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Is an unidentified infectious disease behind the increase in medical emergency admissions in the United Kingdom?

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Please note additional papers have been submitted to Medical Hypotheses investigating additional aspects of this new type of infectious disease. Refer to the 'Emergency Admissions' folder on www.hcaf.biz for details of additional publications.

Author Biography

Rod Jones has a BSc (Hon) in Microbiology, a PhD in Chemical Engineering and is a Chartered Management Accountant. He provides forecasting and statistical consultancy to healthcare organisations in the United Kingdom. He is a member of the Editorial Board of the British Journal of Healthcare Management, is an invited conference speaker and has published around 40 journal articles covering aspects of biotechnology, healthcare forecasting and associated financial risk.

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Introduction

A cyclic outbreak in infectious diseases, where there is an element of acquired immunity, is a well recognised phenomena and the cycle period is a characteristic of the particular disease (*1-4*). It is recognised that an outbreak of an infectious disease can also lead to an associated increase in emergency hospital admission during the period of the outbreak and that after the outbreak it would normally be expected that the level of emergency admissions would revert back to that seen prior to the outbreak (*5*). In this study evidence is presented for a unique cyclic 'outbreak' which results in a permanent increase in both the number of emergency admissions and associated bed occupancy.

The Study

A re-analysis of the trends in emergency admission in England since the 1980's has led to the conclusion that the growth in emergency medical admissions occurs during concentrated bursts at roughly six year intervals (6-*8*). These bursts of growth typically increase the overall number of emergency admissions by around 10%, however, contrary to expectation the new and higher level of admissions continues until the next 'outbreak'. The most recent outbreak of this phenomenon occurred in the summer of 2007. In England emergency admissions to general and elderly medicine account for around 30% of emergency admissions and 42% of total occupied beds (both emergency and elective) and hence a 10% increase in this admission stream represents a significant change in the demand for hospital inpatient treatment, and by extrapolation to roughly a 3% to 4% increase in inpatient bed-day related costs.

The author was first alerted to this step-like behaviour in the number of medical emergency admissions during an outbreak which occurred in 1993. At the time he extensively analysed data collected at the Royal Berkshire Hospital in Reading and compared this to various national studies which were also conducted in an attempt to explain the unexpected, rapid and permanent rise in such admissions. This analysis was drafted into a manuscript but was never submitted for publication given the unusual and controversial nature of the authors' conclusions. The original draft manuscript relating to the 1993 outbreak is now available for wider scrutiny (*9*). An analysis was also made on the effect of this 'outbreak' on the number of occupied medical beds and a similar step-like increase was observed (*10*).

In late 2008 the author was contacted by several hospitals that required assistance in determining the nature of increased demand for medical beds which appeared to be the result of a similar 'outbreak'. This 'outbreak' had commenced toward the middle of 2007 and it was at this point that it was realised that the 1993 and 2007 events may be part of a wider pattern.

This led to a re-examination of the trends in emergency admissions from the early 1980's to the present and confirmed that such step-like increases had occurred in the 1983/84 and 1988/89 financial years and in the 1993, 1996, 2002 and 2007 calendar years, i.e. between three to seven years apart but most commonly around six years apart. The ambiguity in the

