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Improving the allocation of junior doctor resources using a Pareto analysis of pager activity

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ABSTRACT

Background: Pareto analysis is the cornerstone of most businesses improvement strategies around the world. It has been used in healthcare as part of quality improvement endeavours. Pager activity can be used as a surrogate to assess the sources and frequency of demands on junior doctor resources. Thus our aim is to analyse and improve the allocation of junior doctor resources through the study of pager calls using the Pareto principle.
Methods: Retrospective observational study examining pager calls to Ear, Nose & Throat junior doctor/residents at the University Hospital Southampton, a tertiary referral centre on the south coast of the United Kingdom. A Pareto principle analysis was undertaken, assessing whether the majority of activity stems from a minority of sources.
Results: In total, 2853 pager calls were included, averaging 31 pages a day over a three-month period. Highest daily page activity occurred at 11 am and 2 pm. Data conformed to the Pareto principle; 80% of activity came from 22% of sources, with the paediatric department providing the highest demand.
Conclusions: Analysis of pager frequency data has shown confirmation to the Pareto principle, identifying that the majority of calls to the junior doctor/resident originate from a limited number of departments/locations. Such analysis has allowed a restructuring of resources, to better streamline departmental efficiency. A broader appreciation and adoption of Pareto analysis within the healthcare sector would enable improved resource allocation, in an era of limited healthcare budgets.

Keywords: Pareto analysis, Bleeps, Pagers, Paging, ENT, Otolaryngology

INTRODUCTION

The trend of strained health service budgets in the UK and Europe as a whole has spurred many institutions to seek to improve efficiencies in personnel and working practices. One key area in addressing inefficiencies is to find out where limited resources should be deployed to create maximum benefit. The Pareto principle, also known as the "80-20" rule or the rule of the 'vital few', holds that the majority of any given set of effects or outcomes (80%) can be attributed to result from a minority of causes (20%). It was in 1887 that Italian economist Vilfred Pareto first observed that 80% of all agricultural land was owned by only 20% of landowners.[1]

In the 1950s, management consultant Joseph Juran popularised the principle as a means to improve efficiencies in business by allowing them to invest in areas where the bulk of their income was derived from a minority of key activities.[2] The Pareto principle has subsequently been observed not only in areas of human endeavour, such as literature (number of words) or sociology, but also in the natural sciences such as astrophysics (intensity of solar flares).[3]

The bulk of the emergency work within healthcare institutions is usually undertaken by junior doctors or residents. Analysing where the bulk of demand for services lie can allow hospitals to better design working

patterns and restructure how personnel are deployed. This is particularly relevant in the era of shift working patterns for junior doctors, and the ongoing and increasing restriction of financial budgets. The humble emergency pager/bleep, that is almost ubiquitous to junior doctors in the UK, is the commonest, if not only, way to communicate quickly and efficiently. Thus analysing the frequency, timings and sources of pager calls can provide insight into where the demand for junior doctor services are most critical. Our aim was to undertake a Pareto analysis on pager activity within a busy tertiary referral centre on the south coast of the UK. In order to highlight the use of such analyses in improving departmental efficiency and the allocation of resources.

METHODS

Ethical considerations

This study was undertaken as a service improvement project, not involving any patient data. Thus, ethics approval was not deemed necessary.

Study design and conduct

The pager of the on-call Ear, Nose and Throat (ENT) emergency junior doctor (JD)/resident (Res) was analysed over a three-month period at the University Hospital Southampton, 17th April 2018 to 17th July 2018. The data set collected included the date and time of each page and location of paging call. The location was then used as a surrogate marker for identifying the departments contacting the ENT JD/Res. All data was retrieved from the pager management service. Raw data included the date and time stamp of each page received, and the extension numbers sent to the pager. The extension numbers were cross referenced with the hospital directory to ascertain which ward or departments sent the page. Different extensions belonging to the same ward or departments were grouped under a specialty or departmental heading. Over the data collection period, extensions or departments sending fewer than 10 pages in total were removed from the final analysis as these were deemed as not being a significant source of demand for the JD/Res.

Statistical analysis

The data was analysed using descriptive statistics and Pareto chart analysis, using Microsoft Excel. Data was assessed to be non-parametric, and therefore the Mann Whitney U Test was used in all the non-Pareto analysis, with significance achieved at $p<0.05$. An arbitrary cut-off of 10 pages across 3 months was used to reduce the number sources for the final analysis.

RESULTS

In total, 2852 individual pages were made to the ENT JD/Res pager between April and July 2018, across a total of 92 days. This amounts to approximately 950 pages/month, 237 pages/week, 30 pages/day and 2.5 pages/hour. Figure 1 reveals the frequency of pages for each day of the week, revealing a significant ($p<0.01$) increase in the pages for weekdays (35 per day) vs. weekends (21 pages per day). Day to day weekday variation was not deemed to be of statistical significance ($p>0.05$).

