An edited version of this article has been published as: Jones R (2012) Time to re-evaluate financial risk in GP commissioning. ***British Journal of Healthcare Management*** 18(1):39-48. Please use this to cite.

Time to re-evaluate financial risk in GP commissioning

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Abstract
Financial risk is the gap between the available funds and the healthcare costs (activity and case mix) incurred by the population. Costs are subject to both statistical and environmental volatility. Most studies have only looked at statistical risk arising from variation around a (known) average with the assumption that the average into the future will obey forecasting rules. This article demonstrates that the combined and interactive effects of the wider environment (weather, air quality, infectious agents) leads to very high volatility in year to year costs and also generates a set of poorly understood long-term cycles in health care demand which leads to prolonged periods of higher than average cost. It suggests that there are genuine sources of risk over which there is little direct control and that health care funding may need to follow a more flexible trajectory. What is called the 'post code lottery' arises out of the mismatch between the capitation formula (which assumes all costs arise from population socio-economic and demographic factors) and the susceptibility of local costs to volatility due to the environment.

Key Messages

- Financial risk in healthcare is far higher than has been appreciated due to a combination of chance- and environmental-based volatility/risk
- Environment-based risk arises from the interaction of weather, air quality and infectious outbreaks with human health
- Environment-based risk leads to very high volatility in hospital admissions from one year to the next and this makes forecasting activity and costs a difficult task
- Up to 23% of the variation in total costs between populations may be due to the environment
- The environment-based portion of risk also leads to a curious long term cycle-like changes in admissions which appears to affect mainly trauma and medical conditions
- Across England a medical cycle appears to add around £700 million of costs between trough and peak
- This dominant medical cycle may be international in scope but is poorly understood and requires detailed research in order to isolate the cause(s) and required remedies

Introduction
The introduction of GP commissioning in England, along with a series of market style reforms has created intense debate (Delamothe & Godlee 2011, Gerada 2011, Ham et al 2011, Howe 2011). Clusters of GP's will be given the budget for patients using a formula which attempts to calculate their 'fair share' of the national budget as allocated by Parliament (Department of Health 2011). The government has claimed that the present arrangement is inefficient and that GP's, in their role as gatekeeper to the health services, are best placed to implement the required cost savings, through the

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exercise of competitive choice between a mix of private and public service providers and setting local priorities. In the early 1990's attempts by private health insurance companies in the USA to implement a similar scheme led to a series of high profile GP bankruptcies (Casalino 2011). Although issues of size, which are a direct result of simple statistical risk, may have been given consideration the wider issues relating to the environment-sensitive (weather, air quality and infectious outbreaks) components of risk have been largely ignored (Jones 2011e-f, Wood & Ward 2011). The inherent high financial risk in health care purchasing may have been downplayed through rhetoric which suggests that financial problems arise from 'failure', 'inefficiency' or 'incompetence' on behalf of NHS managers and organisations.

This article will use a long time series of English NHS hospital activity and case mix data to investigate both the level of year to year volatility associated with groups of diagnoses and to see how both total occupied bed days and costs behave over time. This will attempt to address questions as to whether financial risk may be higher than is commonly appreciated and whether the trends (and costs) may be behaving in ways which are unexpected (leading to financial forecasting error).

Financial Risk

The financial risk in the purchasing or commissioning of healthcare on behalf of a population by an insurance company, health authority, health maintenance organisation (HMO), managed care organisation (MCO), primary care organisation (PCO) or clinical commissioning group (CCG) is the difference between the largely fixed income for that year (either via some for of capitation payment or revenue from premiums) and the incurred costs. Costs are subject to both statistical and environmental volatility. Even simple statistical variation around a known average gives rise to considerable and unavoidable financial risk (Jones 2004, 2006a, 2008a-c, 2009g). This source of risk escalates dramatically for smaller organisations and around 100,000 head are required to reduce this risk to an acceptable size (Jones 2008a-c). However, the less well characterised environment-sensitive component of risk can be two- to three-times higher than the purely statistical-based risk (Jones 2004, 2006a, 2009e). It remains a poorly studied and therefore a largely ignored area in both fundamental research and health care policy.

It has been proposed that better demand management and contract negotiation with providers by GP's will lead to cost reductions which can then be re-invested in further cost reducing schemes, or perhaps even shared by GP's. However such a notion, whilst almost certainly partially true, has a very clear (but un-stated) assumption that health care costs will rise in a steady manner driven by underlying changes in the population demography and to some degree ameliorated via modification of risk factors such as smoking, obesity, intake of salt and fatty foods, maintaining high levels of vaccination, etc.

Time Trends

Economists have known for many years that demography, or the aging population makes only a small (typically less than 1% p.a.) contribution to rising health care costs (Mayhew 2001). The author's two decade career in health care forecasting has shown that demographic-based forecasting gives largely unreliable long-term estimates of healthcare activity and costs (Jones 2010l). This is due to the fact that demographic forecasting is subject to what is known as the "constant risk fallacy" (Nicholl 2007), and that activity per 1,000 head in each age band is constantly changing over time as trends in morbidity and mortality dominate the real world.

If this is true, why does demographic forecasting form the fundamental basis for predicting health care demand? Large hospitals are built based on such projections and PCO financial forecasts are performed on this basis. Firstly, such forecasts give the 'reassuring' view of a world which is expanding at a controlled and known rate and implies ease of planning (Jones 2010l). The second reason arises from a public health perspective where age and sex adjustment is a standard tool to reveal differences between populations of disparate demographic structure. While entirely appropriate for this purpose, it does not immediately follow that such age and sex adjustment can be applied into the future. In this respect the occupied bed-related portion of costs has been shown to depend more on the trends in death than demography *per se* (Jones 2011a). We have fallen into the trap of taking a valid method beyond the limitations of its usage. Hence an Australian modification of demographic forecasting sought to address this problem via the application of (assumed) linear regression (over the period 1998/99 to 2003/04) to give forecasts for each age band and diagnostic group combination from 2004/05 to 2017/18 (Jones et al 2008). However, this assumed linear trend led these forecasts to fail in 2008 when unanticipated non-linear trends emerged (Jones 2011f).

It has been proposed that the behaviour of healthcare costs can only be fully understood in the light of environment-induced volatility and the fact that activity trends for particular diagnoses show a far higher disposition to long-term cycle-like patterns than is widely appreciated (Jones 2004, 2006a, 2009a-c, 2010e-l). These are in addition to the more commonly recognised seasonal cycles (Lieberman et al 1999) which in themselves are subject to environment-induced volatility (Jones 2009a, 2010l). The word cyclic is used in its widest sense of something showing undulating or wave-like movement over time as opposed to random scatter. Such cyclic patterns appear to arise from the interaction between human physiology and immunology and the prevailing environment (Jones 2012).

