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Variation in medical practice: literature review and discussion



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1. Background

Variation in medical practice has become a major topic of inquiry for health services researchers. Investigators have frequently documented variation in the way in which health services are delivered, both among individual clinicians and across geographic areas, and have found that such variation often cannot be explained by demographic factors or other determinants of health need. The existence of such unexplained variation has provoked questions about the effectiveness, efficiency and quality of health care services. Observations of variation have consequently been used to justify a variety of policies aimed at reducing variability, such as greater emphasis upon outcomes research, feedback to practitioners, and closely monitored performance measures.

2. Explanations of variation

A number of researchers have developed specific explanatory hypotheses about variation, although there is little decisive empirical evidence which can yet distinguish between most of the hypotheses, or even argue strongly in favour of an effect from any one of them. The main strands of explanation which have been posited in the literature include uncertainty, and ignorance of clinical evidence among individual practitioners (McPherson 1994; Evans 1990). These are aspects of the clinical judgement of an individual practitioner. Analyses which place more emphasis upon the wider context of clinical decision-making discuss disagreement (Evans 1990) and enthusiasm (Chassin 1993; Goel et al 1997; McKee 1995), effects which refer to the clinical judgement of an individual within a professional environment of peers. Finally, wider contextual effects can influence the behaviour of individual clinicians: Wennberg and others discuss supplier-induced demand (Wennberg 1982, Wennberg 1985, Eisenberg 1985), while Westert and Groenewegen's 'constraints' model focuses upon the social, environmental and organisational conditions which constrain clinical practice (Westert 1999).

One group of these explanatory approaches emphasises a reductive view of medicine in which variation would be eliminated if sufficiently clear guidance could be given to individual clinicians to support their decision-making. This view of variation tends to see variability as a challenge to the rational basis of medicine. The second general approach towards explaining variation tends to consider elements of variability to be inherent in the environment in which medicine is practised, placing more of an emphasis upon variability as an aspect of normal medical practice.

In reality, the behaviour of any one clinician is surely a complex reflection of all of the factors which have been posited by different researchers. The importance of the debate about explanation lies in the way in which these explanations are used to justify policy responses to variability. In this respect the 'practice style' hypothesis, and more specifically the role of clinical uncertainty, play a significant

role in the variation debate. This strand of research owes much to a seminal review paper on physician practice patterns conducted in the 1980s, which clearly set out a number of factors which are both internal and external to a clinician, but which may influence the clinical decisions of that individual (Wennberg 1984). Such factors include patient benefit, desire for income, the practice setting, defensive medicine, the patient's economic well-being and wider social good.

The most prominent researcher of uncertainty and variation is Wennberg and his colleagues, who argue that this is the most important factor which drives variation (Wennberg et al 1982, Wennberg 1990, Wennberg 1993, Wennberg 1998). The empirical basis for this argument essentially lies upon two findings: the first is that some conditions have inherently high or low degrees of variability across areas, and that high variability conditions are associated with clinical ambiguity. The second is that clinical practice is sometimes modified when clinical guidelines and utilisation feedback are implemented.

Empirically, measures of uncertainty in clinical practice have been found to be associated with higher treatment costs (Davis et al 2000b) and with higher rates of investigation and follow-up in a primary care setting (Allison et al 1998, Davis et al 2000b). Wennberg (1984) and McPherson et al (1981, 1982) measured the small area variability of a range of hospital procedures, categorised these into high and low variability, and suggested that these consistent patterns of variability are explained by clinical uncertainty. For example, inguinal herniorrhaphy is found to be a low-variation procedure with little uncertainty about when it should be performed, whereas tonsillectomy and haemorrhoidectomy are high-variability procedures which have much more scope for individual practice style within a less certain (or at least a less prescriptive) clinical norm. Bronstein et al (1998) have also found greater variation in the use of obstetric interventions where there is clinical uncertainty. It should be noted that the uncertainty in practice style hypothesis is primarily interpreted to explain variations in the intensity of treatment once contact has first been made between patient and clinician, rather than the frequency of first contact utilisation (Wennberg 1987; Folland and Stano 1989).

However, a number of researchers have disputed the role of uncertainty in determining individual practice style. An important argument is that individual practitioners are not uncertain, but have disagreeing enthusiasms for various approaches to clinical practice. Chassin (1993) interpreted earlier data on carotid endarterectomy to suggest that enthusiasm rather than uncertainty explains variability, while Goel et al (1997) have found that regional variations in mammography screening were equally variable for different age groups, even when there was clearer advice for physicians about the benefits of mammography for some age groups than others. They interpret this as a suggestion that variations in mammography are better explained by enthusiasm among physicians than by uncertainty.

A few workers have taken a more theoretical approach to the problem of explaining variation. Folland and Stano (1989) have developed an econometric model of practice style which distinguishes the effects of supplier-induced demand from the uncertainty of beliefs about treatments which influences practice style. They applied their model to data about physician utilisation in Michigan, and concluded that practice style had relatively little influence upon aggregated measures of physician utilisation, whether first occurrence or intensity measures were considered.

