

What can we learn from outliers in Cardiac Surgery?

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Abstract

At a time where delivering the best quality of care is the *raison d'être* of the health service, outliers can pose a serious challenge to both clinicians and policy makers. Methods of outlier detection are highly variable. The collection and assimilation of outcome variables can also be very challenging. Despite this, the publication of surgeon specific data has brought the concept of outliers into the public eye and the consequent punitive action affected upon surgeons can be deleterious to clinician psychology and patient perception. Simultaneously, positive outliers are rarely mentioned and never rewarded. Moving forward, the use of more objective outcomes, including novel biomarkers and patient-centred data, as well as innovative statistical strategies and management cultures, can positively evolve the healthcare paradigm for the future.

What can we learn from outliers in Cardiac Surgery? *shifting the paradigm for interpreting outcomes*

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IntroductionOutliers, “a person or thing that differs from all other members of a particular group or set.”(1) Outliers come in all forms and exist in every fabric of our world. Some have hypothesized their occurrence is random, merely a statistical roulette. They are to be acknowledged and glossed over. Others propose there is untapped potential in analysing and studying outliers for the progression and development of society. Could there be a pattern of behaviour to learn, or an algorithm that the ordinary can use to achieve the extraordinary? In a domain as multidimensional as healthcare, and particularly cardiac surgery, it is no wonder that there is a prevalence of outliers, both positive and negative, institutional and individual. Is the study of outliers in the health service an uncharted path for research to further guide policy-making? If so, what exactly *can* we learn from them?

The renowned Economist, Nassim Taleb, hypothesises that outliers occur randomly, merely a statistical roulette, and that so called “Black Swans” can never be predicted(2). The conflicting opinion is proposed by Malcolm Gladwell: outliers arise when individuals are exposed to observable opportunities in nature and nurture, and there is much to learn from studying them to understand why they occur (3).

Outliers in Cardiac surgery

In recent times, clinical performance has almost become synonymous with outcome measurement(4). What makes outliers in heart surgery particularly intriguing is that the outcomes guiding quality metrics are categorical and infrequent: namely mortality and major adverse cardiovascular and cerebrovascular events (MACCE). Large registries, with particular mention of the STS National Database in the US, are developing which accumulate significant amounts of patient data and have an inevitable role in defining key performance indicators.

When the standards of care are within the middle 95% of the bell-curve, our culture briefly acknowledges the equilibrium and proceeds with a practice of “maintenance”. Afterall, the majority lie in this region. Yet, extreme performers at the lower end of the curve take a larger share of the public and governance limelight. The Bristol Enquiry in the UK is the most pertinent example from recent times where the outlier detection method resulted in sizeable and justifiable repercussions(5).

The side-effect of this is a shift of quality improvement resources towards poorly performing outliers which may lead to less efficient overall improvement in a network of healthcare providers as a whole (6). In fact, newer studies are suggesting that outlier detection using outcomes analysis and the subsequent knee-jerk reward-punishment strategies can be harmful, especially when involving blame(7).

Surgeon-specific outcomes

The practice of scoring surgeons with infrequently occurring outcomes can at times not be sensitive or specific enough surrogate markers to give an indication of the quality of care(8,9), especially when subjected to confounders. The main confounder of note is the variability in case mix, which may skew the data and throw clinical performers into outlying territory. In cardiac surgery this has become a particular issue with the publication of surgeon-specific mortality data (10).

In the UK, surgeon-specific performance remains central, demonstrated by the use of a traffic light system by the Society for Cardiothoracic Surgeons (SCTS), whereby underperforming surgeons with poor outcomes are assigned an amber light (under monitoring) or a red light (suspension from clinical practice pending investigation) (11). This is an example of outlier detection and castigation in its purest form.

Since its dawn, publication of cardiac surgical data has in fact shown little evidence of improvement in outcomes (12). Studies highlight an increase in risk-averse and loss-averse behaviour by surgeons wanting to avoid operating on high-risk patients (the patients who arguably need the most attention) to circumvent poorer outcomes (13).