In this respect both inpatient admissions and emergency department attendances for a wide range of diagnoses/conditions have been shown to respond to environmental variables such as regional weather types, temperature, barometric pressure, humidity, rainfall, hours of sunlight, thunderstorms, various measures of air quality and viral outbreaks (Danet et al 1999, Anderson et al 2001, Diaz et al 2001, Jones et al 2002, Makie et al 2002, Rusticucci et al 2002, Wong et al 2002, Galan et al 2003, Hughes et al 2004, Patz et al 2005, Mangtani et al 2006, Marno et al 2006, Rising et al 2006, Dawson et al 2007, Baldi et al 2008, Sauerzopf et al 2009, Sun et al 2009) and can give rise to longer-term cyclic behaviour (Anderson et al 1984, Flemming et al 1991, Grenfell et al 2001, Koelle & Pascual 2004, Patz et al 2005, Stomp et al 2009, Parsons et al 2011)

For example, over a 36 year period in the Groningen region of the Netherlands trauma admissions were sensitive to changes in temperature, hours of sunshine, humidity, precipitation and prevailing wind direction with ‘good’ weather leading to an overall increase in admissions. Admissions showed cyclic behaviour with maxima in 1970, 1977, 1995 and 2000 (Stomp et al 2009). The reasons for such cyclic patterns are poorly understood but may be due to synergistic interactions between variables, contributions from many other variables not measured in the study and the fact that even random distributions give rise to clusters. The application of the branch of mathematics called wavelet analysis will be among a number of methodologies needed to unravel these issues. Whatever the ultimate reason(s), the gap between the long-term peaks and troughs in this study was around 12 to 15% of the maximum and hence the cost of trauma (as part of the overall budget) will fluctuate in such a manner as to cause cost pressures within the constraints of a fixed total budget.

Wavelets Explained

A **wavelet** is a wave-like oscillation having an amplitude which commences at zero, increases, and then decreases back to zero. It can be visualized as a "brief oscillation" similar to that recorded by a seismograph or heart monitor. Generally, wavelets are crafted to have properties that make them useful for signal processing. To explain the dynamic patterns or signals in the real world wavelets can be combined, using a "shift, multiply and sum" technique called convolution. Wavelet analysis has a vast number of applications, including molecular dynamics, seismology, optics, turbulence, blood-pressure, heart-rate and ECG analyses, brain rhythms, DNA analysis, protein analysis, climatology, general signal processing, speech recognition, computer graphics and multifractal analysis.

A similar study of trauma admissions in England over an 11 year period involving 21 hospitals had an average gap between maximum and minimum of 36% (range 24% to 47%). The exact magnitude of this gap at each hospital will depend on both size (statistical-based volatility) and environment-based

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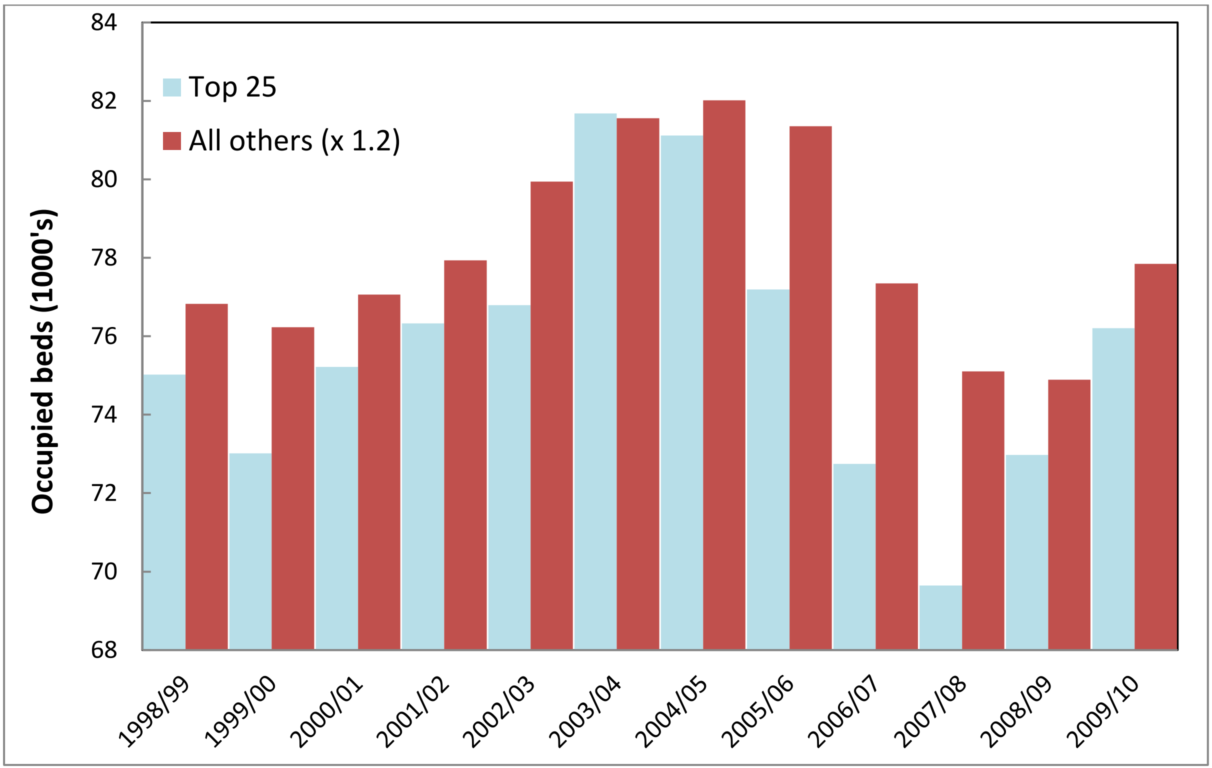
volatility (geographic location). Half of the sites had a maximum in the interval 1999 to 2001 and one-third from 2003 to 2005; and no hospital with maxima in 1998 or 2006 (Parsons et al 2011). It is also of interest to note that both the incidence and prevalence of asthma appears to follow long-term 'undulations' (Fleming et al 2000, Anderson et al 2007, Moorman et al 2007, Gonzalez et al 2009), as does the incidence of visual impairment in diabetics (Burrows et al 2011) and the the incidence of appendicitis (Livingston et al 2007, Kaplan et al 2009, Alder et al 2010). Long term cyclic patterns for Kawasaki disease (an immune mediated damage to the coronary arterial wall and myocardium in children) in Japan, Hawaii and San Diego have been shown to be related to tropospheric wind patterns (Rodo et al 2011). By implication such long term cycles arising from a multiplicity of causes may be more common than is widely appreciated.

Volatility in Healthcare
In order to demonstrate the individual contributions from environment-sensitive volatility and the less well understood cyclic cost pressures Figures 1 and 2 present a time-series of occupied beds for emergency plus elective admission and total costs for emergency admission in England. While the author has consistently noted these factors in local data, on this occasion national data has been used both to illustrate the concepts and to minimise the statistical-based volatility associated with smaller (local) samples.

