Rarity of Respiratory Arrest in ED?

Richard D. Gill
Mathematical Institute
Leiden University
http://www.math.leidenuniv.nl/~gill

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Abstract
Statistical analysis of monthly rates of events in around 20 hospitals and over a period of about 10 years shows that respiratory arrest, though about five times less frequent than cardio-respiratory arrest, is a common occurrence in the Emergency Department of a typical smaller UK hospital.

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1 Summary

In the Ben Geen case, three experts (an anaesthetist, a charge nurse, and a head nurse at three different hospitals) have given their opinion that primary respiratory arrest in ED (Emergency Department) is rare. The defence, following the eminent statistician Prof. Jane Hutton, argue that these statements at best merely constitute anecdotal evidence and at worst can be strongly tainted by observer bias. F.O.I. requests have consequently been made to many hospitals similar to Horton General, resulting in a large data-base containing numbers of various events in ED as well as total numbers of patients admitted to ED per month, in more than 20 hospitals and covering up to 10 years. This report describes the main findings from statistical analysis of the data-base.

We find that respiratory arrests in ED are about five times less frequent than cardio-respiratory arrests, which are of course extremely frequent. Respiratory arrest is certainly less common than cardio-respiratory, but certainly not rare at all, by any reasonable understanding of the meaning of the word “rare”.

The relative size of the variation in small observed rates due purely to chance is much, much larger than the relative size of the variation in larger observed rates (The “law of small numbers” – Poisson variation). On top of purely random variation and strong seasonal variation, the numbers fluctuate quite wildly in time, exhibiting all kinds of trends, bumps, and gaps in different hospitals.

Altogether, one can only conclude that periods with “surprisingly high numbers” of respiratory arrests are by no means rare and hence not in themselves surprising at all. The quality of the data (which to put it kindly, is not high) moreover underlines that all kinds of classification and reporting issues could easily go some way to explain these fluctuations. How events are classified, and how patients are admitted, will vary in time as hospital policies change; moreover, random fluctuations in numbers of events can trigger changes in how events are classified (so called “publicity bias”).

To sum up: respiratory arrest in ED is not rare at all, and moreover its frequency is subject to large, and to a large extent unpredictable, variation of quite innocent nature.

The data-base analysed in this report is available at http://www.math.leidenuniv.nl/~gill/Data/Hdf.csv, and the statistical analysis scripts (written in the R language for statistical computing) can be inspected at http://rpubs.com/gill1109/DraftOpinion. A table with an overview of hospitals and trusts to which F.O.I. requests were submitted is reproduced in the appendix.

2 Preparation of the data

This report focusses on a subset of 16 hospitals (or hospital trusts).

Originally, F.O.I. requests were sent to around 30 different hospitals and/or hospital trusts, supposed to be similar to Horton (though a few are teaching hospitals about five times larger). A few hospitals did not respond or turned out no longer to exist. The
hospitals and trusts which did submit any data used a multitude of different formats including pdf files which though in one sense digital, are actually totally unsuited for transferring large tables of numbers from a hospital data base to a statistician’s computer.

After an extremely laborious process we succeeded in building a more or less “clean” data-base http://www.math.leidenuniv.nl/~gill/Data/Hdf.csv in a format amenable to statistical analysis corresponding to 22 hospitals or trusts. This means that data from eight trusts did not make it into the present data-base for various administrative reasons, the most common reason being that the data asked for was simply not available. The second most common reason was accidental error on our side (lost emails!). We will be able to rectify some of these omissions later, which will add a small number of hospitals to the data-base, but we do not believe this will have any impact on our main conclusions.

Data from Horton General Hospital is not included: all these analyses have been performed before even obtaining any data from that hospital.

For the initial analyses in this report, six hospitals from the data-base have been removed: the data on one of those hospitals is quite weird, the other five did not supply the monthly number of admissions to ED. In an appendix we show what happens when those five are put back: nothing much changes.

3 What are we measuring

In this report, we will study three variables called here Admissions, CardioED and RespED. The original F.O.I. requests defined these data as follows:

Admissions: The number of patients admitted to Hospital/Trust X Emergency Departments, by month, from November 1999 to the present.