The future: potential ways to deal with outliers

Quality assurance is a constant process incumbent on individual clinicians and institutions to maintain practice within acceptable standards. Therefore when negative outliers appear it is logical that “bringing them back” would involve similar active processes (14). As part of a new paradigm, we propose the following:

1. **Novel outcomes** The quality performance equilibrium is in flux. As newer technology for clinical diagnosis and treatment is constantly emerging, so too should our methods of quality assurance. As such, the definitions outliers must be adaptable and relevant. Outlier detection should not rely on mortality alone, which is a poor discriminator in quality of care. Further endpoints are required that are automatically collated or patient reported, which may include quality of life measures, patient satisfaction, imaging outcomes and biomarkers. As an example, analysing post-surgical patient quality of life and satisfaction in a well-run institution may highlight its positive performance, compared to focusing on an unexpected in-hospital mortality it recently suffered. As well as novel outcomes, robust statistical methods that accurately and appropriately classify outliers are required, using both supervised classification strategies and proximity-detection methods. Differentiating between binary and continuous indicators, logistic regression and propensity adjusted scoring and their influences on data hierarchy should be sought(15,16). Statistical methods need to go through cycles of adaptation as outcomes changes and patient populations evolve.
2. **Positive outliers** The emergence of a positive outlier must not only prompt reward, but attempt to shift the equilibrium of clinical performance in the wider field. Perhaps this excellent performance arose from a novel clinical method or management process. With the GMC evolving into a weapon used by healthcare leaders to force outstanding competency and expose negative outliers, there is little being done to reward the excellent. Such mechanisms are psychologically straining for surgeons who are already in a high-risk field and stand to gain very little if they demonstrate good outcomes. Leaders of the NHS on a national, and even a local and departmental level, can evoke more permanent change by encouraging and nurturing those who excel as positive outliers. Individuals and institutions that can go on to encourage others to follow suit(17).
3. **Negative outliers** Focusing on negative outcomes alone in identifying and then improving underperformers is not the optimum method(6). In fact, newer studies are suggesting that outlier detection using outcomes analysis may well be avoided, and the subsequent knee-jerk reward-punishment strategies imposed to bring back outliers, can be harmful, especially when involving blame(7,18). In a recent national survey(13), 58% of UK cardiothoracic surgeons opposed reporting of surgeon-specific mortality. Studies highlight an increase in risk-averse and loss-averse behaviour from surgeons who fear taking on high-risk cases, especially when there is no reward for taking on such cases yet a high punishment when death does occur. The result of such measures has seen more risk-averse behaviour by surgeons wanting to avoid operating on high-risk patients (the patients who arguably need the most attention) to circumvent poorer outcomes (13). A fairer and less punitive attitude with negative outliers is therefore essential: this is especially true if a large body of social science purports that outlier occurrence is indeed random and unpredictable..
4. **Leadership** The need for strong leadership and management is paramount(19,20). Rescuing an outlier requires the unit to challenge the status quo and make significant changes in a timely manner to return to the accepted mean. This would rely on an executive with good management capabilities, effective-

ve communication and a departmental culture conducive to adaptation and change(14). The Bristol Enquiry (21) found that whilst poorer outcomes were being detected and potential causes identified, there was not a strong enough leadership to take command of making significant improvements. Furthermore, the implementation of effective leadership and robust business models will ensure that data driven decision making in healthcare systems is upheld in a structured and innovative fashion.

Conclusion

A random phenomenon or an algorithmic occurrence, one thing unanimously agreed upon is that outliers exist, and they are important. In healthcare, and particularly cardiac surgery, outcome analysis alone may not be enough to accurately reflect performance. A multifaceted approach from all relevant stakeholders of healthcare is required to highlight negative and positive outliers in a fair and sensitive way that promotes true improvement in performance and clinical standard.

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