Figure 1: Trend in occupied beds for England

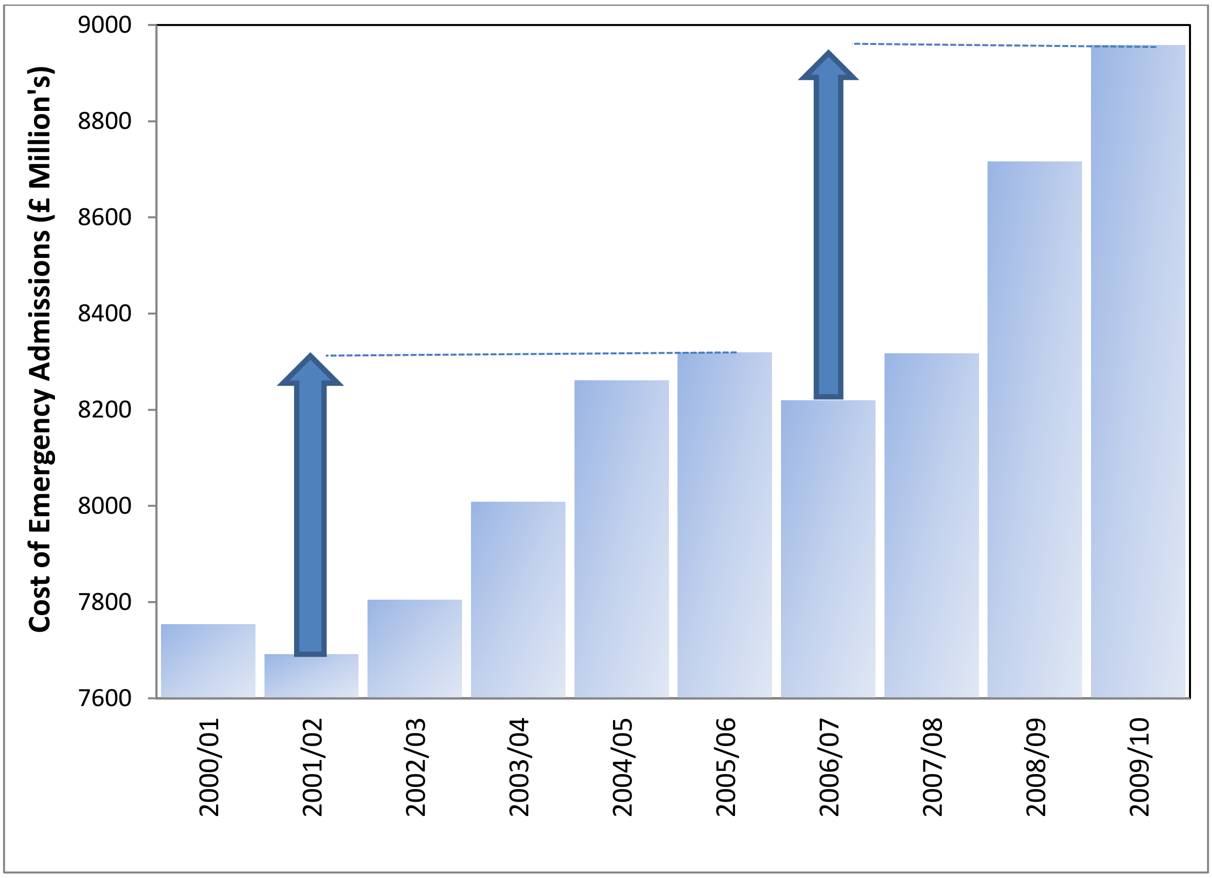


Footnote: Data for both elective and emergency admission types in England using ICD primary diagnosis summary statistics was obtained from http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=202. All types of admission to acute, maternity and mental health beds are included. Bed occupancy in 2008/09 has been adjusted to account for a change in the way in which the bed days associated with episodes spanning the year-end were allocated across years in the HES data. The adjustment factor for each diagnosis group was calculated as: 1+ (average length of stay-1)/365, i.e. the longer the length of stay the greater the opportunity for an admission to span the year end. Total annual bed days were divided by 365 days per year to give occupied beds. Note that ongoing reduction in the total average length of stay over time will lead to some skewing of any underlying cycle.

In Figure 1 total occupied beds have been chosen because they largely avoid issues of counting and coding (Jones 2006b, 2007, 2009a,f, 2010d,k). Occupied beds are the patients in a bed as opposed to the number of available beds and this avoids issues around the counting of available (staffed) bed numbers. The ratio of occupied to available beds is the average bed occupancy which is a measure of operational pressure and propensity of adverse events (Jones 2011b). The nursing and overhead costs (excluding initial diagnosis, theatre and procedure costs) associated with an occupied bed is around £200 per day or £73,000 per annum (Jones 2008d). To illustrate the general importance of cycle-like behaviour bed occupancy has been sub-divided using the International Classification of Diseases (ICD) summary level primary diagnosis. The group labelled 'Top 25' (53% to 55% of total occupied beds) has been selected by looking at diagnoses where there is a large numerical gap between the highest and lowest bed occupancy throughout the time series while the remaining 'All Other' 122 summary level diagnostic groups are those where the gap between maximum and minimum is lower.

Both groups exhibit long-term cyclic behaviour with a minimum gap between peak and trough of around 11% and 7% of the maximum respectively. The occupied bed related costs therefore fluctuate by a minimum of £440 million and given the relatively modest changes in average length of stay over the period (Jones 2009f), will largely arise largely from changes in admissions and associated case mix.

Figure 2: Inflation-adjusted cost of emergency admissions in England



Footnote: Data for emergency admissions in England is from the HES Online website http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=206 and is in version 3.5 of the Health Resource Groups (HRG). Data from the first three years has been converted from V3.0 and V3.1 into V3.5 by allocating activity on a pro-rata basis. All activity was converted into 2008/09 costs using the 2008/09 HRG tariff obtained from http://www.dh.gov.uk/en/Managingyourorganisation/NHSFinancialReforms/DH_081238 and total cost over time has been converted from finished consultant episodes (FCE) to admissions by applying the ratio of FCE to admissions (Spell) applicable in each year. Costs for HRG in which there was no national tariff (mainly in mental health) were estimated using average length of stay at £200 per day.