CardioED: The number of patients admitted to Hospital/Trust X Critical Care Units with cardio-respiratory arrest from the Emergency Department, by month, from November 1999 to the present.

RespED: The number of patients admitted to Hospital/Trust X Critical Care Units with respiratory arrest from the Emergency Department, by month, from November 1999 to the present.

The variable Admissions therefore counts total admissions to ED, and gives us information about the size of the hospital. Moreover, we are specifically interested in events happening in ED which lead to transfer to CC (Critical Care units, including Intensive Care units). Therefore “size of ED”, as measured by rates of admission to ED is more relevant than “size of hospital” measured in number of beds, say.

For completeness, I mention that CardioEd and RespED are just two of a collection of altogether six variables whose names are formed by combining a prefix Cardio, Resp, or Hypo with a suffix ED or Tot. The suffix ED stands for Emergency Department (Accident and Emergency, A&E): the number of such admissions which are from ED. The suffix Tot stands for total: the total number of admissions to critical care units from anywhere, with the corresponding diagnosis.

The prefixes Cardio, Resp, and Hypo stand for cardiac or more precisely, cardio-respiratory arrest, respiratory arrest, and hypoglycaemic arrest.

The intention was that the variables CardioED, RespED, and HypoED should count events in ED causing transfer to CC, rather than diagnosis (events in the recent medical history) of the patient when transferred from ED to CC. In other words, they were intended to count events occurring after the patient was admitted to ED, whose occurrence in ED
was the direct cause of transfer from ED to CC. This should be compared to the variables CardioTot, RespTot, and HypoTot, which were intended to count patients entering CC with the respective diagnoses, irrespective of when the corresponding event had occurred and what was the immediate reason for the admission to CC.

We can only hope that most hospitals did interpret the F.O.I. request as intended. A number of hospitals did not supply any information on the numbers of events occurring in ED – they could only supply data at higher or different aggregation levels. This means that our key variables CardioED and RespED were often missing. For similar reasons, the variable Admissions also was often missing. It was sometimes not easy to see from submitted spread-sheets and supporting documentation whether a blank stood for “zero” or “not available”.

It is not entirely clear whether any particular patient only has one diagnosis, or can have several. Cardio-respiratory arrest is heart-failure (cardiac arrest) together with respiratory failure because the former caused the latter. When your heart stops beating your lungs rapidly stop breathing, so a cardiac arrest without respiratory arrest is essentially impossible, except perhaps in IC (think of a patient in a breathing machine).

Suppose a patient comes into ED who has already been resuscitated after a cardiac arrest. Suppose this patient subsequently (while in ED) also suffers a respiratory arrest. He or she now has both diagnoses (both these things have recently happened to him or her). If this patient is now admitted to CC, is he or she counted both as an admittance to CC with cardio-respiratory arrest and as an admittance to CC with respiratory arrest?

The intention was that cardio-respiratory and respiratory arrest should be mutually exclusive categories, but the F.O.I. does not make that explicit, though one can consider it implicitly implied when one considers all seven questions together. Fortunately, we will be able to take finesse this particular difficulty.

What is respiratory arrest and what is cardiac arrest, anyway? An expert tells me

\[
\text{Both are merely symptoms of an underlying problem. For example a mid-brain stroke may result in respiratory arrest, which leads on to cardio-respiratory arrest if not treated – the heart stopping if artificial respiration has not been instituted. So if the medics pick up early on the stroke, it may only get as far as a fall. If the stroke was left untreated respiratory arrest may follow. If that is left untreated, the heart stops also. So the diagnosis is stroke, and the outcome arrest.}
\]

Wikipedia redirects from cardio-respiratory arrest to cardiac arrest.

### 4 Summary of issues around diagnosis

In the previous section I have discussed difficulties interpreting the data revolving around the fact that the condition(s) a patient has when transferred to CC is not the same as the immediate cause of the transfer. In principle, a patient can have experienced both cardio-respiratory and respiratory arrest, in either order. These events can happen before admission to the hospital Emergency department, or during stay in Emergency. Possibly, one event led to admission to ED, the next event to transfer to CC. What we wanted to count were transfers to CC caused directly either by a respiratory arrest in ED, or by a cardio-respiratory arrest in ED.

