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Information Asymmetry in Financial Forecasting within Healthcare and Simple Methods to Overcome this Deficiency

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Authors' contributions

This work was carried out in collaboration between both authors. Author NB designed the study. Author RPJ performed the analysis, managed the literature searches and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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Policy Article

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ABSTRACT

Aims: To explore the interplay between information asymmetry and financial forecasting in the context of the English National Health Service (NHS).
Study Design: Synthesis of the political context of the English NHS and how this impacts on the information flows to assist NHS accountants with financial forecasting.
Place and Duration of Study: Monthly hospital activity data across the whole of England between 2006/07 and 2016/17, and monthly deaths by place of residence within England between 2000 and 2016.
Methodology: Running 12-month totals. Cumulative activity within a financial year (April to March) adjusted for available working days per month, with examples calculated for the 2016/17 financial year.
Results: The NHS in England operates in a tightly constrained policy-directed manner, in which government health agencies may omit to communicate essential information that is contrary to

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current policy. Long-term trends show anomalous behavior which has been used to 'blame' the NHS for failure to constrain health care demand, and as the basis of the need for further 'corrective' policies. A running 12-month total is presented as a useful method to detect activity trends subject to non-standard behavior. The role of volatility associated with health care trends is emphasized. Volatility arises from Poisson-based variation due to size, and the effects of the environment on human health, i.e. changes in weather, air quality, noise levels, and outbreaks of infectious agents. Volatility is therefore location specific. After adjusting for the number of available work days per month, cumulative monthly activity data can also be used to calculate year-end outturn from any point in the financial year. Multiple years of historic data can be converted into the current financial year equivalent which enables both the median, minimum and maximum potential outturn to be estimated, i.e. with allowance for location-specific volatility. For example, activity totals for month six of the 2016/17 financial year for emergency admissions across England can be multiplied by anywhere between 2.001 to 2.046 to estimate year end, while costs related to end-of-life can be multiplied by 1.945 to 2.258 in West Berkshire or between 1.890 to 2.304 in Redditch (as examples of the effects of size and location).

Conclusion: Information asymmetry is not unique to the NHS in England. Running 12-month totals are a simple method which can be employed by finance departments to detect unusual long-term trends. The activity multiplier method, based on multiple years of historic data, is simple and can be used to estimate a likely year-end position, along with upper and lower limits.

Keywords: England; NHS; financial; forecasting; year-end; information asymmetry; policy-based evidence; end-of-life; costs.

1. INTRODUCTION

Financial forecasting is part of modern medicine, and can affect the allocation of resources to doctors. Hidden (and often erroneous) assumptions are the Achilles' heel of any modelling or forecasting process [1]. With a combined 50 years' experience in finance and planning within the English National Health Service (NHS) the authors are inclined to the opinion that much of financial forecasting is based on old wives' tales passed from one accountant to another; rather than on a system which addresses the real and often uncomfortable realities of activity-based costs.

This study will attempt to present a possible rationale for how this situation has arisen, and issues of information asymmetry in the context of government policy will be considered using the NHS in England as an example. Following that, analysis of longer-term activity trends will then set the scene for a method to forecast year-end from any point in the year.

2. DATE SOURCES AND METHODS

Monthly hospital admission data and annual bed occupancy for primary diagnoses as described by the International Classification of Diseases (ICD) version 10 (2006/07 to 2016/17), relating to the English National Health Service (NHS) was obtained from the Hospital Episode Statistics (HES) section within the NHS Digital website. Data relating to deaths by area of residence (2000 to 2016) was obtained from the Office for National Statistics. Data manipulation was performed using Microsoft Excel. Statistical measures are not directly calculated other than to present the median, minimum and maximum values associated with forecasts of year-end from a mid-year position.

3. RESULTS AND DISCUSSION

3.1 Information Asymmetry

Information asymmetry refers to a transaction or negotiation in which one party has access to the relevant facts while the other parties do not. The importance of information asymmetry in the financial markets and corporate governance field has been recognized for many years [2].

3.2 Context for the NHS in England

The UK NHS provides primary and secondary medical care to all citizens which is free of charge to the individual but funded via general taxation. The NHS is run in slightly different ways in the four countries of the union, which are free to implement their own specific policies. The NHS has very high levels of public support, and public opinion can be a deciding factor for governments to win or lose elections.

The introduction of the purchaser/provider split into the NHS in England in the early 1990's provided ample opportunity for information asymmetry to government agencies such as the Department of Health (now NHS England), which are tasked with implementing government policy and formulating the plans to achieve those policies. Given the political sensitivity of the NHS these departments will not in any circumstance criticize policy or point out flaws in implementation.