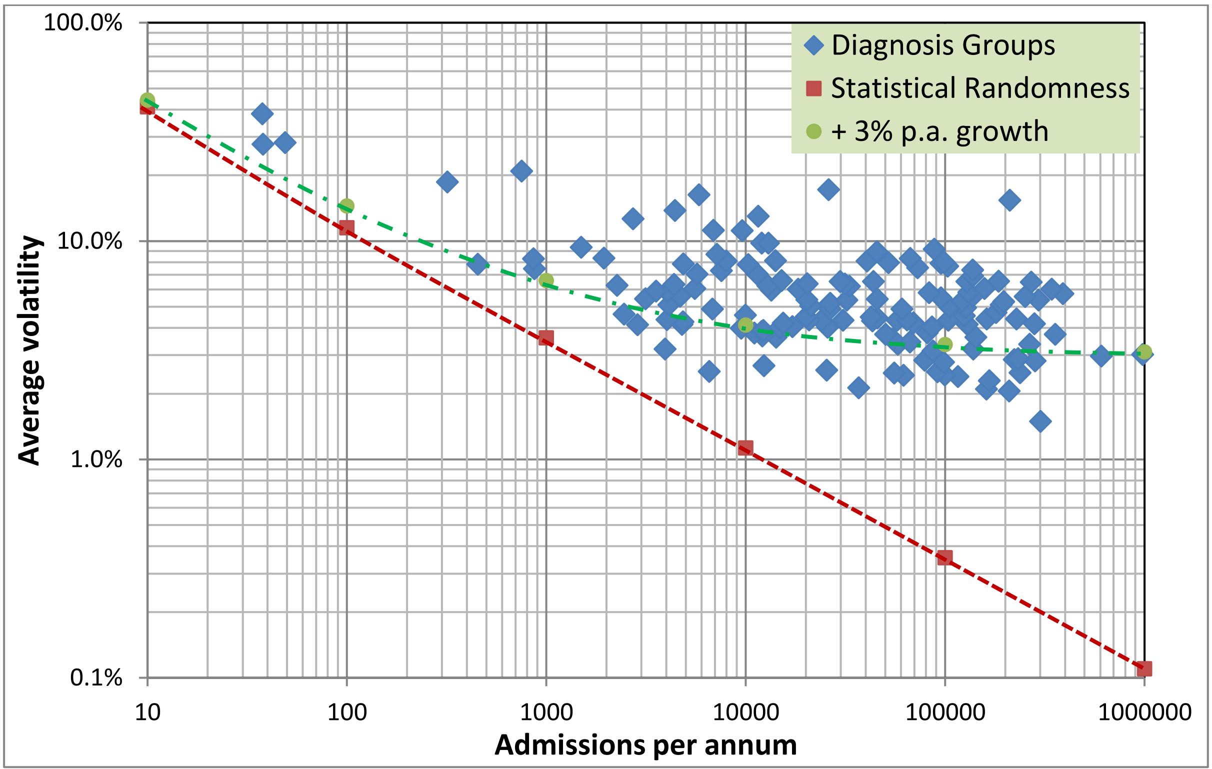
While Figure 1 includes both elective and emergency admission types the propensity to cyclic behaviour appears to be higher for emergency admissions (Jones 2009a-d) and for this reason Figure 2 investigates direct costs for emergency admissions. The impact of cost inflation has been mitigated in Figure 2 by taking a time-series of version 3.5 of Healthcare Resource Group (HRG) activity. This version of the HRG tariff contained 546 unique price groups based on the diagnoses or procedures associated with each admission and consequently 546 unique prices ranging from £337 for HRG S33 (inpatient examination and screening) to £11,031 for HRG Q15 (amputations). The 2008/09 prices for each HRG were then applied across all years to give the equivalent to a case mix and inflation-adjusted time series for costs. This process is illustrated in Table 1 for the first 10 of the 546 HRG where admissions to the two medical HRG (A09 and A10) seem to be showing cycle-like undulations. With respect to HRG A09 and A10 it has been noted that certain neurological conditions along with other medical diagnoses appear to be related to a long-term cycle (Jones 2012). The case mix adjusted total costs given in Figure 2 appear to show two cycles with a rise in 2008/09 equivalent (i.e. inflation adjusted) costs of £627 million from the trough in 2001/02 to the peak in 2005/06 or £739 million from the trough in 2006/07 to the peak in 2009/10.

Table 1: A case mix adjusted cost time series

HRG3 and description	Count of emergency admissions									
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
A01 Intracranial Procedures - Category 1	260	232	238	282	277	361	316	308	352	392
A02 Intracranial Procedures - Category 2	1300	1340	1405	1460	1518	1714	1783	1614	1567	1707
A03 Intracranial Procedures - Category 3	1530	1576	1613	1559	1613	1880	1849	2044	2115	2517
A04 Intracranial Procedures - Category 4	1357	1442	1342	1314	1268	1544	1339	1227	1277	1338
A05 Intracranial Procedures for Trauma w cc	397	411	478	417	470	643	704	724	858	1064
A06 Intracranial Procedures for Trauma w/o cc	1310	1324	1368	1238	1218	1394	1435	1485	1568	1538
A07 Intermediate Pain Procedures	536	482	454	553	664	605	499	509	537	578
A08 Percutaneous Image Controlled Pain Proc	9	15	13	5	7	12	38	30	38	32
A09 Peripheral Nerve Disorder w cc	1145	1159	1388	1465	1792	2100	2234	2561	2924	3577
A10 Peripheral Nerve Disorder w/o cc	4095	3890	4129	4511	5121	6007	6265	6464	7234	7647
HRG and 08/09 Price	Cost of emergency admissions (£1,000's)									
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
A01 £1498	£389	£348	£357	£422	£415	£541	£473	£461	£527	£587
A02 £5057	£6,574	£6,776	£7,105	£7,383	£7,677	£8,668	£9,017	£8,162	£7,924	£8,632
A03 £6677	£10,216	£10,523	£10,770	£10,409	£10,770	£12,553	£12,346	£13,648	£14,122	£16,806
A04 £8346	£11,326	£12,035	£11,200	£10,967	£10,583	£12,886	£11,175	£10,241	£10,658	£11,167
A05 £6174	£2,451	£2,538	£2,951	£2,575	£2,902	£3,970	£4,346	£4,470	£5,297	£6,569
A06 £4670	£6,118	£6,183	£6,389	£5,781	£5,688	£6,510	£6,701	£6,935	£7,323	£7,182
A07 £813	£436	£392	£369	£450	£540	£492	£406	£414	£437	£470
A08 £420	£4	£6	£5	£2	£3	£5	£16	£13	£16	£13
A09 £3215	£3,681	£3,726	£4,462	£4,710	£5,761	£6,752	£7,182	£8,234	£9,401	£11,500
A10 £1899	£7,776	£7,387	£7,841	£8,566	£9,725	£11,407	£11,897	£12,275	£13,737	£14,522
Total cost for first 10 HRG	**£48,971**	**£49,914**	**£51,450**	**£51,266**	**£54,063**	**£63,783**	**£63,560**	**£64,852**	**£69,442**	**£77,449**

The 70% price discount introduced in 2010/11 applying to all emergency admissions above a 2008/09 baseline has not been applied to Fig. 2 simply because this was an entirely arbitrary measure introduced by the DH in an attempt to mitigate the effects of the cost cycle (Jones 2010b). However it should be intuitive that the three year lag in converting reference costs into HRG prices, in the context of a cycle which is roughly double this lag, will lead to a lagged cycle in the difference between underlying cost and prices similar to the cycle in health insurance profit margins seen in the USA (see the 'International Perspectives' section).

Figure 3: Volatility associated with admissions in diagnostic groups



Footnote: Data is from the same source as Figure 1 and covers 1998/99 to 2009/10. Statistical-based volatility was calculated by Monte Carlo simulation using 'Oracle Crystal Ball' software. The average volatility was calculated using 50,000 trials. Between 10 and 1,000 admissions a Poisson distribution was assumed to apply while for 10,000 and above a Normal approximation to a Poisson distribution was applied with a standard deviation equal to the square root of the average (Jones 2009g).

Having established the tendency to some degree of cyclic behaviour in both occupied beds and non-elective costs the issue of year-to-year volatility in admissions is explored in Figure 3. Volatility has been calculated as the absolute difference between one year and the next divided by the value in the first year. Such analysis makes no assumption regarding the fundamental nature of growth over time.