This all turns around the difference between the little words “in” and “with”, and whether, when one asks for numbers of patients in different categories, administrators (or
their data-base software) will understand that the categories should be understood as mutually exclusive. It depends on what information actually is in the data-base. I do not know how the the F.O.I. requests have been interpreted by the hospital administrators who have kindly supplied us all this data. We can go back and ask. Or we can ask medical experts what they think those questions actually mean, and what data they think these questions would actually elicit.

On the other hand, we are missing cardio-respiratory and respiratory arrests in ED which do not result in transfer to CC, if that is possible. Many events occur in hospital wards which do not end up in the hospital data-base. If a patient has suffered either arrest in ED and is immediately successfully resuscitated there, does that person necessarily go directly to a critical care unit?

Finally we should be aware that the records stored in hospital data-bases were not collected for the purpose of answering our questions, but are the results of an administrative system which collects some information about some of the processes going on in the hospital, but not all. Many events do not find their way into the data-base at all. Many events are wrongly classified. In any case, the classification can be somewhat subjective. The system allows only a small collection of possible categories and choosing just one of them might well not do justice to the complex state of any particular patient. So an administrator picks one out of habit or for convenience. Registered rates of various kinds of event can change because culture changes, policy changes, staff changes, staff start “seeing” a new kind of event happen more often because they have been alerted to it by a notable occurrence; thus awareness of particular categories of events changes in response to occurrence of other events.

5 Which Hospitals?

“Hospital” is the name (more precisely: my “short name”) of the hospital, or in some cases the trust. A table will be supplied separately, giving full names of hospitals and trusts.

Here are the (short) names of the 22 hospitals (or trusts) in our data-base:

| Barking | C Manchester | Darlington | Doncaster & B |
|---------|--------------|------------|---------------|
| Frenchay | Good Hope | Heartlands | Hertfordshire |
| Hexham | Hull & E Yorksh | Leicester | Maidstone |
| N Tyneside | Nottingham | Oxford Radcliffe | R Liverpool |
| Sandwell | Solihull | Stoke | UHN Durham |
| Wansbeck | Wycombe |

These are the names of the 16 hospitals left after we have omitted those which did not report the numbers of admissions to ED:

| C Manchester | Doncaster & B | Frenchay | Good Hope |
| Heartlands | Hexham | Hull & E Yorksh | Leicester |
| Maidstone | N Tyneside | Nottingham | Oxford Radcliffe |
| R Liverpool | Sandwell | Solihull | Wansbeck |

The six hospitals which have been omitted to form the smaller data set are

| Barking | Darlington | Stoke | UHN Durham |
| Wycombe | Hertfordshire |
The first five, because the number of admissions to ED is missing; the sixth, Hertfordshire, because the numbers there do not make much sense at all, and probably had not been processed correctly.

As mentioned before, it was actually very hard to deduce whether blank fields in tables of numbers in the files provided by some hospitals meant “zero” or “not available”. As we will later see, another four hospitals (Sandwell, Solihull, Heartlands, Good Hope) need to be removed from the presently remaining 16 for this reason. On the other hand, for the final steps of our analysis below, we will not use “total admissions to ED” so we could just as well have put Barking, Darlington, Stoke, UHN Durham and Wycombe back in. We will do that in an appendix. It turns out that our substantive conclusions do not change at all.

6 Which Time Period?

We have monthly data from each hospital from various periods of time, but all within the overall period November 1999 to December 2011. That is 12 years and 2 months, or altogether 146 months. The variable MonthNr in our analyses measures time, by months, starting with month -1 = November 1999, month 0 = December 1999, month 1 = January 2000, . . . , month 144 = December 2011.

Most hospitals could only supply data for (varying) parts of the period named in the F.O.I. request. This will be clearly visible in the graphics shown later in this report.

7 Are the hospitals comparable?

I have deliberately avoided studying data from Horton General Hospital, in order to avoid personal bias. Roughly speaking, the hospitals in this study vary in size by a factor of up to 5: we have quite a few hospitals with around 250 beds, quite a few around 500, a few with around 750, and just a couple with more than 1000 beds. Horton General belongs at the low end of the scale, among Hexham, Solihull, Wansbeck, Wycombe.