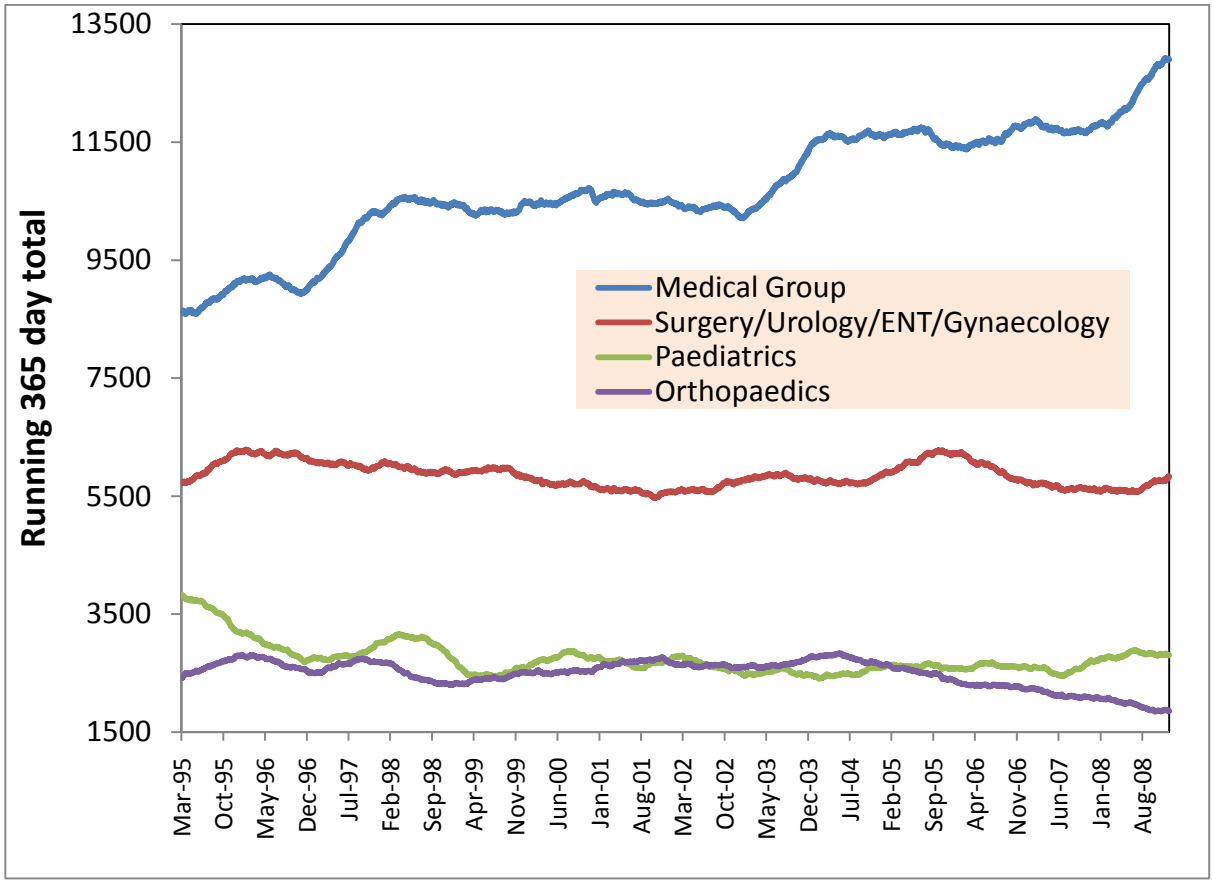
early two dates arises due to the fact that only non-computerised financial year data exists for this period (*7*).

Zero Day Stay

A central feature of the apparent high growth in emergency admissions in England has been the explosive growth in zero day stay 'admissions' (6). This has been especially evident since the introduction of the four hour Accident and Emergency target (6). In the USA, such 'admissions' would normally be considered part of emergency ambulatory care, i.e. emergency department assessment and observation; and are paid under a separate tariff from otherwise genuine inpatient admissions (*11*). It is for this reason that zero stay day admissions have been specifically excluded from the analysis of trends in 'genuine' emergency admissions.

The Trends

Figure 1: Trends in medical and non-medical acute emergency admissions at the Royal Berkshire Hospital.