The important feature of Figure 3 is the fact that the line describing the volatility which would arise from statistical-based randomness is considerably lower than the points for the 147 diagnostic groups. Any diagnosis with strongly cyclic behaviour would tend to have high apparent volatility due to the up and down progression through such a cycle. Repeating this analysis using HRGs or individual ICD diagnoses leads to graphs similar to Figure 3 with only a minority of HRG/diagnoses coming close to the line describing pure statistical randomness.

Underlying demographic growth of 1% per annum would lead to 1% apparent volatility plus simple statistical volatility; however, all diagnoses are more than one percentage point above the line for statistical-based volatility. In this respect a line describing statistical-based volatility plus 3% per annum underlying growth (or change equivalent) has also been added to Figure 3 to give a reference point for the degree of consistent growth (change) that would be required to give the very high volatility observed for most of the high level diagnosis groups. Observe how statistical volatility makes a dominant contribution below 1,000 admissions per annum (the likely size for most CCGs) and hence the total average volatility is almost always greater than ±10%. It is of interest to note that the underlying growth in acute non-elective costs from trough to trough in Figure 3 is around £100 to £110 million per annum or only around 1.1% to 1.4% per annum; hence, it is the strong cycle which appears to be dominating the cost pressures.

Each diagnosis grouping represents the equivalent to a line in the total budget with the activity (and hence cost) jumping around, on average, at 6 % ± 3% (for the group of diagnoses with 1,000 or more admissions per annum). These results concur with analysis which suggests that the length of stay for particular diagnoses is also environment sensitive (Jones 2010d). Hence, even in the absence of the background cycle in costs it will be fundamentally difficult to manage the total budget simply because the volatility in almost all diagnoses is high and will be higher still in the smaller CCGs as the effect of size adds back the additional component of statistical-based risk, especially seen below 1,000 admissions per annum (Jones 2008a-c).

At this point it is relevant to note the basic flaw in the arguments around 'better' commissioning, cost reduction and financial risk. Let us say that all areas reach outcomes described by the Torbay Care Trust (a combined health and social care organisation) with 30% lower acute occupied bed days than most other English PCOs (Jones 2011d). Would this reduction in bed occupancy solve the financial risk problems? The answer is no, simply because both the volatility and cyclic nature are intrinsic to health care and so even when the average costs in each year are shifted downward in Figs 1 and 2 the financial and operational implications of the long-term cycle and associated volatility remains unaltered (personal communication with Dr Sasha Karakusevic). Hence, a large reduction in acute costs (offset by higher primary, community and social care costs) will only act to leave a bigger safety margin relative to funding but does not remove the financial risk arising from intrinsic volatility. It also needs to be pointed out that the very broad cyclic behaviour will not apply to every diagnosis and that additional cycles may lie buried in the data as per the cycles for trauma, asthma, appendicitis and Kawasaki disease discussed above.

Indeed what is known as the 'post code lottery' arises out of the mismatch between the capitation funding formula, which assumes that health care costs arise from population socio-economic and demographic characteristics (Dixon et al 2011), and the fact that costs at a local level are subject to high environment induced volatility. This suggests that the only route to 'fair' funding of individual CCGs needs to have a retrospective component which is based on environment-based health forecasts. Indeed the very fact that many diagnoses appear to have a long-term cyclical component presents an interesting challenge to the development of funding formulae. For example, the most recent attempt to develop a formula applicable to CCGs utilised data from 2005/06 and 2006/07, the downward part of the larger cost cycle, to estimate costs in 2007/08 (the minimum point of the cycle). Only 77% of cost variation at practice level was explained by the model (Dixon et al 2011) and this implies that up to 23% of cost variation may be due to the environment. Such models need to incorporate environmental variables and be developed and tested over far longer time periods to ensure that their predictive power remains robust.

International Perspectives

Is this behaviour is peculiar to England or is it fundamental to health care, per se, in other countries? During the 1980's members of the health insurance industry in the US began to suspect that a cycle of profit and loss was occurring (Kip et al 2003) and the evidence for this was reported in 1991 (Gabel et al 1991). This cycle implied that the process of setting annual premiums via analysis of historical costs was subject to some form of anomaly. Further research suggested that this cycle was linked to a sudden, unexpected and approximate 6% (range 3% to 15%) increase in inflation-adjusted total costs (Born & Santere 2008, Jones 2010f) which will arise from a rapid change in the volume, case-mix and/or complexity of the health care contacts, the sum of which leads to the total cost. The pattern of hospital admissions, occupied bed days and wider costs seen in Canada, all four countries of the UK, Australia (Jones 2010f-h, 2011c) and also in Estonia, Austria and Switzerland (unpublished studies) appears to mirror the health insurance underwriting cycle seen in the US. The bulk of this unexpected increase is largely due to medical admissions and specifically to particular diagnoses (Jones 2010i-k). This cycle has been proposed to be the main contributing factor to a cycle of surplus and deficit seen within the NHS over many years (Jones 2010a,c,f) and is most likely the cause of the legacy deficit which some PCTs may be passing on to CCGs.

The cost cycle seen in the US equates to around $150 billion in 2008 equivalent costs based on a figure of 6% derived from re-analysis (Jones 2010f) of the annual inflation-adjusted work of Born and Santerre (2008) We are clearly dealing with something having widespread and profound effects upon costs of health care which almost certainly requires further investigation.

It would appear that GP's in England are being asked to assume responsibility for cyclic cost changes of around £700 million of acute costs plus additional cyclic community and primary care costs (Jones 2010h). This is on top of high volatility in costs from one year to the next arising from the interaction of the environment with the expression of human health. This is all well and good in the downward parts of the cycle. The upward parts of the cycle may partly explain the bankruptcies observed in certain years when the equivalent to GP commissioning was implemented in the USA (Casalino 2011) and almost certainly explains the recent poor financial performance of PCO's in England. Indeed what is perceived as good performance may have more to do with where an organisation is in relation to the larger cost cycle rather than 'good' management (Jones 2009b, 2010g,k, 2011e) although 'poor' forecasting and management may only engender inappropriate responses (to symptoms rather than primary causes) in an attempt to 'fix' the problem.

Limitations

Perhaps the first criticism of this analysis is that the larger cycle is simply an outcome of wider economic cycles which would imply a direct link between acute admissions and the economy. Unemployment is a well known contributor to mental and physical health issues (Linn et al 1985) although these should affect personal health in the community rather than acute admissions and should not affect those above retirement age who account for the greatest proportion of total admissions. However, contrary to expectation, mortality actually reduces during economic downturns (Bezruchka 2009) and the net effects of economic cycles may be complex. Hence some form of cyclic contribution to acute admissions may be expected from the wider economic 'environment' and such cycles will lie buried within the data along with the other cycles discussed herein.