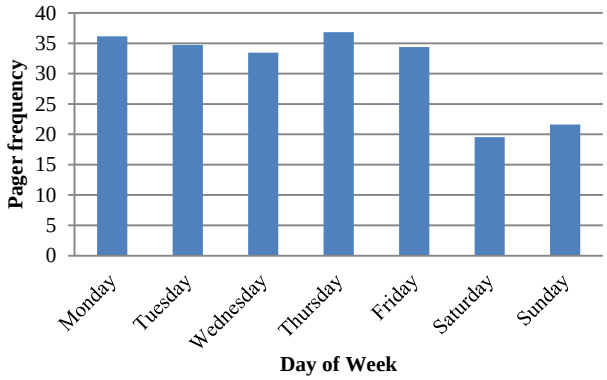

Figure 1 Frequency distribution of pages across the week. Frequencies are medians for each day across the 92 day period of data collection.

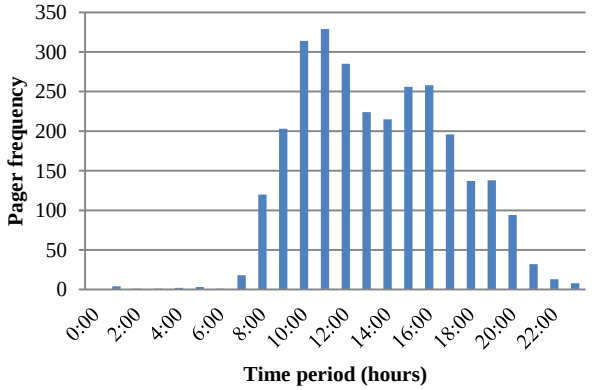

Figure 2: The intra-day variation of page frequencies. Data shows sum total frequency for each one hour time period across all 92 days.

When analysing the timings of pages (Figure 2), there was a marked increasing frequency from 08:00 onwards, peaking at 11:00 with an average 4 pages/hour. This would later drop to a mid-afternoon low of 2.5 pages/hour at 14:00, then peaking once again to 3.5 pages/hour at 16:00. This intra-day variation of peaks and troughs held true for individual days and cumulatively across all 92 days. After removing page sources with page frequencies of less than 10, 27 page sources were identified producing a total of 2491 pages. Pareto chart analysis demonstrated that the top 6 (22%) sources (consisting of paediatrics, external calls, admissions, Emergency Room, ENT ward and Emergency theatre) accounted for 2029 (80% of pages) pages, outlined in Figure 3.