For example, 'choose and book', a scheme for booking outpatient attendances, was mathematically impossible to implement within the context of a guaranteed maximum waiting time due to the role of Poisson variation as a source of (high) volatility in the arrival of General Practitioner (GP) referrals [3,4], the highly seasonal nature of GP referral in most specialties, the seasonal nature of NHS staff availability [5], and unexplained trends in GP referral [6]. Much of this was available in the literature prior to the implementation of choose and book in 2005.

One of the authors of this paper has published over 200 papers and articles pointing out the huge flaws in policy areas such as the Health Resource Group (HRG) tariff (similar to the DRG tariff used to pay hospitals in the USA), financial risk in commissioning, hospital bed numbers and occupancy, and trends in admissions (see http://www.hcaf.biz/2010/Publications_Full.pdf). To our knowledge none of the issues raised in this extended series has ever been openly discussed with the NHS or the public. However, at the same time any evidence remotely supportive of policy and implementation has been regularly presented as the 'truth'. This is called policy-based evidence, as opposed to evidence-based policy [7].

For example, the so-called weekend effect on hospital mortality has been paraded by the current government (see https://www.gov.uk/government/publications/research-into-the-weekend-effect-on-hospital-mortality) as a need to move toward 7-day working. However, recent analysis suggests the weekend effect is simply an artefact of fewer but higher acuity admissions on the weekend [8]. Further analysis of the 'evidence' produced by NHS Digital on behalf of the government likewise shows that the weekend effect is very poorly correlated in the same hospitals from one year to the next (close to no correlation in most year on year comparisons) [9].

Information asymmetry and policy-based evidence are not an issue exclusive to the NHS in England, and a recent Australian study investigated the multiple practical and political impediments faced by policy makers in assimilating epidemiological evidence into policy [10].

How does this impact on the processes of financial forecasting? By omission, the NHS has never really been explicitly informed that a mix of chance- and environment-based volatility affects every activity and cost trend [11-15], or that emergency medical admissions and emergency department attendances are showing long-term trends including single year of age specificity and step-like increases in activity which defy all currently accepted mechanisms/explanations for growth [16].

In addition, by omission, the NHS has been largely left to believe that demographic-based forecasting is reliable, when in fact it is highly unreliable [17]. Demography leads to smooth trends in admission which rarely grow more than 1.5% per annum [18], with the NHS being blamed for incompetence or poor financial planning during the regular times when growth and costs are far higher. Most finance departments will have huge forecasting spreadsheets based largely on the demographic assumption or may even have purchased planning tools with demography embedded into the forecasts.

All of this was probably exacerbated by a seemingly endless series of highly disruptive health service 'reforms' and 'reorganizations', some small others larger, occurring at roughly yearly intervals, including the widely-criticized Lansley reforms [19,20]. In addition, the major reorganizations led to a hemorrhage of local knowledge and organizational memory which may well have led to activity trends going unnoticed.

Other countries will have their own specific examples of information asymmetry. Indeed, accountants cannot be expected to be aware of the implications of epidemiology upon health care trends, and would naturally expect expert support from appropriate government agencies. However, the aim of this study is to present simple methods for the analysis of trends which will work in the absence of 'perfect' knowledge of all the contingent factors. A brief analysis of activity trends will now be presented.

3.3 Activity Trends

One of the key principles in forecasting is, that if you cannot understand the past, you will certainly not be able to forecast the future. Fig. 1 therefore presents a running 12-month total of emergency and day case admissions in England, commencing at the 12-month total ending Mar-08. National data has been used to avoid the confusing jumble of service changes which can occur at local level. Demographic growth has been included for comparison [17,18]. From Fig. 1 it should be immediately obvious that demographic change is only making a small contribution to the observed growth and that other mechanisms dominate the trend.

A running 12-month total has been used for three reasons:

1. It removes any seasonal behaviour which may arise due to winter (mainly emergency admissions) or summer holidays (mainly elective activity).
2. It minimises the higher statistical scatter associated with monthly totals, and removes the need to adjust monthly data for work days or total days (see later).
3. A running total is a powerful method for detecting sudden step-like changes in activity.

While the first two points are relatively self-explanatory, the third point requires further elaboration. In a running 12-month total a sudden step-increase in activity leads to the generation of a ramp whose slope is equal to the magnitude of the step change, while the exact magnitude of the step-change is seen in the total 12 months

