissions relating to medical examination, acute cerebrovascular disease and gastroduodenal ulcer (except haemorrhage). Some of these are due to a shift toward outpatient care while others are due to greater awareness, new drugs and treatment in primary care. Over the last seven years, despite upward pressure due to demographic change, this group of conditions has declined from 13% of all admissions down to 10%. A study of surgical emergency admissions showed a decrease in the incidence of appendicitis and non-malignant intestinal obstruction over a 25 year time frame (Campbell et al 2002). Experience shows that emergency admissions to Gynaecology have been steadily declining over the past fifteen years.

There is another group of conditions where there has been virtually no growth in the past seven years, i.e. negative growth in real terms; however these only account for 1% of all emergency admissions. In a 25 years study a group of surgical conditions (carcinoma of colon & rectum; peripheral arterial disease and femoral & inguinal hernia) also showed this behaviour (Campbell et al 2002). Once again these are longer term trends and their relatively small proportion implies little overall effect.

Zero Day Admissions

Up to this point the assumption has been made that everything counted as an ‘emergency admission’ is genuine. Is it possible that the definition of an emergency admission may be less than clear?

Another source of increasing admissions over and above that from demography is short stay admissions with admission and discharge on the same day (zero day stay) or a single overnight stay (one day stay). Prior to 1990 in Scotland these admissions remained at relatively the same proportion of total emergency admissions. After 1990 they began to rise with inflections leading to a higher rate of increase in 1993 and at the end of 1996. Hence between 1990 and 1997 a massive 90% of the total increase in Scotland was due to short stay admissions (Pettinger 2001). A similar increase in same day (zero day stay) emergency admissions has been observed in Australia where there was a 46% increase in zero day admissions in the six years between 1994 and 1999 and this accounted for over 95% of the total increase in emergency medical admissions (HMA 2000). It was noted that the main medical zero day stay admissions were for chest pain, abdominal pain, injuries, digestive diseases, poisoning, urinary stones and headache.

Table One presents data for the medical group of specialties in England over the period 1989/90 to 2005/066. As can be seen overnight stay medical admissions increase by 33% over the 14 year period to 2005/06 which is roughly 2.4% per annum or about double that expected from demographics, however, in a nine year period to 2000/01 zero day stay

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admissions have doubled which is roughly 10% per annum growth. Beyond 2002/03 zero day stay admissions show unprecedented growth due to the reclassification of A&E attendances as an 'emergency admission' arising as an artefact of the A&E four hour target.

In a similar way Trauma & Orthopaedic overnight stay emergency admissions only grow by 3.8% over a 16 year period to 2005/06 (which is far less than demographic growth) while zero day stay admissions grow by 107% over the same time period.

We must therefore ask the fundamental question, are the zero day stay emergency admissions simply a part of the natural continuum of ambulatory care, i.e. they are the equivalent to an urgent outpatient appointment or an A&E attendance? If viewed in this light the large apparent increase in zero day stay 'emergency admissions' becomes a much smaller increase in outpatient first or A&E attendance and the residual increase in emergency admission for the majority of diagnoses becomes much closer to that arising from simple demography. The presence of large numbers of zero day stay admissions in the emergency data set does create serious problems for the evaluation of average length of stay and for the correct determination of rates of hospital admission and for this reason it is recommended that future research in this area treat zero day stay activity as a separate entity.

The limitations of attributing the higher than expected increase to primary care will be discussed in part two of this paper. Higher numbers of short stay admissions, re-admission rates and related factors are however an underlying longer term phenomenon and cannot explain the step-like behaviour seen in the time series for medical emergency admissions (as per Fig 1) and also in Table 1.

Table One: Growth in Medical group admissions

Year	Overnight Stay	Zero Day Stay	% Zero Day
1989/90	1,825,458	129,074	6.6%
1990/91	1,829,971	133,157	6.8%
1991/92	1,682,075	119,924	6.7%
1992/93	1,751,072	131,973	7.0%
1993/94	1,782,528	143,591	7.5%
1994/95	1,863,739	153,287	7.6%
1995/96	1,815,903	163,173	8.2%
1996/97	1,816,923	180,835	9.1%
1997/98	1,884,559	205,188	9.8%
1998/99	1,913,379	213,432	10.0%
1999/00	1,907,629	227,631	10.7%
2000/01	1,941,616	243,360	11.1%
2001/02	1,936,556	253,386	11.6%
2002/03	2,003,204	283,618	12.4%
2003/04	2,108,208	365,523	14.8%
2004/05	2,194,743	466,831	17.5%
2005/06	2,245,412	602,408	21.2%

Data is from a HES extract. An admission covers the entire hospital stay and are to English hospitals including residents from outside of England.