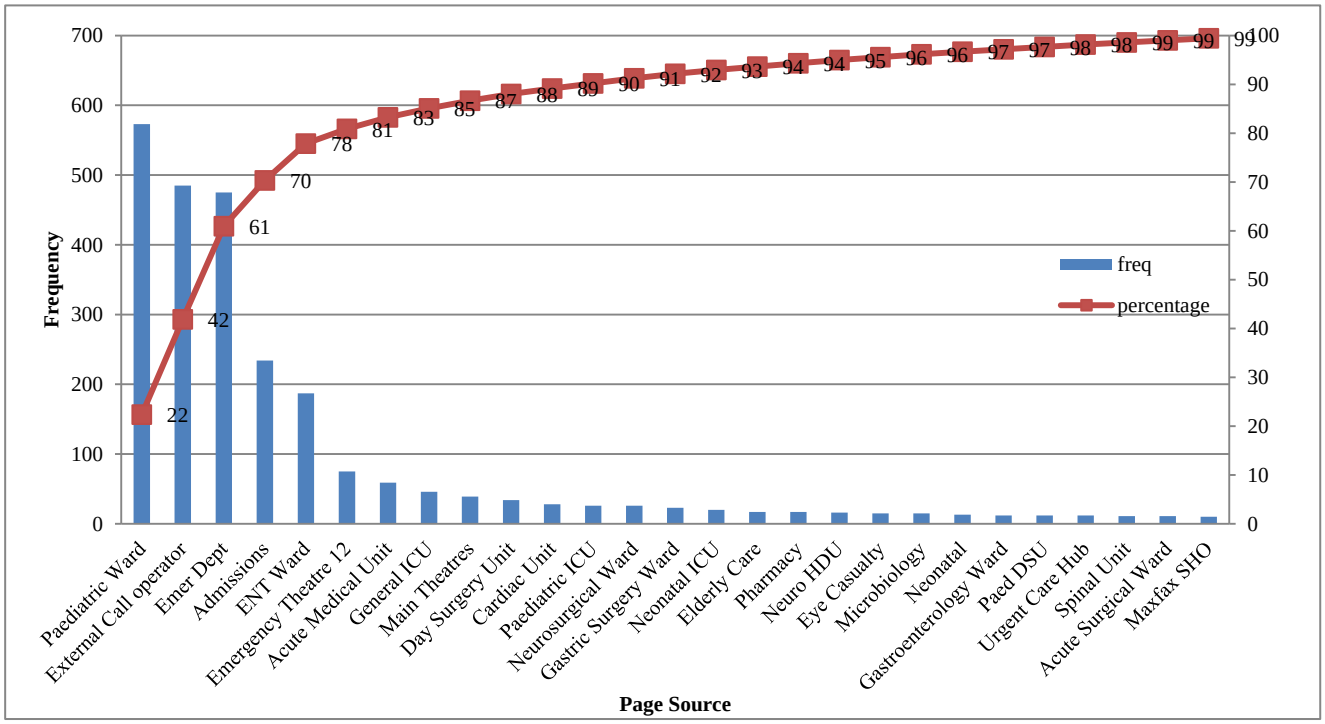

Figure 3: Pareto pager analysis. Pareto chart of rank ordered counts (blue) against page source and cumulative distribution, in 2491 pages. The top six (22% of sources) account for 80% of all documented pages.

DISCUSSION

This study is the first in the UK to analyse page frequencies and sources to an emergency pager held by a JD/Res in a tertiary hospital. The average daily page rate of 2.5/hour seems reasonable for the workload of a JD/Res, however the significant intra-day variation does show that early morning and later afternoon periods are particularly busy. The mid-afternoon dip at 14:00 would be explained by this being the traditional time for lunch breaks where a reduction in referral activity would be expected to occur. No one particular weekday showed a preponderance for increased pager activity. This runs counter to anecdotal reports of the 'Monday morning and Friday afternoon rush' to refer from both the emergency room (ER) and community practices. As expected, weekend pager activity was significantly lower than on weekdays. This could be explained by the fact that most community practices are closed on weekends and referrals would only occur via patients attending the ER.

The Pareto chart analysis revealed that paediatric ward activity was the single highest source of pages. This was an unexpected result, as the ER and community practices referrals (external call/external automated/admissions) have subjectively been the major contributors to the JD/Res pager activity. This may be explained by attendance of emergency paediatric cases to the paediatric ward, and the inherent tendency for these patients to be seen and assessed more urgently.

The analysis presented here does agree with the Pareto principle. Eighty per cent of pager activity was produced by some 22% of identified sources. This information can be used to re-allocate resources and personnel to address the main demand drivers. In our own practice, this has resulted in an extra junior doctor being available to help in the weekday afternoons, where increased demand is to be expected, whilst only having one junior doctor on the weekend. Furthermore, there is also a drive for more senior doctors (registrars) to field calls from the ER and external calls, thus significantly reducing pager workload on junior doctors.

Though Pareto analysis has mainly been utilised in the business sector to boost productivity and efficiency there has been increasing use in healthcare. An analysis of primary care consultations in Ireland demonstrated that 80% of hospital admissions from primary care were accounted by only 12% of patients.[4] There has also been evidence of the principle in surgical training where 80% per cent of verbal correction during laparoscopic training given by supervisors were accounted for by only 14% of trainee behaviours requiring correction, thus allowing for targeted training.[3] Some 50% of delays in radiology appointments at a tertiary hospital were accounted by only 2 factors, addressing these led to a median waiting time reduction from 19 to 7 days.[5] Furthermore, drug medication errors and improvements in drug prescribing have been shown to conform to the Pareto principle.[6-8] The success of such analyses and targeted interventions derived thereof have led to calls for greater use of the

Pareto principle and related management strategies in areas such as critical care and community dentistry.[9-10]

CONCLUSION

This study is the first published Pareto analysis of JD/Res pagers in the UK. The analysis has shown some striking results of where the demands for JD/Res resources originate from. The study has thus directly affected how the departmental work force resources are allocated to improve both departmental efficiency and the quality of service afforded to both patients and allied specialties. Pareto analysis is a useful tool in quality improvement projects and the authors recommend a greater uptake of such analyses in the healthcare sector.

Limitations

This was a single centre study of only one sub-specialty in a tertiary hospital, thus it is difficult to generalise our findings to other centres. Pages were used as surrogate marker for clinical activity, however the outcome of each page to the pager was not known, nor was the workload generated from each page, thus limiting the inferences drawn. That said, the large number of calls gathered would reduce the effect of anomalous or non-clinical calls made.

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Ethical approval: Not required

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