The next source of criticism could be around the application of the HRG tariff from a single year to act as an inflation adjusting factor. If cycles are a fundamental feature of health care then one would expect prices to show corresponding cycles since cost and volume are related entities. In this respect a recent study has shown that the calculated HRG prices in the period 2002/03 to 2005/06 exhibits far higher price volatility than may otherwise be expected (Jones 2011g). Since this period covers the start of one of the major cycles this only tends to support the fundamental existence of these cycles and this concurs with the lagged cycles in health insurance profit/loss observed in the USA (Born & Santere 2008). The 2008/09 tariff prices were derived from 2005/06 reference costs which is at a minimum point in the medical cycle. This may act to moderately overstate the impact of the cycle but will not remove its existence which depends on the volume and case mix of admissions rather than the need for an accurate price specific to each year. It does however suggest that the HRG tariff may need to be corrected for the fundamental cost effects of the larger cycle and something more sophisticated than the 70% price discount applied by the DH is needed to reflect the fact that only particular diagnoses/HRG are involved in the larger cycle.

The final potential criticism arises from the growth in short stay admissions arising as a by-product of the introduction of the Accident & Emergency (A&E) four hour target in 2001 such that by 2005 medical 'admissions' with a zero or same day stay had increased by 500,000 out of a total of 4.7 million emergency admissions (Jones 2006b, 2009f). This shift specifically led to an increase in 'admissions' where the diagnosis was indicative of an A&E assessment rather than a genuine inpatient admission (Jones 2010m). The 2008/09 tariff did include a separate short stay tariff which applies to some medical HRG; however, the data used in this study did not have a separate count of short stay admissions. Analysis of the average cost per emergency admission (using the 2008/09 tariff) shows that average fell from £1974 per admission in 2002/03 down to £1749 in 2006/07 (an

11% reduction) but remained fairly constant either side of these years (analysis not shown) and this is reflective of the increased number of 'admissions' into lower cost HRG which tend not to have a short stay tariff. The limited span of years over which this effect applied does not therefore have a material effect on the evidence for the longer term cycle. The omission of a short stay cost adjustment will therefore act to slightly overstate the extent of the financial impact of the larger cycle.

In summary, the potential limitations of this study highlight the need for further research and the acknowledgement that the contribution from the larger cycles may be more profound that has hitherto been appreciated.

Solutions

The first step to solving a problem is to acknowledge that it exists. A range of (partial) solutions to the unexpected risks arising from environment-induced volatility and the cyclic behaviour of (mainly) emergency medical admissions can be proposed. At local level data will be required for diagnosis and latest HRG version going back to around 2000 so that trends can be constructed which enable forecasts to be developed which are sensitive to the ongoing (and complex) trends. Issues of local hospital counting and coding will be an additional confounding factor in some instances (Jones 2006b, 2007). Running twelve month totals are a useful way of checking how the present position compares to the past. To ascertain if endeavours to reduce acute bed days via admission avoidance and speedy discharge are successful the long term trends in bed days per death (excluding children and maternity) should be available for comparison (Jones 2011a,d). Realistic forecasting of activity, case mix and cost is therefore needed to carry forward cost savings to cover those years where cost pressures will (once again) be higher than average (Jones 2010e). It goes without saying that none of the above removes the risk arising from funding trajectories which may be determined by other national priorities although the need for efficiency and cost reduction is an assumed and on-going part of health care delivery.

While national data has been used in this study to demonstrate the wider issues, at sub-national level there may be little point for CCGs in one location clubbing together to form a risk pool since all will be experiencing roughly the same weather and environment. Hence, to mitigate the effects of environment-based volatility will probably involve CCGs forming financial risk pools with members from widely different locations, i.e. city/rural, north/south, coastal/inland, etc. This will be required in order to use the differences in weather types as an attempt to cancel out the volatility in costs. Such risk pools are relatively easy to run (Jones 2009c). However, all concerned need to be aware that the basic problems behind financial risk are not solved by the transition from PCOs to CCGs, but are perhaps made worse by the potentially smaller size of most CCGs. Indeed the issues highlighted in this paper need to become part of the ethos of appropriate structure(s) and financial risk frameworks being discussed for CCGs (Wood & Ward 2011).

Conclusions

It would appear that the combined and interactive effects of the environment exert a far higher effect on the expression of acute health care demand than has hitherto been acknowledged. While the integration of health and social care can reduce acute costs it does not remove the underlying causes of volatility in demand, i.e. volatile demand (and costs) are simply shifted to another location. GPs must be cautious in taking responsibility for the risks of volatile costs at diagnosis level plus what appears to be an overarching cycle in health costs having financially catastrophic consequences and to which there are a range of hypotheses but no proven explanations, and hence, proven remedies (Kendrick 1995, Blunt et al 2010, Jones 2010i, Jones 2012). They should be insisting on a programme of national research to understand what appear to be a broad (medical) cycle and the lesser trauma and other cycles. While the Secretary of State for Health (England) has sought to quickly divest responsibility for such a perplexing and intractable problem a more pragmatic view would be to investigate the fundamental causes of these behaviours in order to apply the correct remedies (be they public health measures, etc) rather than assuming that a change of commissioners will solve the problem. Supporting tools such as health forecasts need to be universally available to enable staff costs to be minimised across the entire NHS.

An edited version of this article has been published as: Jones R (2012) Time to re-evaluate financial risk in GP commissioning. ***British Journal of Healthcare Management*** 18(1):39-48. Please use this to cite.

Conflicts of Interest

The author provides consultancy to health care organisations.

References

Due to the limitations of space and in consultation with the editor a full list of references were not published in the BJHCM article, however, this list contains all references:

Alder A, Fomby T, Woodward W, Haley R, et al (2010) Association of viral infection and appendicitis. Archives of Surgery 145: 63-71

Anderson H, Gupta R, Strachgan D, Limb E (2007) 50 years of asthma: UK trends from 1955 to 2004. Thorax 62(1):85-90.

Anderson R, Grenfell B, May R (1984) Oscillatory fluctuations in the incidence of infectious disease and the impact of vaccination: time series analysis. Journal of Hygiene 93: 587-608.

Anderson W, Prescott G, Packham S, Mullins J, Brookes M, Seaton A (2001) Asthma admissions and thunderstorms: a study of pollen, fungal spores, rainfall and ozone. Q J Med 94: 429-433.

Baldi M, Salinger J, Dirks K, McGregor G (2009) Winter hospital admissions and weather types in the Auckland region. Australian Government Bureau of Metrology. http://www.bom.gov.au/events/9ichsmo/manuscripts/M1415_Baldi.pdf

Bezruchka S (2009) The effect of economic recession on population health. CMAJ 181(5): 281-285.