Methodologically, the problem of explaining variation highlights the distinction between ecological and individual observations of variability. All of the approaches which have been used to explain variability operate, ultimately, at the level of the individual clinician. However, the observations being explained are often based upon area-level data rather than information about individual clinicians. This point particularly applies to the work of Wennberg.

3. Consequences of variation

3.1 Equity

Whatever the immediate cause of variability, an important part of interest in the field has arisen through concern about the implications of variation. It has already been suggested that problems of equity, appropriateness of care and the underlying effectiveness of health services are implied by the observation of widespread variation in medical practice. Each of these points represents an intermediate step between underlying explanations of variation, particularly uncertainty, and policy responses which try to manage and reduce variability.

Variation may imply inequity in terms of resource allocation if, as a consequence of practice variation, different levels of per capita funding are devoted to the care of different populations. The essential observation is that different populations of people have access to different levels of health care resource, and that people living in different geographical areas, or being cared for by different individual physicians, may have a different level of access to a service.

Classically, Wennberg and colleagues have found that there are very different rates of hospital utilisation in Boston and New Haven. They used this observation to pose the question of how equitable the allocation of health resources was between the two areas – essentially asking whether the observation of variation implies that the residents of the two areas were not all receiving a fair share of the available health resource (Wennberg 1987, Wennberg et al. 1987). Other authors have discussed the issue of the economic impact of variation (Eckerlund and Hakansson 1989; Price et al 1992) variously noting that the observed differences in utilisation rates imply inequity and inefficiency in the total delivery of health services.

3.2 Appropriateness

Quality of care is also sometimes considered to be in question when variability is observed. Some researchers have studied the interpretation of variability as a sign of poor quality of care by framing hypotheses about the correlation of inappropriate care with a high degree of variability. Such studies tend to involve defining appropriate processes of care and measuring that appropriateness in comparison with clinician variability and the absolute level of utilisation. There has been limited success in finding an association between variability and appropriateness of care, although there remain methodological challenges to be addressed in this field (Leape et al 1990; Fertig et al 1993; Knottnerus et al 1990; Payne et al 1995).

It must be noted that the failure to associate inappropriate use with variation should not imply that these studies have not found inappropriate use of health services. Chassin found considerable inappropriate use, but was unable to explain it in terms of the absolute rate of utilisation or the variability of that utilisation (Chassin 1993).

While the issue of quality of care is clearly an important one both for health care providers and for patients, the interpretation of variability as a necessary and sufficient indicator of poor quality is still very much an open question.

4. Responses to variation

One general response to the phenomenon of medical practice variation has been to use indicators or performance measures to identify when practitioners are behaving outside some norm, and to make practitioners aware of their differences in practice (Kerleau 1998). This approach has sometimes been promoted by proponents of the evidence-based medicine movement as a technique for disseminating the results of medical research into practice (Lomas 1990, 1993a, 1993b; Haynes et al 1995; James and Hammond 2000), and for investigating and managing variation (De Marco et al 1993). The use of 'report cards', or physician profiling, has become increasingly common in American managed-care organisations (O'Donnell et al 2011) and professional medical organisations (Schwartz 1984), although some commentators have criticised the effectiveness of the individually applied performance indicator approach (Hofer et al 1999).

Wennberg (1984) has argued that the responsiveness of physician practice patterns to feedback suggests that variation is inherently a question of uncertainty, and that a more informed body of clinicians is therefore less likely to produce small area variations.

Two Cochrane Effective Practice and Organisation of Care (EPOC) reviews consider aspects of modification of clinical practice. Jamtvedt et al (2006) reviewed studies which assessed various forms of audit and feedback to practitioners to improve compliance with stated best practice. They found that these interventions were more likely to be effective where they were undertaken intensively, and where the baseline level of compliance was low. Overall, though, the median improvement in compliance was 5 percent (where the studies had dichotomous outcome measures), and 16 percent (where the studies had continuous outcome measures), leading the authors to conclude that while audit and feedback could be used to improve practice, the effects were generally small to moderate.

Another relevant EPOC review considered the impact of meetings and workshops on clinical practice (Forsetlund et al 2009). In this case the reviewers found changes in process of care were, at the median, 6 percent for interventions involving educational meetings, with educational meetings being more effective for changing simple rather than complex behaviours, and higher attendance at meetings being associated with a greater level of change. A mixture of interactive and didactic elements was more effective than either type of meeting alone.

The moderate effectiveness of feedback on its own as a behaviour modifier suggests that it is a poor response to observed variation. Since Wennberg's hypothesis that uncertainty is the major driver of variation rests in part upon the effectiveness of feedback in reducing variation, that hypothesis is weakened to the extent that feedback seems to have limited effectiveness.

Payment for performance has been used as an explicit approach for reducing variation, with the UK Quality and Outcomes Framework (QOF) a prominent example (Roland 2004). Extensive evaluation of the UK QOF indicates at most a limited impact upon quality improvement and reduction in variation, with little impact upon inequity in patient populations (O'Donnell et al 2011).