8 Visualisation of the Data

For the time being we look at 16 hospitals, partly for the opportunistic reason that $16 = 4 \times 4$, which is very convenient for graphical displays in which we can see the individual data of each hospital separately.

We plot just three of our variables against time (MonthNr). The three variables of interest in this report are Admissions, CardioED, and RespED.
Three hospitals – Nottingham, Leicester, Doncaster & B – stand out as having apparently five times larger emergency departments than most of the others: the three big ones have around 11000 admissions per month (mean monthly admissions equals 11196); the smaller ones only around 2000 (mean monthly admissions of all remaining hospitals equals 2838, or around 3000). The regular seasonal fluctuations in the large admission numbers are particularly clear.

Nottingham and Leicester are both big teaching hospitals. Doncaster & B is a trust: my short name is short for “Doncaster and Bassetlaw hospitals”.

I draw the plot again, capping the admissions at 6000, so we can better see the 13 time series of lower numbers. Seasonal variation at Frenchay is very clear to see; less visible in the others. This too is only to be expected: by the law of small numbers (Poisson variation if not super-Poisson variation) random variation becomes proportionately larger when looking at low rates, hence more easily masks a given amount of systematic variation.
Now we turn to the heart of the matter: admissions to CC (Critical Care units, Intensive Care) from ED (Emergency Department, aka A&E) because of (or at least: with) cardiac and/or respiratory arrest.

The intention was to count admissions to CC from ED caused by just one of those events. If both had occurred, then the first might be reasonably imagined to have triggered the second. In other words, we wanted to know the numbers of admissions to CC caused primarily by either type of arrest having occurred after admission to ED. However we do not know how exactly the hospitals have interpreted the request for data, or indeed, whether the interpretation was uniform. Fortunately, whether the counts are of cases “with”, or only cases “primarily caused by”, we will still be able to extract some very pertinent information from the data.
9 Observations

Very globally, we can say that even in the smaller hospitals there often 1 or 2 respiratory arrests in one month (sometimes none, sometimes 3 or 4), and anything from 0 to 10 and upwards cardio-respiratory arrests. Transfer from ED to CC because of cardio-respiratory arrest is, on the whole, very common. Transfer from ED to CC because of respiratory arrest is less common but not rare, by any account.

Four important features should be observed.

First feature: four hospitals stand out as not reporting any cardiac or respiratory arrests at all in ED: Sandwell, Solihull, Heartlands, and Good Hope.

Second feature: cardio-respiratory arrest is about five times more frequent than respiratory arrest. It is therefore somewhat less common. But it could well be considered rather misleading to call it “rare”.

Third feature: within each hospital, the numbers per month are highly variable.

Fourth feature: there are clear differences in levels between different hospitals, up to perhaps a factor of 5 between the lowest and the largest numbers. Regarding the numbers of admissions to ED this is mainly accounted for by scale. Regarding the numbers of transfers to CC because of (or with) various diagnoses this is no doubt exacerbated by different interpretations of the events to be counted, different registration systems or cultures. This careful selection of “similar” hospitals is actually extremely inhomogenous, even taking account of scale (size). Inhomogeneity might be administrative and/or cultural in nature, rather than due to scale or case-mix differences.

Obviously, we should compare Horton General to similar hospitals. Regarding size, this means Hexham, Solihull, Wansbeck, and Wycombe. As we will see the data from Solihull is anomalous, so this leaves us with Hexham, Wansbeck, and Wycombe.

10 Dealing with Anomalies

The complete absence of cardiac arrest in Sandwell, Solihull, Heartlands, and Good Hope must be caused by data-registration issues. It is inconceivable that there was not a single cardio-respiratory arrest in ED in all those years. I suspect we have incorrectly interpreted “blank” columns in a spreadsheet as zeroes rather than “not available”.

So in the next section, I will remove the hospitals with zero events – I am guessing that these are not true zeroes, but rather “not known”. In any case, hospital months when neither event happens do not tell us anything about whether respiratory without cardiac arrest is rare.