Blunt I, Bardsley M, Dixon J (2010) Trends in Emergency admissions in England 2004-2009. The Nuffield Trust, London. http://www.nuffieldtrust.org.uk/sites/files/nuffield/Trends_in_emergency_admissions_REPORT.pdf

Born P, Santerre R (2008) Unravelling the health insurance underwriting cycle. Journal of Insurance Regulation 26 (Spring): 65-84, see also additional material at http://www.business.uconn.edu/healthcare/files/working-papers/Unraveling%20the%20Health%20Insurance%20Underwriting%20Cycle.pdf

Burrows N, Hora I, Yanfeng L, Saaddine J (2011) Self-Reported Visual Impairment Among Persons with Diagnosed Diabetes — United States, 1997–2010. MMWR 60(45);1549-1553. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6045a2.htm?s_cid=mm6045a2_e&source=govdelivery

Casalino L (2011) GP Commissioning in the NHS in England: Ten suggestions from the United States. Nuffield Trust, London. http://www.nuffieldtrust.org.uk/members/download.aspx?f=/ecomm/files/GP_Commissioning_in_the_NHS_Ten_suggestions_from_US.pdf

Danet S, Richard F, Montaye M, Beauchant S, Lemaine B, Graux C, et al (1999) Unhealthy effects of atmospheric temperature and pressure on the occurrence of myocardial infarction and coronary deaths. Circulation 100: e1-e7

Dawson J, Weir C, Wright F, Bryden C, Aslanyan S, Lees K, et al (2007) Associations between metrological variables and acute stroke hospital admissions in the west of Scotland. Acta Neurologica Scand 117(2): 85-89

Delamothe T, Godlee F (2011) Dr Lanslee's monster. Brit Med Jnl 342:d408 http://www.bmj.com/content/342/bmj.d408.full

Department of Health (2011). Resource allocation papers. http://www.dh.gov.uk/en/Managingyourorganisation/Financeandplanning/Allocations/DH_4108515 [Accessed 28/9/2011].

Diaz J, Alberdi J, Pajares M, Lopez C, Lopez R, Lage M, Otero A (2001) A model forecasting emergency hospital admissions: Effect of environmental variables. Journal of Environmental Health, 64: 9-15.

Dixon J, Smith P, Gravelle H, Martin S, Bardsley M, et al (2011) A person based formula for allocating commissioning funds to general practices in England: development of a statistical model. Brit Med Jnl 343; doi: 10.1136/bmj.d6608 http://www.bmj.com/content/343/bmj.d6608?etoc= [Accessed 25/11/2011]

Fleming D, Norbury C, Crombie D (1991) Annual and seasonal variation in the incidence of common diseases. Occasional Paper 53, October 1991,The Royal College of General Practitioners, London.

Fleming D, Sunderland R, Cross K, Ross A (2000) Declining incidence of episodes of asthma: a study of trends in new episodes presenting to general practitioners in the period 1989-98. Thorax 55: 637-661.
Fullerton K, Crawford V (1999) The winter bed crisis – quantifying seasonal effects on hospital bed usage. Q J Med 92: 199-206.
Galan I, Tobias A, Banegas J, Aranguez E (2003) Short-term effects of air pollution on daily asthma emergency room admissions. Eur Respir J, 2003, 22, 802-808.
Gerada C (2011) Letter to Mr Cameron, 6 May 2011. www.rcgp.org.uk/pdf/Mr%20David%20Cameron,%20HSCBill%20060511.pdf [Accessed 1/10/2011]
Gonzalez E, Johansson S, Wallander M A, Rodreguez L.(2009) Trends in the prevalence and incidence of diabetes in the UK:1996-2005. J Epidemol Community Health 63:332-336.
Grenfell B, Bjornstad O, Kappey J (2001) Travelling waves and spatial hierarchies in measles epidemics. Nature 414: 716-723.
Galan I, Tobias A, Banegas J, Aranguez E (2003) Short-term effects of air pollution on daily asthma emergency room admissions. Eur Respir J, 22, 802-808.
Ham C, Imison C, Goodwin N, Dixon A, South P (2011) Where next for the NHS reforms? The case for integrated care. The Kings Fund, London.
Howe E (2011). Letter to the House of Lords, 20th October 2011 http://www.nhsmanagers.net/sitebuildercontent/sitebuilderfiles/Lettertothelords.pdf
Hughes S, Bellis M, Bird W, Ashton J (2004) Weather forecasting as a public health tool. Centre for Public Health, Liverpool John Moores Universtity. http://www.cph.org.uk/showPublication.aspx?pubid=151 [Accessed 12/11/2011]
Jones N, Hardes G, Ryan S, Sheehan J, Cox C, Meleady K, Jayasinha H (2008) Projected acute inpatient activity in New South Wales - aIM2005. Australian Health Review 32(3): 528-536
Jones R (2004) Financial risk in healthcare provision and contracts. Proceedings of the 2004 Crystal Ball User Conference, June 16-18th. Denver, Colorado. http://www.hcaf.biz/Financial%20Risk/Microsoft%20Word%20-%20CBUC%20Paper.pdf
Jones R (2006a) Financial and operational risk in healthcare provision and commissioning. Healthcare Analysis and Forecasting, Camberley. http://www.hcaf.biz/Capacity%20Management/Microsoft%20Word%20-%20Variation%20in%20healthcare.pdf
Jones R (2006b) Zero Day Stay 'Emergency' Admissions in Thames Valley: Higher volumes at particular acute sites after adjusting for population characteristics. Healthcare Analysis & Forecasting, Camberley, Surrey. http://www.hcaf.biz/Forecasting%20Demand/benchmark_zerodaystay_emergency_admissions.pdf
Jones R (2007) Equilibrium: a report on the balance between commissioners and providers over the use of NHS Data Standards in admitted patient care. Healthcare Analysis & Forecasting, Camberley. http://www.hcaf.biz/Recent/Microsoft%20Word%20-%20Counting_and_coding.pdf
Jones R (2008a) Financial risk in practice based commissioning. British Journal of Healthcare Management 14(5): 199-204.
Jones R (2008b) Financial risk in health purchasing Risk pools. British Journal of Healthcare Management 14(6): 240-245.
Jones R (2008c) Financial risk at the PCT/PBC Interface. British Journal of Healthcare Management 14(7): 288-293.
Jones R (2008d) Limitations of the HRG tariff excess bed days. British Journal of Healthcare Management 14(8), 354-355.
Jones R (2009a) Trends in emergency admissions. British Journal of Healthcare Management 15(4), 188-196.
Jones R (2009b) Cycles in emergency admissions. British Journal of Healthcare Management 15(5), 239-246.
Jones R (2009c) Cycles in emergency admissions – supplement. Healthcare Analysis & Forecasting, Camberley, UK. http://www.docstoc.com/docs/5705782/Cycles-in-emergency-admissions-Supplement
Jones R (2009d) Emergency admissions and hospital beds. British Journal of Healthcare Management 15(6), 289-296.