5. Clinical evidence and variation

Beyond the strategy of providing information to clinicians, there have been calls from a wide variety of commentators in several countries to intensify support for outcomes research, which has the potential to reduce clinical uncertainty and therefore minimise variation with any consequential bad effects. Again, this is a position which has been strongly endorsed by Wennberg and his colleagues (Wennberg 1990, 1992; Caper 1984). Eddy (1984) argued in the 1980s that while a degree of clinical uncertainty is manageable, and probably inevitable, much clinical uncertainty is harmful, and that outcomes research is an important response to this problem.

Stano (1993), as a consequence of his criticisms of the mainstream interpretations of variation, has also criticised what he sees as a misplaced policy emphasis upon outcomes research. He argues that the commonplace assumption of an association between uncertainty and inappropriate care are not founded upon robust methods, and that outcomes research cannot therefore be justified on those grounds.

Clinical guidelines are sometimes implemented as explicit tools for reducing clinical variability (Anis et al 1996; Pai et al 2000), although there are again dissenting opinions (Long et al 1999). Escarce (1993) has argued that guideline implementation would do little to reduce variation in the specific case of cataract surgery, and Fertig et al (1993) have argued the same point with general practice referral rates. Similarly, the finding (discussed previously) that inappropriateness of care is difficult to correlate with variation implies that guidelines which promote appropriateness of care may not have an impact upon variability per se.

6. Definitions and statistical issues

Negative definition is a problem for medical practice variation. This sort of approach is seen when analysts define variability as that degree of variation which is left unexplained once specific factors have been taken into account. However, such a negative or 'residual variance' approach has limitations (Folland and Stano 1989).

The first issue with negative definitions is the lack of precision about what variability measures. McPherson (1994) defines medical practice variation in terms of standardised rates at some level of aggregation. This is an example of a negative, question-begging definition. Exactly what factors should the rates be standardised for? If variation is understood to be the unexplained residual which is left over in multivariate analysis, then the definition inherently precludes the possibility of explaining variation. The point is raised obliquely by Wennberg when he discusses a 'medical care black box', and explains that the practice style theory was developed after it became clear that "the variation phenomenon could not be explained by traditional theories". However, Wennberg (1984) recognises the difficulty of explaining variation without direct evidence for the positive phenomenon of practice style.

Negative definition leaves researchers with the risk of confusing the phenomenon under investigation with the inevitable effects of random variation, particularly if the statistical aspects of a study are not well handled. In a simulation study, Diehr used random number simulation to model the variability which is expected from chance alone in hospital procedures for large populations (Diehr 1990, Diehr 1992). An important finding from this study was the demonstration of the potential to observe high variation in the presence of low underlying procedure rates as a consequence of purely random effects. Similarly, Moore and Roland (1989) successfully simulated distributions of GP referral, demonstrating that a high degree of variability is to be expected by chance alone. Clearly, the problem of statistical significance in variation studies is a complex one, which is exacerbated

by imprecision in defining the phenomenon under investigation. In a generalist field of clinical practice, numbers of any single condition can be relatively small, making statistically robust estimates of variability very challenging.

While at first glance the phenomenon of variation may seem to be an easily grasped concept, it presents several methodological difficulties. The root of some of these methodological difficulties lies in finding an appropriate definition of variation.

7. Discussion

Perhaps the most glaring methodological issue in interpreting variation for policy purposes is the problem of confusing variability at the individual level and the aggregate level. Many of the policies which have been implemented for reducing variation work at the level of the individual clinician. Examples of such approaches include feedback, or 'report cards' on the individual clinician's use of resources, implementing guidelines in a prescriptive fashion, and the general development of performance indicators for individual clinicians. But the justification for such interventions is often based upon observations of area-level variation. This is a classic example of ecological fallacy – reasoning from an aggregated level to a conclusion about the individual.

A further important issue for policymakers is the tendency to use negative, residual definitions of variability. The inherent bias in defining variability in such a way without being explicit about the 'null hypothesis' – the degree of variation which is to be expected by chance – presents a trap. Such loaded interpretations of research can appear to be a strong justification for constraining clinical activity, but in fact hide the desirability of understanding variation before seeking to eliminate it. Naïve interpretations of variability can give the impression of great problems of quality, equity and efficiency in a health system, but the impact of such impressions can melt away under more detailed scrutiny. Interpreting observations of variation is therefore a complex task, fraught with challenges and methodological difficulties.

The debate about appropriate responses to observations of variability is certain to continue. But, although some observations of variability can be dramatic, it is a subtle and complex phenomenon which demands careful thought about the methodology of analysis and the underlying philosophy of clinical practice. The common interpretation of variation as a marker of poor quality, inequity or inefficiency may be justified in some, or even many, circumstances, but there is a need for robust research which will discriminate between circumstances in which variation does or does not have adverse consequences for patients or for the

health system. The challenge which medical practice variation presents to researchers and policy makers is to make sure that clinical judgement is as effective as possible without unduly stifling the scope of that judgement.

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