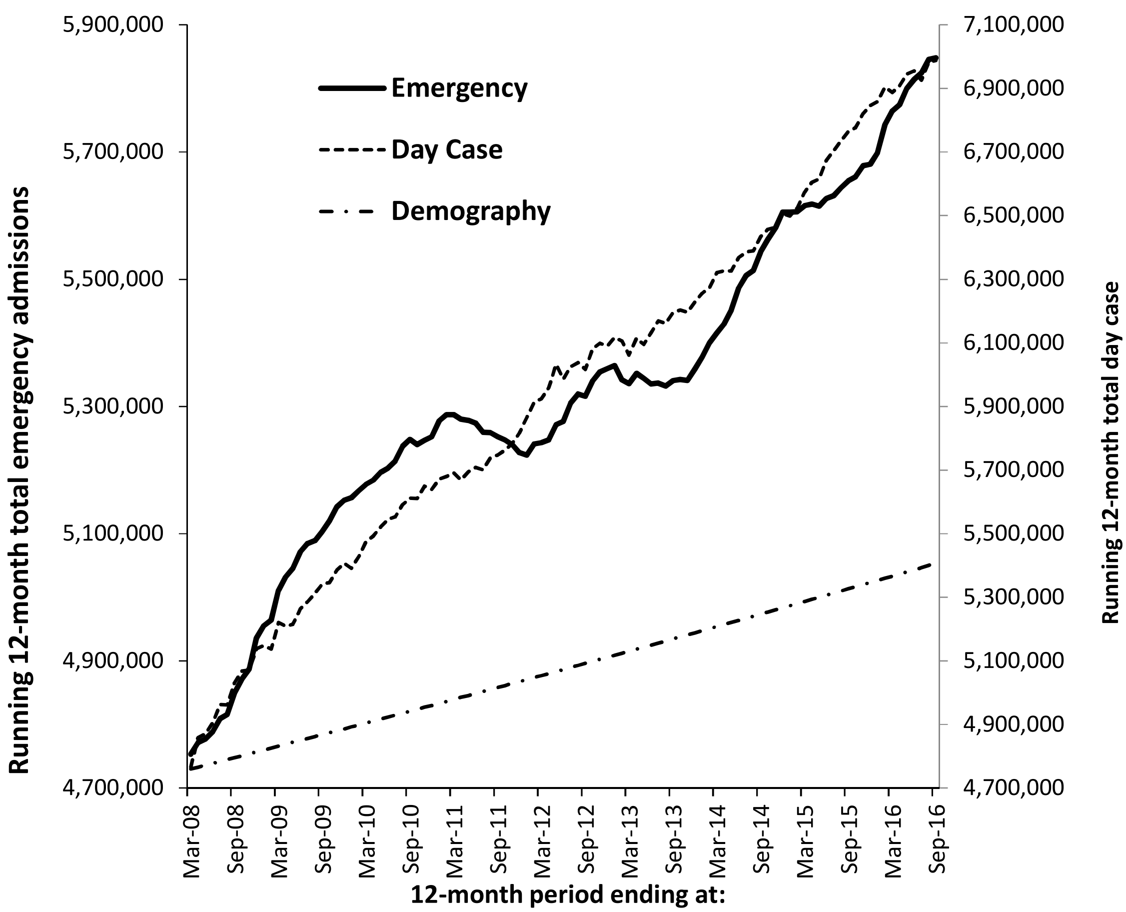

Fig. 1. Running 12-month total of day case and emergency admissions in England. Monthly data (April 2007 to September 2016) was obtained from NHS Digital

later [21]. For example, monthly activity jumps from 100 to 120 via a step-increase. Before the step-increase the annual total is 1,200. However, one month after the step-increase the running total is only 1,220 as there are now 11 month at the old average plus one month at the new. Twelve months later the ramp reaches an apex of 1,440. Step-down leads to a corresponding downward sloping ramp.

The trend line for emergency admissions is characterized by five large step-increases commencing early 2008, late 2009, late 2011, late 2013 and late 2015. Step-down behavior is also seen but it is usually overwhelmed by the start of the next step-up. Curiously, this step-up and step-down behavior appears to coincide with similar behavior in deaths (all-cause mortality) [16,17].

3.4 Trends in End-of-life Activity

In locations with a higher proportion of elderly people the activities associated with the end-of-life take greater prominence in health care activity [17]. Numerous studies have noted that hospital admission occurs most frequently in the last six months of life and markedly escalates in the last month [see references in 17]. A count of total deaths therefore becomes a good proxy for end-of-life related activity and costs.

In Fig. 1 a degree of saw-tooth behavior was noted for emergency admissions, and Fig. 2 illustrates how this behavior emanates out of the role of end-of-life. On this occasion data from West Berkshire in the south of England has been used as an example of a location with a higher than average number of elderly people [17]. The magnitude of the saw-tooth behavior is far *less* prominent in locations with a high proportion of younger people such as London or Birmingham [17]. Very small area spread of an infectious agent is highly implicated in this behavior [22].

Returning to the issue of information asymmetry, it is of interest to note that no UK government agency will acknowledge the existence of this saw-tooth behavior, or its impact on health care activity and costs [16,17]. This information is seemingly 'omitted' from official communication, presumably to blame the NHS for failure to contain rising demand, thereby absolving government policy.