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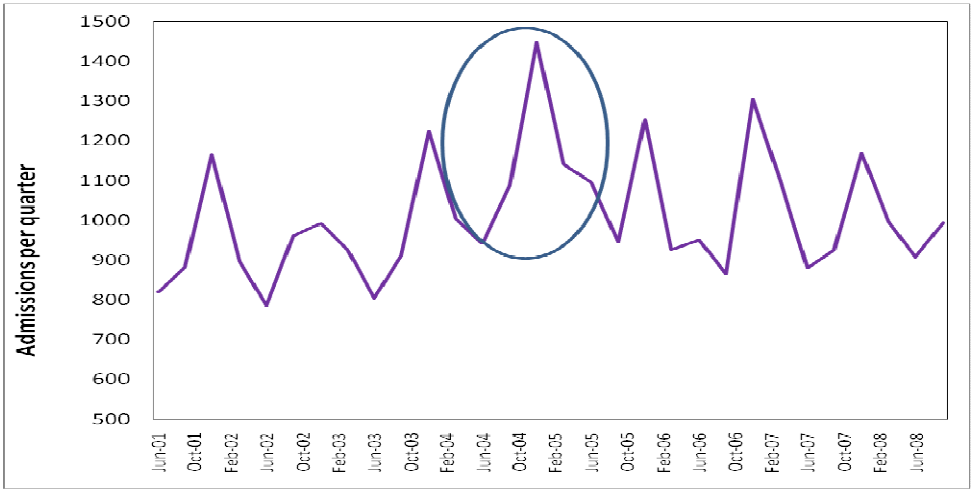
Spike Events

In England on the 30th December, 1995 melting snow turned to ice and trauma admissions over the next few days rose to four-times the annual average (Jones 2004). Similar spike events occur for asthma and are related to the multi-factorial effects of a range of air pollutants and pollens (Galan et al 2003). Weekends, Christmas and the New Year will typically show an increase in alcohol related admissions (Scottish Government News 2005). Influenza outbreaks are also a well known cause for increased emergency admissions relating to admissions for not only influenza but also for heart and respiratory conditions (Jones 1997, Mangtani et al 2006). The US website for 'My weather and health forecast'(2009) lists nine disease categories which will respond to sudden changes in the weather (temperature, pressure, humidity, etc) including heart disease, induced labour and psychological conditions. Indeed a wide variety of medical conditions respond to metrological trigger events (Hughes et al 2004). For example, the trigger events for asthma are viral infection, weather conditions, pollen and sinusitis (decreasing order respectively) with higher sensitivity for patients with pulmonary and allergy conditions (Kuo & Craig 2001). Events such as these can explain short term increases in emergency admissions although the duration of the increase will depend on the condition and the nature of the environmental shift.

The cumulative effect of multiple factors can lead to particular years where the general level of emergency admissions is higher than the underlying trend, i.e. this generates the equivalent to a 'spike year'. The age-adjusted time series between 1981 and 2001 for Scotland shows spike years in 1985 and 1989. The 1985 spike affected age groups over 80 years while the 1989 spike affected those over the age of 70 years. The 1989 spike may have been associated with a very high incidence of influenza (Lung & Asthma Information Agency 2009) (AQ9 ref added to list of references). A spike in 1999 appeared to principally affect the 80-84 age group (Kendrick & Conway 2002). Figure 2 illustrates the nature of a spike year where the 2004/05 financial year was a particularly bad year for asthma admissions due to higher than normal admissions in all four quarters of the year. Spike years can also be discerned in Table One.

Fig. 2: Quarterly asthma admissions



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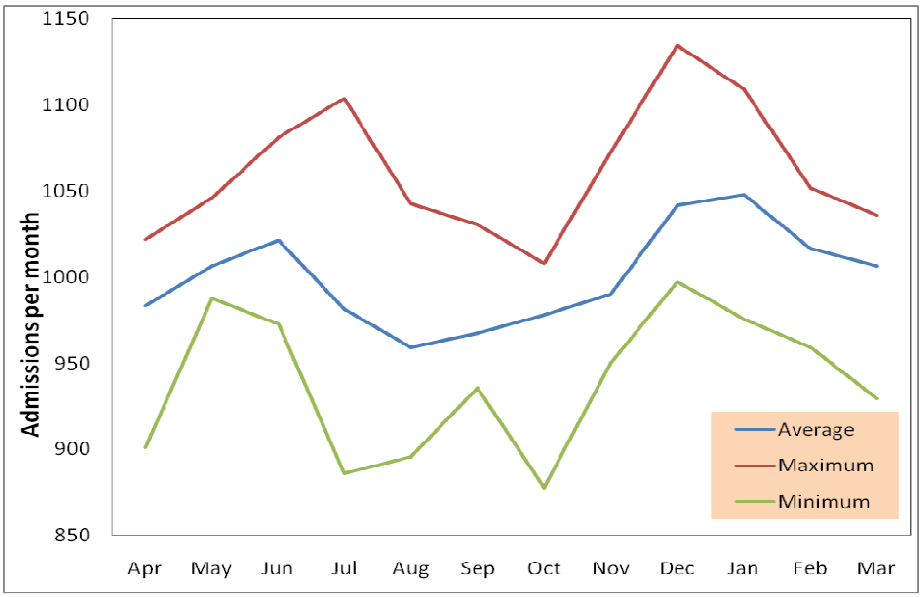
Seasonal Patterns