11 Some Statistics

The following statistics therefore pertain to just 12 hospitals

| C Manchester | Doncaster & B | Frenchay | Hexham |
|------------|-------------|---------|-------|
| Hull & E Yorksh | Leicester | Maidstone | N Tyneside |
| Nottingham | Oxford Radcliffe R Liverpool | Wansbeck |
Mean number of respiratory arrests per month:
0.4592

Mean number of cardio-respiratory arrests per month:
2.207

Number of hospital months in which the number of respiratory arrests exceeded the number of cardio-respiratory arrests:
94

Total number of hospital-months in the data from this sample of 12 hospitals:
415

Average number of months per year in which the number of respiratory arrests exceeded the number of cardio-respiratory arrests:
2.718

Average number of respiratory arrests per year:
5.511

In round numbers, cardio-respiratory arrest is five times more common that respiratory arrest.

Even if some patients are counted twice, at least half of the respiratory arrests are without accompanying cardio-respiratory arrest.

12 Analysis

In very round numbers, per hospital, there are on average about 3 months in every year with a respiratory but no cardiac arrest. Therefore there are at least 3 cases per year of respiratory without cardiac arrest. There are on average about 6 respiratory arrests per year. This means that at least half (if not all) of the respiratory arrests are not accompanied by cardiac arrest.

On average, per hospital, there are at least about 3 respiratory arrests (unaccompanied by cardiac arrest) per year; that can hardly be called rare. It is true, but hardly relevant, that respiratory arrest is less common than cardiac arrest (about five times as infrequent).

13 Conclusion

Though some of what is called “respiratory arrest” in our data-sets might actually represent a combination of respiratory and cardiac arrest, in either order, it is absolutely clear that respiratory arrest (not caused by immediately preceding cardiac arrest) (and leading to transfer to CC) is not rare at all.

Respiratory arrest – leading to transfer to CC – is about five times less frequent than cardio-respiratory arrest. In a hospital of the same size as Horton General, there are on average 1 or 2 cases per month. Fluctuations are large.

Respiratory arrest not leading to transfer to CC has not been accounted for at all: the numbers are unknown, unregistered.
Appendix 1: Changing the sample of hospitals

Let's check what happens when we put back the hospitals with no “admissions to ED” data. That means we are now talking about the following 17 hospitals; and our sample now has relatively more smaller hospitals.

- Darlington
- Frenchay
- Good Hope
- Hertfordshire
- Hexham
- Hull & E Yorksh
- Leicester
- Maidstone
- N Tyneside
- Nottingham
- Oxford Radcliffe R Liverpool
- Sandwell
- Solihull
- Stoke
- UHN Durham
- Wycombe

Mean number of respiratory arrests per month:
- 0.3077

Mean number of cardio-respiratory arrests per month:
- 1.563

Number of hospital months in which the number of respiratory arrests exceeded the number of cardio-respiratory arrests:
- 84

Total number of hospital-months in the data from this sample of 12 hospitals:
- 854

Average number of months per year in which the number of respiratory arrests exceeded the number of cardio-respiratory arrests:
- 1.18

Average number of respiratory arrests per year:
- 3.693

In round numbers, cardio-respiratory arrest is still five times more common than respiratory arrest.

Even if some patients are counted twice, at least one third of the respiratory arrests are without accompanying cardiac arrest.

The hospitals we put back, all of them quite small, have reduced the overall rates both of cardiac and of respiratory arrest. However, we still see that with respect to this larger sample of hospitals, including more small hospitals, respiratory arrest without cardiac arrest accounts for at least one third of (if not all) respiratory arrests; and respiratory arrest, though less common that cardio-respiratory arrest (it occurs five times less frequently), still occurs many times year. It cannot be called rare.

Appendix 2: The author’s expertise

I am a mathematician and a statistician, presently full professor of mathematical statistics at Leiden University, Netherlands (Mathematical Institute, Science Faculty). I am presently 62 years old. I have both British and Dutch nationality. I am a member of the Royal Dutch Academy of Sciences, and a past president of the Dutch Statistical Society, to mention just two marks of distinction. My research interests span both theoretical and applied statistics. I have worked for a long time in medical statistics, both on topics connected to clinical trials.
and to observational studies (epidemiology). This work has involved many collaborations with (hospital) medical doctors.