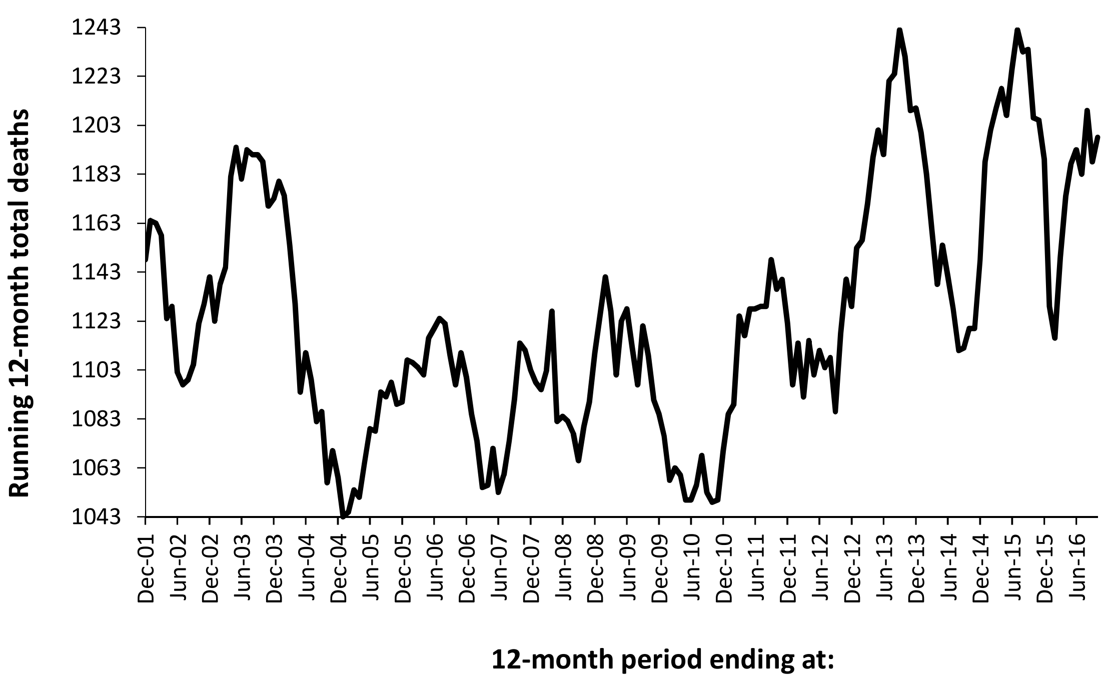

Fig. 2. Running 12-month total deaths in West Berkshire, England. Monthly data from the Office for National Statistics

Clearly both Figs. 1 and 2 show a degree of unexpected volatility. While most financial managers will understand the need to forecast, the requirement to understand the volatility associated with the trends is often overlooked.

3.5 Volatility in Health Care Activity

The volatility associated with health care trends arises from two sources [23]. The first is related to size and is largely described by Poisson statistics. Poisson variation applies to integer events, and by definition; the standard deviation associated with the average is equal to the square root of the average. Also by definition the two most common values are the average and the average minus one. At an average above 1,000 per unit of time the Poisson distribution can be approximated by a normal distribution, however, it becomes increasingly skewed as the average reduces.

The next major contributor to volatility is the role of the external environment in human health, hence, the weather, climate and metrological variables, pollution (air or noise), and outbreaks of infectious agents.

To illustrate the concept that forecasts are uncertain Fig. 3 has calculated the average year-to-year volatility in bed occupancy for ICD-10 primary diagnoses (3-digit) associated with inpatient admissions in England between 1998/99 and 2015/16. Occupied beds (as bed days divided by 365) has been chosen rather than admissions to avoid the distortion due to same day stay emergency admissions. As can be seen, the volatility associated with each diagnosis is very high, i.e. this year's position is a poor estimate of next years. Recall that this is the average of the volatility over a 15-year period, and hence the year-to-year actual can be much higher than the long-term average.

Diagnoses at the lower edge of the data are those which show very little environmental sensitivity, while those at the top edge show extreme environmental sensitivity. Top edge diagnoses also include those associated with intermittent infectious outbreaks such as influenza, and diagnoses associated with infectious outbreaks occurring with a degree of periodicity [24]. All infectious outbreaks eliciting an immune response have their own unique periodicity [25]. For example, the incidence of syphilis shows an approximate nine-year cycle while gonorrhea (which evades immune surveillance) has no cyclic behavior [26]. Any disease with greater than a one-year periodicity will therefore have high volatility. Since most infectious create inflammation, this inflammation (along with environmental sources of inflammation such as air pollution) has knock-on consequences for the rate of deterioration of seemingly unrelated conditions such as appendicitis [25,26]. While this is only a summary of a vastly complex area it should be sufficient to indicate that most of the trends may behave in unexpected ways, making forecasting somewhat difficult [27-29].

Once again organizations' such as the Department of Health have not made concerted efforts to communicate this reality to the finance community, and by default many are making highly simplistic assumptions about future financial trends.