Seasonal patterns appear to exist in almost every condition or specialty and affect primary care, GP referral to outpatients and emergency inpatient demand (Fleming 1995, Jones 1996a, 2000, RCGP 2007, Pitt & Sigle 1997). Even the birth weight of babies follows a seasonal cycle. These seasonal patterns are the cumulative expression of the same weather and environmental conditions (including infectious agents) which lead to the spike events just discussed (Makie et al 2002, Rusticucci et al 2002, Mangtani et al 2006, Rising et al 2006). While seasonal patterns do exist it is important to realise that the seasonal trend is surrounded by a wide spread in the upper and lower limits and so the level of admissions is only very broadly 'predictable'. Fig. 3 gives one example of a seasonal trend for emergency medical admissions. Monthly (indeed daily) admissions in any year can bounce around anywhere between the maximum and minimum limits, hence in some years the expected winter peak can be lower than the summer dip. This is to be expected given the broad association with the weather and environment. The wide gap between the upper and lower limits explains the fundamental operational dilemma faced by acute hospitals, i.e. how do we efficiently allocate resources especially in the winter months? The assistance of an agency such as the former MET Office Health Forecasting Unit is therefore an absolute necessity if hospitals are to allocate beds and staff in the highly flexible (and therefore cost efficient) manner implied by Fig. 3 (MET Office 2001, 2009).

Fig. 3: Seasonal variation in emergency admissions to the medical specialties



A consideration of the implications of Fig. 3 and a study of the daily behaviour of emergency admissions seems to point to the conclusion that seasonal patterns are simply the combined effect of a series of spike events triggered by shifts in the weather and communicable infections (Jones et al 2002). This explains why the expected winter peak in medical emergency admissions in some years can be lower than the summer, i.e. there are very few spike events in that winter. Hence in the absence of the spike events the level of emergency admissions simply reverts back to simple chance variation around a basal level which is

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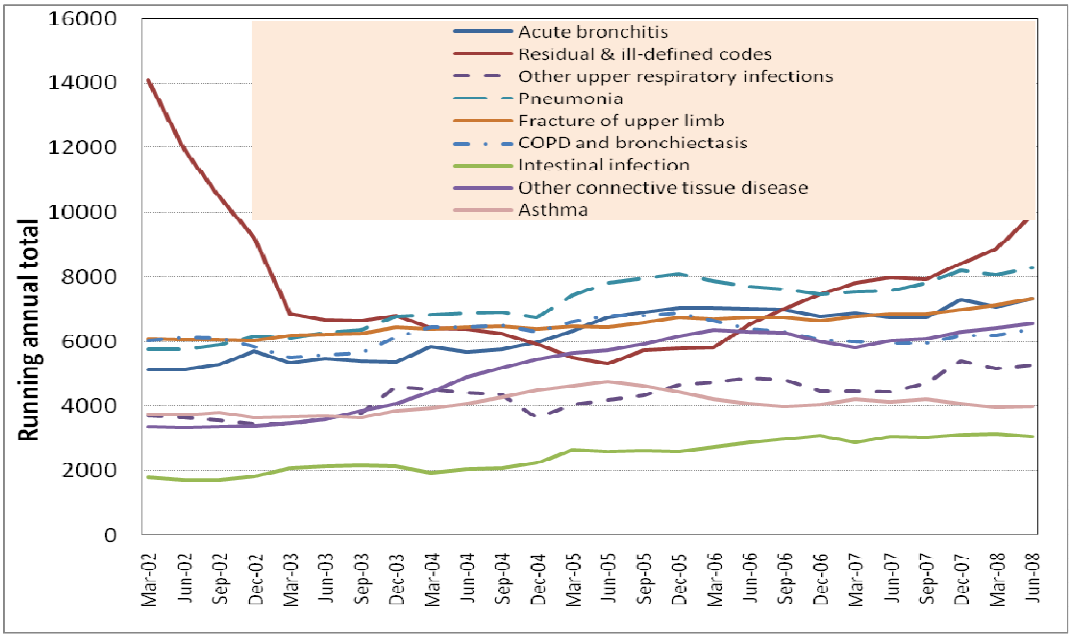
probably set by the prevailing average temperature, i.e. the minimum line in Fig. 2 (Diaz et al 2001, Jones et al 2002). If primary care is to make a demonstrable reduction in emergency admissions it therefore follows that predictive tools such as those for COPD developed by the UK MET Office health forecasting unit need to be available for a wide range of conditions and should be part of wider Department of Health support (MET Office 2009). Without such tools both primary and secondary care will be powerless to achieve the required cost savings.