More recently I became involved in forensic statistics which is the art and science of applying statistics and probability to problems of two kinds: statistics involved in solving crimes (police investigation) and statistics involved in prosecuting criminals (evaluating the weight of statistical evidence). For instance, I have recently worked for the United Nations Special Tribunal on Lebanon, analysing mobile phone meta-data used to identify (?) the perpetrators of the assassination of Prime Minister Hariri some years ago. I am now regularly consulted by the Dutch police and by Dutch courts. Recently I was asked by a Dutch court to collaborate with a gynaecologist in order to comment on probabilities in a case of (alleged) serial infanticide. It was absolutely necessary for a medical expert and a statistical expert to look at the evidence and the relevant scientific literature together. We needed to figure out what were the right questions to ask, and neither of us could do that on our own. Lawyers and judges are even worse placed to figure out what are the right questions to ask. Fortunately, the realisation that multi-disciplinary scientific work should be performed in first instance by collaborating scientists, not by courts of law, is growing, due to many recognised miscarriages of justice where faulty interpretation of scientific evidence, and recruitment of the “wrong” scientific experts, has been involved.

Particularly relevant to the present particular case (Ben Geen) is my involvement in a celebrated Dutch miscarriage of justice. A nurse, Lucia de Berk, was given a life sentence for murder of 6 patients and attempted murder of 4 more, largely on the basis of statistical evidence linking her presence to “incidents” on the wards where she worked. The conviction was revoked after a sequence of legal battles lasting altogether 9 years. At the final acquittal, the judges not only announced that she was not guilty, but that in actual fact no murders had occurred at all. In actual fact, according to the trial judges, nurses had battled heroically to save lives of patients which, despite this, were ultimately shortened by the mistakes of their doctors. Cases like this, internationally, are by no means rare. In fact, “health care serial killers” are rare, but witch hunts triggered by medical errors and magnified out of proportion by the rigid social structure of a hospital are unfortunately all too common, with often devastating consequences.

16 Appendix 3: Some anecdotes from the case of Lucia de Berk

The case of Lucia de Berk – perhaps the biggest miscarriages of justice which ever occurred in the Netherlands, a country which prides itself on its justice system – contains a multitude of shocking parallels with the case of Ben Geen. What is all the more shocking is that this seems to have gone totally unremarked, to date.

I will here recall just a few “anecdotes” from that case which have particular relevance to the statistical aspects of the Ben Geen case.

A key piece of evidence in the Lucia case was that the number of incidents on Lucia’s ward was 9 in one year (the year in which she was supposed to be on a killing spree), and close to zero during both the two preceding years, and in the subsequent year. This enormous unexpected number of incidents in that ward was a key piece of prosecution evidence. It later transpired that the name of the ward had been changed, just prior to those two years of almost no incidents. In the years preceding, it had been somewhat larger than 9, several years in succession. The hospital director’s statement was the truth (he referred to the ward by its current name), but not the whole truth. He himself was responsible for the name-change of the ward. And later: the year after the quiet year after the big year, the numbers were big again.

Amusingly, in the case of Lucia de Berk, the argument put by the prosecution was precisely that respiratory arrest was normal, while cardiac arrest was supposed to be unusual! In one of the key events, the crucial question for deciding whether a baby had died of poisoning or
naturally, was whether heart failure took place before or after lung failure. The argument being: if someone is terminally ill, then the natural course of events is that the body becomes exhausted, the lungs fail, consequently there is shortage of oxygen, then the heart fails. On the other hand, “unexpected” heart failure (after which the lungs naturally fail, too) could indicate poisoning.

It turned out that the temporal sequence of events was not remembered in the same way by different observers (doctors, nurses) and moreover that different registration systems appeared to give a different answer. Only after an extremely carefully and thorough investigation taking everything into account, could it be concluded that quite definitely, respiratory arrest came first, followed by heart failure.