3.6 Unit Costs are Uncertain

In England, hospitals are paid for their activity using a fee-for-service tariff called the Healthcare Resource Group (HRG) tariff. Costs for each HRG are collected on an annual basis (called reference costs) from each hospital and are then averaged to give the ultimate HRG tariff. The HRG tariff assumes that there is no economy of scale in costs. Activity occurring within each HRG is (in theory) supposed to cost roughly the same. While the HRG tariff for the current financial year is known, it is perhaps not widely appreciated that the Tariff (national average price) for the same HRG varies wildly from year to year [30-32]. This is due to several factors, namely:

1. NHS costing systems are rather poor at apportioning costs to the large number of HRGs.
2. At local level the number of admissions per HRG is low, and hence the average cost per HRG for each organisation suffers from a high degree of sampling error.
3. For both medical and surgical HRG both diagnosis and procedure are poor at predicting acuity, and hence length of stay and total cost per patient.
4. The cost of the same HRG varies widely per the specialty in which the HRG occurs.
5. The distribution of length of stay (as a proxy for variable costs) is highly skewed with a long tail, which impacts on sampling error (#2 above).

6. The volume and acuity of the case mix attending hospitals can vary significantly from one year to the next [16], leading to variable apportionment of fixed and variable costs over time.

In England, there is a three-year gap between the collection of reference costs at hospital level and calculated HRG tariff prices used to run the NHS. Indeed, it is highly likely that the high year-to-year variation in certain diagnoses seen in Fig. 3 arises from the behavior illustrated in Fig. 1 and Fig. 2.

Hence when seeking to forecast future income managers should always run scenarios based on multiple years of HRG prices (or whatever costing methods are employed in each country), and even using previous versions of the HRG, i.e. costs for each activity derived over past years. This situation combined with exceedingly high forecasting uncertainty at HRG level, leads to highly uncertain future forecasts of income for providers and costs for purchasers.

3.7 Forecasting Out-turn from Mid-year

Having sought to outline why forecast activity for this year's out-turn may be somewhat uncertain it is useful to determine how a forecast of year-end can be derived from points within the year. A method based on work days per month has been shown to be of use [33]. In the NHS, most elective and outpatient activity occurs on working days. It is perhaps less clear as to why emergency activity may follow the same pattern. In the UK, the cost of an admission is counted on the discharge date and not on the date of admission. Hence, we are dealing with discharges, and these mostly occur on week days. While this is an approximation, it is one which is sufficient for the purpose, however, depending on hospital organization this can be modified to use total days or an activity-weighted mix of work days, plus weekends, plus public holidays. An example for available work days in England is given in Table 1. Public holidays in the different countries in the UK may fall on different days/months, as will be the case around the world.

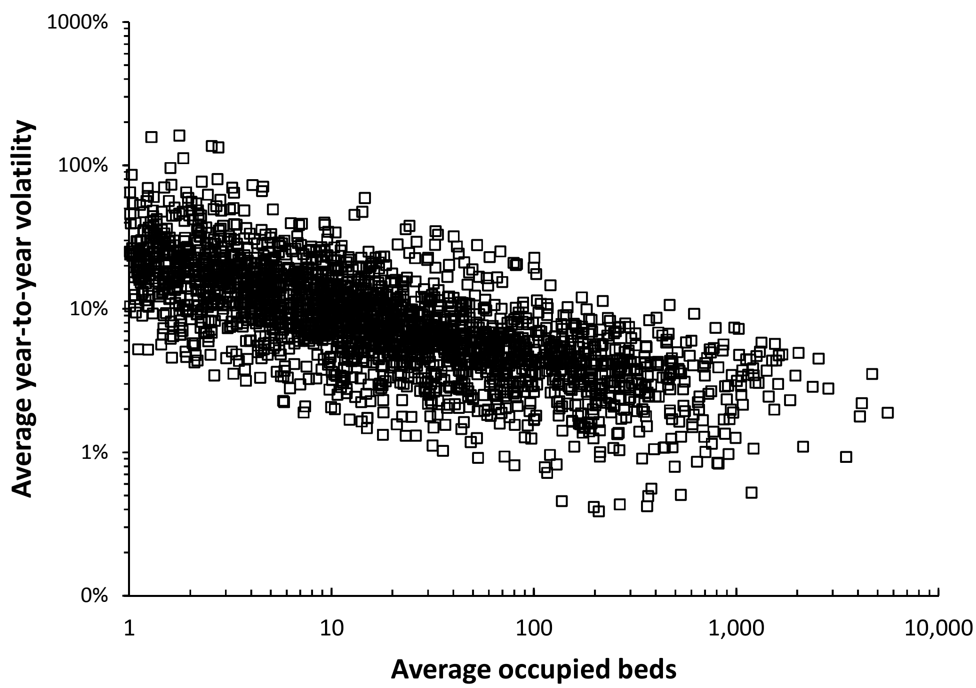

Fig. 3. Average year-to-year volatility in occupied beds for over 1,200 primary diagnoses describing admissions into English hospitals