Jones R (2009e) Emergency admissions and financial risk. British Journal of Healthcare Management 15(7), 344-350.
Jones R (2009f) Length of stay efficiency. British Journal of Healthcare Management 15(11), 563-564.
Jones R (2009g) The actuarial basis for financial risk in practice-based commissioning and implications to managing budgets. Primary Health Care Research & Development 10(3): 245-253.
Jones R (2010a) Cyclic factors behind NHS deficits and surpluses. British Journal of Healthcare Management 16(1), 48-49.
Jones R (2010b) Emergency preparedness. British Journal of Healthcare Management 16(2), 94-95.
Jones R (2010c) Do NHS cost pressures follow long-term patterns? British Journal of Healthcare Management 16(4), 192-194.
Jones R (2010d) Benchmarking length of stay. British Journal of Healthcare Management 16(5), 248-250.
Jones R (2010e) Forecasting demand. British Journal of Healthcare Management 16(8), 392-393.
Jones R (2010f) Nature of health care costs and financial risk in commissioning. British Journal of Healthcare Management 16(9), 424-430.
Jones R (2010g) Forecasting emergency department attendances. British Journal of Healthcare Management 16(10), 495-496.
Jones R (2010h) Trends in programme budget expenditure. British Journal of Healthcare Management 16(11), 518-526.
Jones R (2010i) Unexpected, periodic and permanent increase in medical inpatient care: man-made or new disease. Medical Hypotheses. 74(6):978-983.
Jones R (2010j) Can time-related patterns in diagnosis for hospital admission help identify common root causes for disease expression. Medical Hypotheses 75(2): 148-154.
Jones R (2010k) The case for recurring outbreaks of a new type of infectious disease across all parts of the United Kingdom. Medical Hypotheses 75(5): 452-457.
Jones R (2010l) Myths of ideal hospital size. Medical Journal of Australia 193(5): 298-300.
Jones R (2010m) Emergency assessment tariff: lessons learned. British Journal of Healthcare Management 16(12): 574-583.
Jones R (2011a) Is demand for beds about death or demography? British Journal of Healthcare Management 17(5): 190-197
Jones R (2011b) Hospital bed occupancy demystified. British Journal of Healthcare Management 17(6): 242-248.
Jones, R (2011c) Bed occupancy: the impact on hospital planning. British Journal of Healthcare Management 17 (7): 307-313.
Jones R (2011d) Demand for hospital beds in primary care organisations. British Journal of Healthcare Management 17(8): 360-367.
Jones, R. (2011e) Cycles in volatility of emergency bed occupancy. British Journal of Healthcare Management, 17(9): 424-430.
Jones R (2011f) A review of bed requirements at the Royal North Shore Hospital (Sydney, NSW). Healthcare Analysis & Forecasting, Camberley, Surrey.
Jones R (2011g) Limitations of the HRG tariff: the national average. British Journal of Healthcare Management, 17(11): 556-557.
Jones R (2013) Could cytomegalovirus be causing widespread outbreaks of chronic poor health? In ***Hypotheses in Clinical Medicine,*** pp 37-79, Eds M. Shoja, et al. New York: Nova Science Publishers Inc.
Available from: http://www.hcaf.biz/2013/CMV_Read.pdf
Jones S, Joy M, Pearson J (2002) Forecasting demand of emergency care. Health Care Management Science, 5(4), 297-305.
Kaplan G, Dixon E, Panaccione A, Fong L, Chen L, Szyszkowicz M, et al (2009) Effect of ambient air pollution on the incidence of appendicitis. Canadian Medical Association Journal 181(9): 591-597.
Kendrick S (1995) Emergency admissions: what is driving the increase? Health Serv Jnl 105(5451): 26-28.
Khot A, Burn R, EvansN, Lenny C, Lenny W (1984) Seasonal variation and time trends in childhood asthma in England and Wales 1975-81. Brit Med Jnl 289: 235-237

Koelle K, Pascual M (2004) Disentangling extrinsic from intrinsic factors in disease dynamics: A nonlinear time series approach with an application for cholera. Am Nat 163: 901-913.
Lieberman D, Lieberman D, Friger M (1999) Seasonal variation in hospital admission for community acquired pneumonia. Journal of Infection 39(2): 134-140.
Linn M, Sandifer R, Stein S (1985) Effects of unemployment on mental and physical health. Am J Public Health 75(5): 502–506.
Livingston E, Woodward W, Sarosi G, Haley R (2007) Disconnect between incidence of nonperforated and perforated appendicitis. Ann Surg 245(6): 886-892.
Makie T, Harada M, Kinikawa N, Toyoshiba H, Yamanaka T, Nakamura T, et al (2002) Association of metrological and day-of-the-week factors with emergency hospital admissions in Fukuoka, Japan. International Journal of Biometrology 46(1), 38-41.
Mangtani P, Hajat S, Kovats S, Wilkinson P, Armstrong B (2006) The association of respiratory syncytial virus infection and influenza with emergency admissions for respiratory disease in London: an analysis of routine surveillance data. Clinical Infectious Diseases 42: 640-646.
Marno P, Bryden C, Bird W, Watkin A (2006) How different measures of cold weather affect chronic obstructive disease (COPD) hospital admissions in London. European Respiratory Review 15: 185-186.
Mayhew L (2001) Japan's longevity revolution and the implications for health care finance and long-term care. The Pensions Institute, Cass Business School, City University, London. http://www.pensions-institute.org/workingpapers/wp0108.pdf
Moorman J, Rudd R, Johnson C, King M, et al (2007) National surveillance for asthma – United States, 1980-2004. MMWR 56(5508): 1-14; 18-54.
Nicholl J (2007) Case-mix adjustment in non-randomised observational evaluations: the constant risk fallacy. J Epidemiol Community Health 61: 1010-1013.
Parsons N, Odumenya M, Edwards A, Lecky F, Pattison G (2011) Modelling the effects of the weather on admissions to UK trauma units: A cross sectional study. Emergency Medicine Journal 28: 851-855.
Patz J, Campbell-Lendrum D, Holloway T, Fdey J (2005) Impact of regional climate change on human health. Nature 438: 310-317.
Rising W, O'Daniel J, Roberts C (2006) Correlating weather and trauma admissions at a level 1 trauma center. J Trauma-Injury Infection & Critical Care 60(5): 1006-1100.
Rodo X, Ballester J, Cayan D, Melish M, Nakamura Y, et al (2011) Association of Kawasaki disease with tropospheric wind patterns. Nature Scientific Reports 1, Article Number 152 doi: 10.1038/srep00152
Rusticucci M, Bettoli L, de los Angeles Harris M (2002) Association between weather conditions and the number of patients at the emergency room of an argentine hospital. International Journal of Biometrology, 46(1): 42-45.
Sauerzopf V, Jones A, Cross J (2009) Environmental factors and hospitilisation for chronic obstructive pulmonary disease in a rural county of England. J Epidemiol Community Health, 63: 324-328.
Stomp W, Fidler V, ten Duis H-J, Nijsten M (2009) Relation of the weather and lunar cycle with the incidence of trauma in the Groningen region. J Trauma 67(5): 1103-1108.
Sun Y, Heng B, Seow Y, Seow E (2009) Forecasting daily attendance at an emergency department to aid resource planning. BMC Emerg Med 9(1) www.biomedcentral.com/1471-227x/9/9
Wong C-M, Atkinson R, Anderson H, Hedley A, Ma S, Chau P, Lam T-H (2002) A tale of two cities: effects of air pollution on hospital admissions in Hong Kong and London compared. Environmental Health Perspectives, 110: 67-77.
Wood J, Ward C (2011) Clinical Commissioning Groups – Addressing outstanding size and configuration issues. Discussion document, work in progress. NHS Alliance/ NAPC Clinical Commissioning Coalition
http://library.constantcontact.com/download/get/file/1102665899193-760/CCGs_configuration_14_11_11_final2.pdf