I don’t suppose that how terminally ill people die in the Netherlands is terribly different from how they do it in the UK. And I apologise for appearing to offer anecdotal medical evidence when I am a statistician. However this point is crucial: medical diagnosis is not an exact science! Many things happen in rapid succession. What one takes as the “cause of death” or the “cause of the emergency” is fuzzy. Impressions of skilled doctors might easily be different from the information obtained from fairly reliable medical monitoring systems. The output from different monitors can get confused and mis-interpreted. Memories are unreliable. Memories change, certainly when people start to believe that there is a killer around.

These points are actually very relevant to any interpretation of the statistics in the case of Ben Geen. Which events are registered as events of which category is to a large degree subjective, and variable.

I would also like to mention an “incident” pertaining to the present case. At my request, an F.O.I. request was also put to Horton General, sometime later than all the others. The data which this hospital was able to prepare pertained only to a very short, recent, period, and with almost all categories merged. All numbers of events in any month smaller than 5 were simply reported as “< 5”. No other hospital took this weird precaution, allegedly taken for reasons of confidentiality. Is this an attempt to suppress embarrasing evidence?
### Table 1

| Item nr. | Trust name                  | Name hospital or trust | Short name hospital or trust | Status of Hospital or Trust |
|----------|-----------------------------|------------------------|------------------------------|-----------------------------|
| 1        | Oxford Radcliffe hospitals  | Horton Hospital        | Postponed                    | Missing                     |
| 2        | Royal Derby Hospital        | Derby Hospital         | Missing                       | Missing                     |
| 3        | Queen Alexandra Hospital    | Portsmouth Hospital    | Notice                        | Missing                     |
| 4        | Barnet Hospital             | Barnet Hospital        | Skipped                       | Missing                     |
| 5        | Kent and Canterbury Hospital| Canterbury Hospital    | Notice                        | Missing                     |
| 6        | Wycombe Hospital            | Wycombe Hospital       | No Admissions                 | Missing                     |
| 7        | Wansbeck Hospital           | Wansbeck Hospital      | OK                            | Missing                     |
| 8        | University Hospital of North Durham | University Hospital of North Durham | Missing | Missing |
| 9        | Stoke Mandeville Hospital   | Stoke Mandeville Hospital | Missing | Missing |
| 10       | Sandwell General Hospital   | Sandwell Hospital      | OK                            | Missing                     |
| 11       | Royal London and Broadgreen Hospital | Royal London and Broadgreen Hospital | OK | Missing |
| 12       | North Tyneside General Hospital | North Tyneside General Hospital | OK | Missing |
| 13       | Maidstone and Tunbridge Wells Hospital | Maidstone and Tunbridge Wells Hospital | OK | Missing |
| 14       | University Hospitals of Leicester | University Hospitals of Leicester | OK | Missing |
| 15       | Hull Royal Infirmary and Castle Hill Hospital | Hull Royal Infirmary and Castle Hill Hospital | OK | Missing |
| 16       | Hexham Hospital             | Hexham Hospital        | OK                            | Missing                     |
| 17       | East and North Hertfordshire Hospital | East and North Hertfordshire Hospital | Odd Admissions | Missing |
| 18       | Heartlands Hospital         | Heartlands Hospital    | OK                            | Missing                     |
| 19       | Good Hope Hospital          | Good Hope Hospital     | OK                            | Missing                     |
| 20       | Frenchay Hospital           | Frenchay Hospital      | OK                            | Missing                     |
| 21       | Doncaster and Bassetlaw Hospitals | Doncaster and Bassetlaw Hospitals | OK | Missing |
| 22       | Darlington Memorial Hospital | Darlington Memorial Hospital | No Admissions | Missing |
| 23       | Manchester Royal Infirmary Hospital | Manchester Royal Infirmary Hospital | OK | Missing |
| 24       | King George Hospital        | King George Hospital   | No Admissions                 | Missing                     |

**Notes:**
- [Data: HRI: 790; CHH: 610 beds](#) (Hull Royal Infirmary; Castle Hill)
- [Four hospitals](#) (East and North Hertfordshire)
- [Closed this spring](#) (Frenchay Hospital)
- [692](#) (Heartlands Hospital)
- [521](#) (Good Hope Hospital)
- [437](#) (Darlington Memorial Hospital)
- [750](#) (Manchester Royal Infirmary Hospital)
- [450](#) (King George Hospital)

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17 Appendix 4: Overview of our data sources