Hospital Episode Statistics (HES) data was downloaded from NHS Digital. Volatility was calculated as the difference between two successive years divided by the value in the first year. A major revision of ICD-10 was implemented at the start of 2012/13 in England. Data was analyzed in two halves as 1998/99 to 2011/12 and 2012/13 to 2015/16. The average volatility and the average occupied bed days was calculated for each diagnosis in each of the two periods. Occupied beds are simply bed days divided by 365 (days per year)

Table 1. Example of available work days with English public holidays

Month-Year	Total days	Work days	Public holidays	Available work days
Apr-15	30	22	2	20
May-15	31	21	2	19
Jun-15	30	22		22
Jul-15	31	23		23
Aug-15	31	21	1	20
Sep-15	30	22		22
Oct-15	31	22		22
Nov-15	30	21		21
Dec-15	31	23	2	21
Jan-16	31	21	1	20
Feb-16	29	21		21
Mar-16	31	23	2	21
Apr-16	30	21		21
May-16	31	22	2	20
Jun-16	30	22		22
Jul-16	31	21		21
Aug-16	31	23	1	22
Sep-16	30	22		22
Oct-16	31	21		21
Nov-16	30	22		22
Dec-16	31	22	2	20
Jan-17	31	22	1	21
Feb-17	28	20		20
Mar-17	31	23		23

Hence take a series of monthly emergency discharges (or other activity) from previous years and divide each month by the number of available work days in that month, and then multiply by the number of available work days in the financial year of interest. Next construct a cumulative sum of this adjusted activity for each year and calculate the activity multiplier throughout the year. For example, activity after two months into the financial year will need to be multiplied by something roughly around 6-times to get year-end, after six months roughly by 2-times, etc. An example is presented in Table 2 using the data for emergency admissions used to construct Fig. 1.

Table 2 has encapsulated nine years of uncertain activity into a forecast for 2016/17, along with the potential uncertainty for that year. The data in this table is for the whole of England and therefore avoids the additional issue of small number Poisson uncertainty. However, the point is that a forecast for year-end, along with uncertainty, can be derived from past year's data. This forecast will include whatever underlying growth, cyclic or step-change phenomena lie buried in the overall trend.

Finally, Table 3 illustrates the impact of local environmental conditions and Poisson variation on an activity profile for deaths (end-of-life activity and costs) in the West Berkshire Local Authority in the south of England and the Redditch Local Authority located in the West Midlands, which has around 40% fewer deaths per annum than West Berkshire. Data source is the same as in Fig. 2. Compared to Table 2 (whole of England) the variation around the median is far greater, and there is still reasonably high uncertainty in the financial year-end total even at the end of February due to the impact of winter. Also note the variation between West Berkshire and Redditch which illustrates the location-specific nature of volatility and forecasting uncertainty. As above, work days have been used to adjust monthly totals to the 2016/17 equivalent since in England deaths are only reported on work days, and counts of monthly deaths are based on deaths reported in the month. Countries based in the southern hemisphere can expect a different profile due to winter falling in the middle of the year, while different financial year start/end will also affect the profile. For example, October/September for federal expenditure in the USA.

3.8 Costs Associated with these Events

Having demonstrated that health care trends are subject to a regular series of step-like changes it is apposite to consider their potential impact upon costs and cost pressures. These step-like changes seen in the UK are also seen in the USA, and lead to an event known as the health insurance underwriting cycle [see references in 34-37]. In the underwriting cycle health insurers in the US all simultaneously go into deficit due to a step-like increase in the volume and acuity of health-related claims [34-37]. A detailed analysis of costs incurred during the 2002 and 2007 events in the English NHS concluded that around £750 to £1,000 million of additional costs (in today's prices) were involved with each event [36], and that groups of conditions were affected worse than others [35].

Hence as discussed above, the rise and fall in admissions, deaths and case-mix associated with these events generates additional financial volatility around the long-term trends. Once again, none of this has been discussed with the NHS, other than to accuse the NHS of inefficiency.