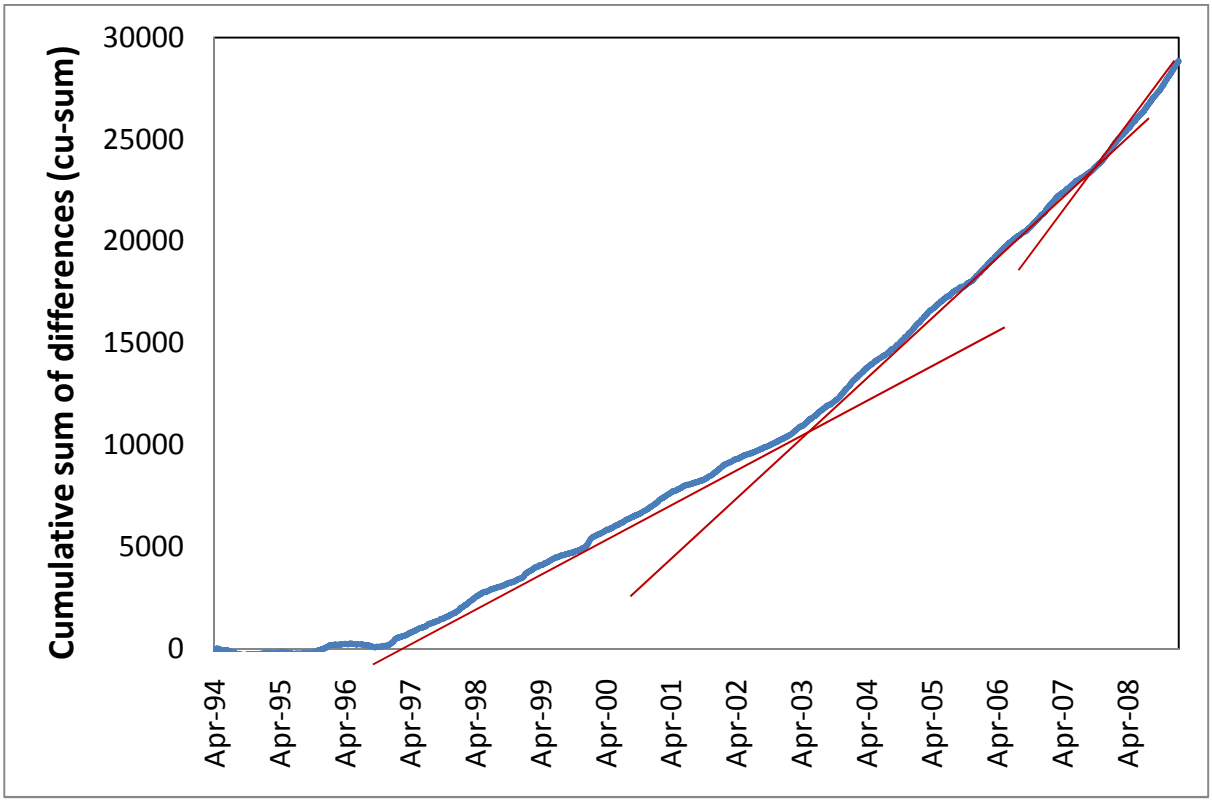


Footnote: Data kindly provided by the Royal Berkshire Hospital NHS Foundation Trust. To calculate a running 365 day total take a long time series of daily admission data, add up the first 365 days, move forward one day and total 365 days, etc. Note that a step change in admission rate will show up as a ramp-like feature in a running 365-day total chart.

The nature of this step like-behaviour is illustrated in Figure 1 using daily admission data over the period April 1994 to January 2009 at the Royal Berkshire Hospital. This behaviour is representative of other hospitals (6). Unfortunately this hospital no longer holds data prior to April 1994 and so the 1993 'outbreak' is not included in the time series (9). Emergency admission to the non-medical specialties (mainly surgical, orthopaedic and paediatric) are included to show that the cyclic step-like behaviour is a characteristic of medical admissions. In this figure the daily data has been converted into a 365 day running total. Such a running total smoothes out the annual summer/winter cycle in admissions and allows the onset of the step change to be clearly seen as well as the transition from a lower to a higher admission rate.