The combined effect of spike events and the upper- and lower-limits around the seasonal patterns leads to the situation where there is very high financial risk associated with commissioning emergency admissions. A recent study has demonstrated that greater than 60% of emergency activity is covered by diagnoses which exhibit variation that is greater than two-times higher than arising from chance alone (Jones 2009b). This study concluded that the financial risk associated with emergency admissions was incompatible with Practice Based Commissioning (PBC) and raised serious questions about the impact on the overall finances of the NHS.

Expected Trends

A consideration of all factors leads to the apparent conclusion that most diagnoses should follow an approximate linear trend over time with occasional excursions due to spike events. Indeed as Fig. 4 demonstrates this appears to be the case for most diagnoses except for the group of miscellaneous and ill-defined diagnoses.

Fig. 4: Apparent trends in some common diagnoses



Ill-defined diagnoses have been highlighted in a number of studies as demonstrating high growth (Kendrick & Vize 2007, Walsh et al 2008). In the past the group of ill-defined diagnoses have been seen as evidence for poor clinical coding, however, the curious U-shaped behaviour seen in Fig. 4 may be pointing to an alternative explanation given the fact that the Trusts in South Central show, in general, a better standard of coding than the England

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average and there is no reason for a collective outbreak of poor coding in recent months. The group of ill-defined diagnoses cannot however explain the magnitude of the step seen in Fig. 1 and this suggests an additional measure of collective behaviour which is difficult to discern in the smaller numbers associated with individual diagnoses.

Conclusions

It would appear that the commonly recognised causes for rising emergency admissions can only explain a proportion of the much larger increase seen over very long time scales especially in medical emergency admission. It is difficult to know if the increase in re-admission and short stay emergency admission can be attributed to a shift to more conservative GP behaviour or to a shift to ambulatory care. The highly seasonal nature of emergency admissions in the medical group of specialties imply that both primary and secondary care will not be able to efficiently allocate scarce resources and make large savings unless they receive outside support via some form of health forecasts as were previously offered by the UK MET Office Health Forecasting Unit. It is recommended that any future studies on trends in emergency admissions specifically analyse the short and longer stay components separately as the former is probably more correctly viewed as an extension of ambulatory care. Indeed in support of this conclusion, a recent re-analysis of same day 'admissions' via emergency assessment units in England has shown that the cost per 'admission' is far closer to an outpatient or A&E attendance than it is to an inpatient admission (Jones 2009a).

The implications of the high growth in zero day stay emergency admissions since 1990 have been largely overlooked. The claimed rapid decline in average length of stay (LOS) is partly an artefact of including increasing numbers of zero's in the calculation of the 'average'. Hence the whole industry which has sprung up around assessing 'efficiency' based on average LOS needs to be re-calibrated on a basis which excludes zero day stay's from the calculation. By association the supposed decline in average LOS has fed through into a perceived need for fewer and fewer emergency beds. This issue is discussed further in part three of this series.

A review of emergency admissions across the former Thames Valley SHA revealed huge differences in the way acute sites counted zero day activity (Jones 2006). The differences were so great that the whole basis for assessing population 'demand' and public health rates of admission for particular diagnoses could be called into question. Indeed the whole basis of Payment by Results (PbR) relies on a consistent standard for what is counted as an 'emergency' admission. Strictly speaking a separate tariff should exist for zero day stay activity and the current short stay tariff (zero plus one day stay) only serves to obscure the real nature of the issues. One suspects that the commissioning of emergency admissions would yield far greater clarity of objective if the zero day stay stream were separately identified and appropriately priced at a level consistent with an ambulatory attendance rather than an 'inpatient' admission (Jones 2009a).

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Hopefully this paper has given fresh insight into the essential nature of the growth in emergency admissions for the bulk of diagnoses but has set the scene for an even deeper re-evaluation of some very long term trends which may be present in specific conditions. These will be investigated in part two along with the implications to the operation of payment by results (PbR) and the financial pressures experienced within the NHS.

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