Table 2. Example of calculated activity multiplier for 2016/17 emergency activity based on adjusted past year's activity

Month	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Median	Maximum	Minimum
Apr	11.306	12.935	11.632	11.699	11.209	11.381	12.150	11.680	11.976	11.680	12.935	11.209
May	5.931	6.264	5.815	5.809	5.817	5.930	6.187	5.898	5.934	5.930	6.264	5.809
Jun	3.953	4.105	3.938	3.942	3.947	3.958	4.034	3.924	4.008	3.953	4.105	3.924
Jul	3.018	3.127	3.037	3.004	2.991	3.003	3.079	3.013	3.078	3.018	3.127	2.991
Aug	2.427	2.457	2.415	2.401	2.411	2.417	2.448	2.394	2.436	2.417	2.457	2.394
Sep	2.010	2.046	2.019	2.008	2.017	2.001	2.033	2.003	2.035	2.017	2.046	2.001
Oct	1.739	1.762	1.731	1.721	1.729	1.732	1.756	1.732	1.750	1.732	1.762	1.721
Nov	1.522	1.519	1.504	1.506	1.514	1.515	1.525	1.498	1.520	1.515	1.525	1.498
Dec	1.345	1.346	1.336	1.339	1.341	1.336	1.346	1.331	1.352	1.341	1.352	1.331
Jan	1.215	1.208	1.199	1.197	1.204	1.208	1.211	1.198	1.208	1.208	1.215	1.197
Feb	1.113	1.104	1.097	1.095	1.101	1.107	1.105	1.098	1.105	1.104	1.113	1.095
Mar	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Table 3. Activity multiplier for 2016/17 deaths in West Berkshire and Redditch

Month	West Berkshire			Redditch		
	Median	Maximum	Minimum	Median	Maximum	Minimum
Apr	11.872	15.852	9.994	11.227	15.802	9.251
May	6.222	7.388	5.286	5.944	7.379	4.975
Jun	4.150	4.463	3.674	3.985	4.836	3.460
Jul	3.182	3.472	0.089	3.051	3.338	2.730
Aug	2.557	2.740	2.344	2.470	2.744	2.241
Sep	2.087	2.258	1.945	2.061	2.304	1.890
Oct	1.808	1.918	1.688	1.794	1.904	1.657
Nov	1.567	1.644	0.148	1.570	1.672	1.493
Dec	1.383	1.429	1.334	1.365	1.433	1.308
Jan	1.221	1.25	1.183	1.211	1.246	1.172
Feb	1.100	1.137	1.075	1.104	1.149	1.088
Mar	1	1	1	1	1	1

(15 years of monthly deaths from 2001/02 to 2015/16 were aggregated into financial years, and form the base data)

4. CONCLUSION

The role of information asymmetry arising from policy-based evidence has been illustrated using the English NHS as an example, where key information essential to financial planning has been omitted to be highlighted by government agencies. The behavior of emergency admissions and admissions related to end-of-life are behaving in a way that defies the assumptions within current health care policy. The use of a running 12-month total is recommended as a tool to identify long-term trends which may contain hidden cyclic events. Volatility in both activity and costs was highlighted as an important part of financial forecasts, and demands the need for upper and lower limits in the forecasts. Very large peaks in total costs have been observed to occur in particular years, and high uncertainty is implied in all future forecasts. Death (end-of-life) was identified as a contributor to activity trends and month-to-month volatility. A system of activity multipliers has been employed to estimate year-end outturn based on mid-year activity, and the role of volatility in such projections has been highlighted.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

DISCLAIMER

The opinions expressed in this article are those of the authors and may not be shared by the Kings College NHS Foundation Trust or other NHS organizations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ley E, Steel M. On the effect of prior assumptions in Bayesian Model Averaging with applications to growth regression (May 13, 2007). SSRN
   Available:http://dx.doi.org/10.2139/ssrn.986224
2. Stigler G. The economics of information. Journal of Political Economy. 1961;69(3): 213–25.
3. Jones R. Outpatient appointments: A pretty little sum. Health Service Journal. 2001; 111(5740):28-31.
4. Jones R. Outpatient waiting times: Quick, quick, slow. Health Service Journal. 2001; 111(5778):20-3.
5. Jones R. Outpatient appointments: Feeling a bit peaky. Health Service Journal. 2000; 110(5732): 28-31.
6. Jones R. Increasing GP referrals: collective jump or infectious push? British Journal Healthcare Management. 2012; 18(9):487-495.
7. Marmot M. Evidence based policy or policy based evidence? British Medical Journal 2004;328:906.
   DOI:http://dx.doi.org/10.1136/bmj.328.7445.906