As discussed above, 'admissions' which are admitted and discharged on the same day (zero day stay admissions) have been excluded from the analysis since there is doubt over whether these are genuine emergency 'admissions' or more correctly come under the category of emergency department assessment and observation (*6*). The step-like increase cannot be explained by any form of demographic change and does not affect Paediatric, Orthopaedic or Surgical group emergency admissions.

Figure 2: Cu-sum plot of medical admission rates at the Royal Berkshire Hospital.



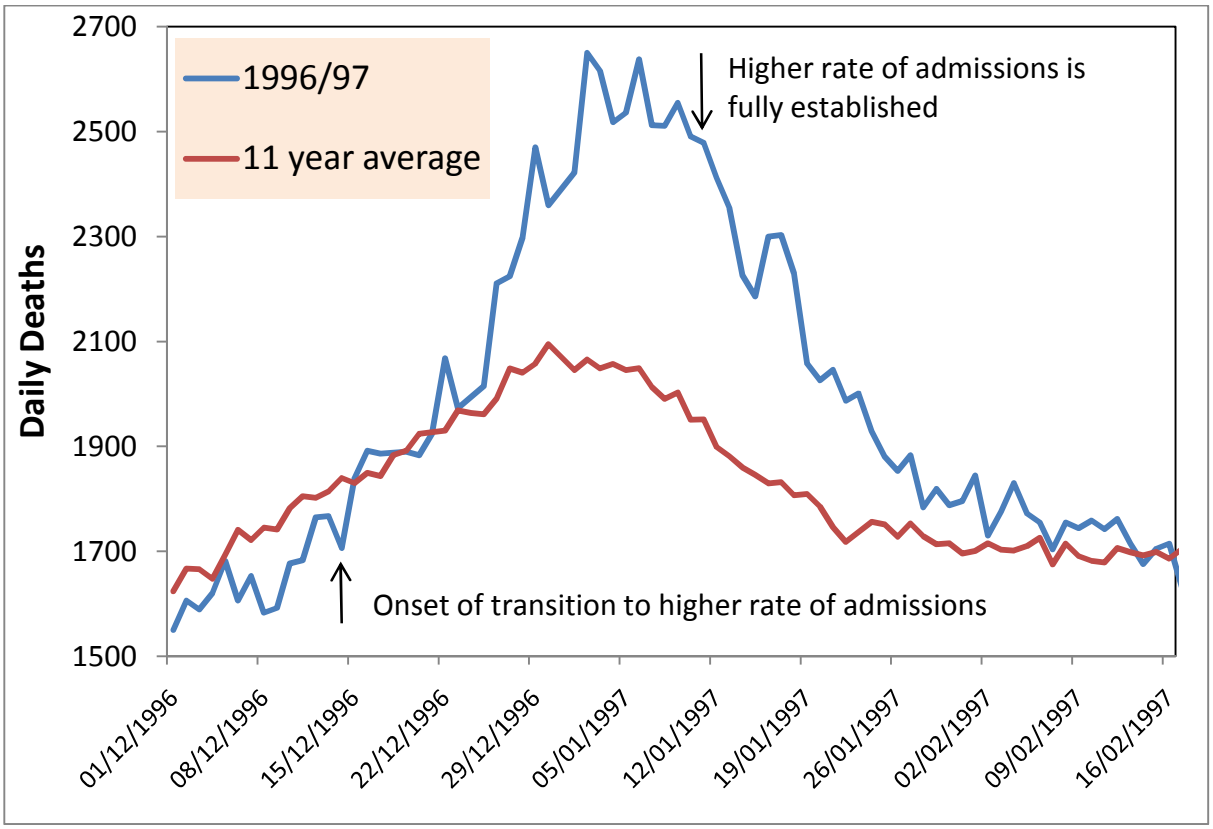
Footnote: The average daily admission rate of 24 per day seen during 1994 and 1995 was subtracted from daily admissions figures and a cumulative sum calculated. Each change in slope represents the point of transition to the new higher admission rate.