8. Raspin C, Bassi S. Weekend mortality in the NHS – Debunking the myths. CHKS; 2016. Available:http://www.chks.co.uk/userfiles/files/Weekend%20Mortality%20in%20the%20NHS%20%E2%80%93%20Debunking%20the%20Myths.pdf
9. Jones R. Is the 'weekend' mortality effect real? British Journal Healthcare Management. 2017;23(1):39-41.
10. Jenkins L, Kelly P, Cherbuin N, Anstey k. Evaluating and using observational evidence: The contrasting views of policy makers and epidemiologists. Frontiers Public Health. 2016;4:267. DOI: 10.3389/fpubh.2016.00267
11. Jones R. Why is the 'real world' financial risk in commissioning so high? British Journal Healthcare Management. 2012; 18(4): 216-217.
12. Jones R. Volatile inpatient costs and implications to CCG financial stability. British Journal Healthcare Management. 2012;18(5):251-8.
13. Jones R. Cancer care and volatility in commissioning. British Journal Healthcare Management. 2012;18(6):315-24.
14. Jones R. Gender and financial risk in commissioning. British Journal Healthcare Management. 2012;18(6):336-7.
15. Jones R. End of life care and volatility in costs. British Journal Healthcare Management. 2012;18(7): 374-81.
16. Jones R. Recurring outbreaks of an infection apparently targeting immune function, and consequent unprecedented growth in medical admission and costs in the United Kingdom: A Review. British Journal of Medicine and Medical Research 2015;6(8):735-70.
17. Beeknoo N, Jones R. The demography myth - how demographic forecasting vastly underestimates hospital admissions, and creates the illusion that fewer hospital beds or community-based bed equivalents will be required in the future. British Journal of Medicine and Medical Research. 2017; 19(2):1-27.
18. NHS England. NHS Five year forward view. Recap briefing for the Health Select Committee on technical modelling and scenarios. Available:England.nhs.uk/up-content/uploads/2016/05/fyfv-tech-note-090516.pdf
19. Socialist Health Association. Reform of the National Health Service Chronology; 2016. Available:http://www.sochealth.co.uk/national-health-service/reform-of-the-national-health-service/
20. Johnston I. Government's reorganisation of the NHS was its biggest 'mistake', say senior Tories. The Independent, 12th October; 2014. Available:http://www.independent.co.uk/news/uk/politics/government-s-reorganisation-of-the-nhs-was-its-biggest-mistake-say-senior-tories-9790247.html
21. Jones R. Simulated rectangular wave infectious-like events replicate the diversity of time-profiles observed in real-world running 12 month totals of admissions or deaths. FGNAMB. 2015;1(3):78-9. DOI: 10.15761/FGNAMB.1000114
22. Jones R. A regular series of unexpected and large increases in total deaths (all-cause mortality) for male and female residents of mid super output areas (MSOA) in England and Wales: How high level analysis can miss the contribution from complex small-area spatial spread of a presumed infectious agent. Fractal Geometry and Nonlinear Analysis in Medicine and Biology. 2016;2(2):1-13.
23. Jones R. Financial risk in healthcare provision and contracts. Proceedings of the 2004 Crystal Ball User Conference, June 16-18th, 2004. Denver, Colorado, USA. Available:http://www.hcaf.biz/Financial%20Risk/CBUC_FR.pdf
24. Fleming D, Norbury C, Crombie D. Annual and seasonal variation in the incidence of common diseases. The Royal College of General Practitioners: London, Occasional Paper 53; 1991.
25. Grassly NC, Fraser C, Garnett GP. Host immunity and synchronized epidemics of syphilis across the United States. Nature. 2005;433(7024):417-21.
26. Jones R. Roles for cytomegalovirus in infection, inflammation and autoimmunity. In Infection and Autoimmunity, 2nd Edition, Eds: N Rose, et al. Elsevier: Amsterdam. 2015;Chapter 18:319-57. DOI:10.1016/B978-0-444-63269-2.00068-4
27. Jones R. An unexpected increase in adult appendicitis in England (2000/01 to 2012/13): Could cytomegalovirus (CMV) be a risk factor? British Journal of Medicine and Medical Research. 2015; 5(5):579-603. DOI: 10.9734/BJMMR/2015/13302

28. Jones R. Trends in emergency admissions. British Journal Healthcare Management. 2009;15(4):188-96.
29. Jones R. Cycles in emergency admissions. British Journal Healthcare Management. 2009;15(5):239-46.
30. Jones R. Limitations of the HRG tariff: The national average. British Journal Healthcare Management. 2011;17(11): 556-7.
31. Jones R. Limitations of the HRG tariff: gross errors. British Journal Healthcare Management. 2011;17(12):608-9.
32. Jones R. Is the Health Resource Group (HRG) tariff fit for purpose? British Journal Healthcare Management. 2012;18(1):52-3.
33. Jones R. Estimation of annual activity and the use of activity multipliers. Health Informatics. 1996;2:71-7.
34. Jones R. Nature of health care costs and financial risk in commissioning. British Journal Healthcare Management. 2010; 16(9): 424-430.
35. Jones R. Trends in programme budget expenditure. British Journal Healthcare Management. 2010;16(11):518-526.
36. Jones R. Time to re-evaluate financial risk in GP commissioning. British Journal Healthcare Management. 2012;18(1):39-48.
37. Jones R. A previously uncharacterized infectious-like event leading to spatial spread of deaths across England and Wales: Characteristics of the most recent event and a time series for past events. British Journal of Medicine and Medical Research 2015;5(11):1361-1380. DOI: 10.9734/BJMMR/2015/14285

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