It is important to note that while a running 365 day total mimics the incremental financial effects of such a step change, it has the disadvantage of turning a step change into the appearance of a ramp-like change. Hence an immediate step change will lead to a ramp which

is 365 days long while an infectious outbreak (with a permanent effect) lasting, say, six weeks would lead to a ramp which is 394 days long, etc. The ramps in Fig. 1 are around 390 days in length.

To demonstrate a true step-change it is better to use a cumulative sum of differences (cusum) plot (*12*). This is illustrated in Fig. 2 where three step changes can be seen. Each straight line portion in the chart represents a period with a relatively constant admission rate, where a higher slope represents a new higher admission rate. The average rate in the four periods are 24.1, 28.5, 31.5 and 35.3 admissions per day respectively which represents step changes of 18%, 11% and 12% respectively. The slight fluctuations around the straight line portions are due to the summer/winter variation in admission rate around the new longer-term admission rate.

Figure Three: Excess daily deaths in England and Wales and the dates of the step change observed in Reading for the 1996 outbreak as shown in Figure 2.



Footnote: The baseline eleven year average for deaths covers the years 1989 to 1999. During this time annual total deaths in England & Wales remained relatively constant. Excess deaths occur above the 11 year average; hence, the 15th of December in 1996 has been compared to the average of eleven 15th of December's between 1989 to 1999, etc. Since this particular outbreak occurred in winter the effect of weather and other winter viruses will need to be separated out to reveal the portion of the excess deaths solely attributable to the proposed infectious agent, although this has been partly achieved via comparison with the eleven year average.

The evidence that this could be the work of a previously unrecognised infectious agent is as follows:

1. The unique behaviour has been consistent over a very long time frame.
2. The 'outbreak' results in a step increase in admissions, i.e. within a very short space of time (six to eight weeks) the admission rate steps up to a new and higher rate as demonstrated in Figure 2 (*9*).
3. There is considerable regional variability in the timing and extent of the step increase (*8,9*).
4. The onset of the 'outbreak' appears to be characterised by a statistically significant increase in excess deaths which lasts for around six to eight weeks (*6*). This is illustrated in Figure Three using data for the 1996 outbreak.
5. The increase in emergency admissions is also accompanied by a permanent and parallel increase in occupied beds (*10,13*). Investigation of the 1993 outbreak revealed that the summer/winter peaks and troughs in medical bed occupancy were accentuated by this event (9).
6. The outbreak also appears to coincide with a non-specific increase in GP referral for a general outpatient appointment (*8*).
7. A range of vague and non-specific diagnoses appear to increase during the 'outbreak' (*7,9*)
8. The increase is specific to particular medical specialties as opposed to wider surgical, trauma or paediatric, i.e. it is not due to some generalised factor effecting all admissions (6,7).

The author has postulated that the infectious agent may be viral in nature. This is based on the observation that certain viruses maintain a state of permanent infection in the host and this could account for the step-like change in emergency admission rates which will arise from the wider pool of infected persons who could be experiencing some form of compromised or altered immunity – perhaps similar to that seen in alcoholics, diabetics, the elderly or in various allergies (6,8).

Wider Effects

A similar phenomenon may be occurring in the USA where the cost of care for insured individuals was known to follow a six year cycle over the 32 year period from 1960 onward, although after 1986 the cycle period appeared to become less regular (*14,15*). This cycle in costs led to a corresponding cycle in underwriting profit and loss, which once recognised led to a change in underwriting processes such that premiums were based on the here and now rather than the usual historical analysis which is inappropriate for a cyclic phenomenon (*16*). The existence of this cycle did not appear to be widely communicated outside the underwriting industry and hence did not attract the interest of epidemiologists and other researchers.

Alternative Explanations

Alternative explanations will be based on the hypothesis that the effect is due to some form of policy, organisational or admission threshold phenomena (*17*). It is difficult to establish a linkage to any common administrative or policy change within the NHS, and even if this were possible, policy is usually implemented in piecemeal fashion over an extended period of

time. Organisational change in healthcare likewise occurs after considerable planning and implementation effort (17). In this respect the 'outbreak' has repeated over a very long time frame and on each occasion appears to come unexpectedly to both provider and purchaser alike, i.e. it is totally unplanned. If we accept the hypothesis that it may be linked to the same pattern observed for 32 years (1960 to 1992) in the USA it becomes even more likely that no common administrative or policy linkage exists to explain the behaviour. Indeed it must be noted that the 1993 step change also occurred in New Zealand (6,8).

The long held view that the increase is largely a demand management problem, has led the NHS to invest considerable time and money into implementing solutions based on this premise (18), but which in practice have largely only achieved a modest impact. If the infectious disease hypothesis is correct, then efforts directed toward demand management may be treating symptoms and not root causes (6).

The increased incidence of vague diagnoses associated with this apparent infectious 'disease' is perhaps best understood in the context that according to wrongdiagnosis.com (wrongdiagnosis.com/sym/vague-symptoms.htm#intro) there are at least 61 medical conditions with vague symptoms and hence this possibility should not be disregarded without further research. The work regarding symptom-based conditions may shed some light regarding such diagnoses and their association with the outbreak (19).

Further Research

An initial study is required to analyse data from a wider range of hospitals and locations looking at shifts in age, sex and diagnosis for both admissions and bed occupancy. In particular changes in the length of stay distribution may reveal hospital sites whose process of acute medical diagnosis and discharge is better equipped to handle the step change in potential admissions (20). National data at postcode level will requires analysis to determine if the 'outbreak' has a geographical profile consistent with the spatial spread of an infection. The point of onset of each outbreak needs to be linked with measured levels of a wide variety of infections to establish if there is any link with any known agent or vector. The author has recently analysed bed occupancy data for the intensive care unit (ICU) at one outer London hospital and a similar step increase in ICU bed occupancy occurred around the middle of 2007. This is not proof in itself but merely suggests a wider scope for research is required.

Researchers need to be aware that the analysis of NHS data is fraught with many pitfalls. The process of counting and coding is exceedingly varied from one NHS site to another (21, 22). For example, a patient with the same condition can be admitted to the consultant administrative specialty General Medicine, Cardiology or Elderly Care, depending on the exact hospital site at which the admission occurs. The process of clinical coding (from a range of clinical records into codes) is likewise highly site specific and the use of the International Classification of Diseases (ICD) Chapter R (Signs and Symptoms) diagnostic codes shows great variation between sites. Chapter R codes are scattered across a wide range of Health Resource Groups (HRG) and it is for this reason that researchers are advised not to use HRG as the basis for analysis, but should use the base ICD codes. The use of hospital site codes can be very patchy within multi-site organisations, and the author has found that population data can only be understood when the data is aggregated into site catchment areas using minimum distance or travel time criteria (22). The division between emergency and

elective is less clear for medical admissions and also shows considerable variation between hospitals. Since we appear to be dealing with largely medical admissions the distinction between emergency and elective may best be ignored. It may even be possible that data is best derived directly from each acute Trust rather than indirectly via other sources and a discussion be had over the use of non-standard local codes which may lead to gaps in the national data.

Part of this research should include a re-evaluation of published time series for specific diseases. For example, one study involving admission for anaphylactic shock (an immune related condition) shows a distinct step change in the 93/94 financial year compared to the 92/93 financial year, i.e. at the point surrounding the March 1993 outbreak (23). The implications of research into non-biological causes of poor health such as the work on chaotic solar cycles will also need to be considered (24, 25).

Conclusions

The advance of science is via observation of a phenomena and the formulation of a plausible hypothesis. This phenomena requires further research to establish if an infectious agent is indeed implicated and hence if appropriate public health measures can be applied as the solution to the real root cause. Whatever the cause it is undisputedly 'highly infectious' in the sense that the medical admission rate moves rapidly from a lower to a permanently higher rate in a matter of weeks across a range of hospitals and will have enormous implications to the financial pressures faced by the health service (6).

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