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Review

Why do high-volume hospitals achieve better outcomes? A systematic review about intermediate factors in volume–outcome relationships

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ABSTRACT

Objective: To assess the role of process and structural factors in volume–outcome relationships.
Data sources: Pubmed electronic database, until March 2014.
Study design: Systematic review. Based on a conceptual framework, peer-reviewed publications were included that presented evidence about explanatory factors in volume–outcome associations.
Data collection: Two reviewers extracted information about study design, study population, volume and outcome measures, as well as explanatory factors. Included publications were appraised for methodological quality.
Principal findings: After screening 1756 titles, 27 met our inclusion criteria. Three main categories of explanatory factors could be identified: 1. Compliance to evidence based processes of care ($n = 7$). 2. Level of specialization ($n = 11$). 3. Hospital level factors ($n = 10$). In ten studies, process and/or structural characteristics partly explained the established volume–outcome association. The median quality score of the 27 studies was 8 out of a possible 18 points.
Conclusions: The vast majority of volume–outcome studies do not focus on the underlying mechanism by including process and structural characteristics as explanatory factors in their analysis. The methodological quality of studies is also modest, which makes us question the available evidence for current policies to concentrate care on the basis of volume.

1. Introduction

One century ago differences in outcomes for patients in high and low volume hospitals were identified and published for the first time [1]. Questions raised by this discovery lay dormant until the 1970s when volume–outcome studies in surgery became widespread. The main conclusion derived from the vast amount of these studies is that higher volume correlates to better outcomes, especially in high-risk surgery such as esophagectomy, pancreatic resection and repair of an abdominal aortic aneurysm [2–4]. This conclusion is confirmed in various systematic reviews [5–7].

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Although some studies focus on volume–outcome relationships in non-invasive medicine, the research is predominantly aimed at the surgical domain. In these studies both hospital and individual surgeon volume are used as the unit of analysis. Hospital volume reflects characteristics of the institution, such as infrastructure and nurse-to-patient ratio. Surgeon volume can be seen as a proxy for individual traits of the surgeon, for example certain technical or decision-making skills [8]. Even though both levels seem to influence patient outcomes, the strength of the relationship varies according to the technical difficulty of the surgery or the availability of specific hospital-based services [3]. Although scarce, research wherein the interaction between both levels on outcomes is examined, shows that better outcome in high-volume hospitals is partly explained by higher surgeon volumes and vice versa [9,10].

Over the years, the available evidence supporting higher volumes for better outcomes, has been applied in quality and cost improvement policies. For example, by volume-based selective purchasing of care, referral to high-volume hospitals is stimulated. In the USA this is illustrated by volume thresholds implemented by the Leapfrog Group. The Leapfrog Group is a voluntary program that represents employer members from some of USA's largest corporations and public agencies. These members agree to implement a number of 'purchasing principles' when buying health care for their enrollees. In their effort to improve quality and safety of care hospitals are required to meet volume standards for high-risk procedures in order to be eligible for a contract [11].

The 'more is better' approach is intuitively attractive. The question remains however whether selective purchasing based on volume standards can be effective when the underlying mechanism of volume–outcome relationships still remain to be identified. Various authors have attempted to shed some light on the predominant underlying factors. Luft et al. [12] have explored the plausibility of two alternative, not mutually excluded hypotheses for the inverse volume–outcome relationships: "selective referral" versus "practice-makes-perfect". The first indicates possible reverse causality in the volume–outcome relationship: physicians and hospitals with better outcomes attract higher volumes of patients. The second hypothesis is based on the mechanism 'learning by doing', by which providers achieve better patient outcomes as a result of increased experience. Both explanations proved to be valid for 17 categories of patients from a sample of over 900 hospitals [12]. Because both causal models have different policy implications, many authors have tested the two hypotheses for various procedures. Huesch [13] for example found that learning effects played no significant role in driving patient outcomes for coronary artery bypass grafts (CABG) procedures. Tsai et al. [14] used an instrumental variable approach and concluded that selective referral effects may contaminate volume–outcome relationships for congestive heart failure.

Despite the heterogeneity in evidence for the true mechanism, there is wide consensus that volume is an imperfect correlate of quality; volume alone does not result in better performance, but acts as a proxy measure for various processes and provider characteristics that directly influence outcomes [3,15,16,4]. On this premise we conducted a systematic review of empirical studies to assess the role of processes of care and provider characteristics mediating volume–outcome associations.

2. Material and methods

2.1. Conceptual framework

Halm et al. [34] developed a conceptual model displaying the factors which are likely to be the most potent explanatory variables in understanding how volume of services is related to health outcomes. The model includes patient selection, patient characteristics and physician and hospital characteristics, such as skills and availability of certain resources. In this review we are focused on provider characteristics, such as processes of care, physician skills as portrayed by level of specialization and hospital or organizational skill. Patient characteristics were not included in our framework (Fig. 1).

The framework contains three relationships. Firstly, the main focus of most volume–outcome studies, i.e., the association between procedure volume for a hospital or surgeon and patient outcomes such as mortality, complications, or length of stay (Fig. 1, arrow 1). The second relationship represents the association between provider volume and structural and process characteristics (Fig. 1, arrow

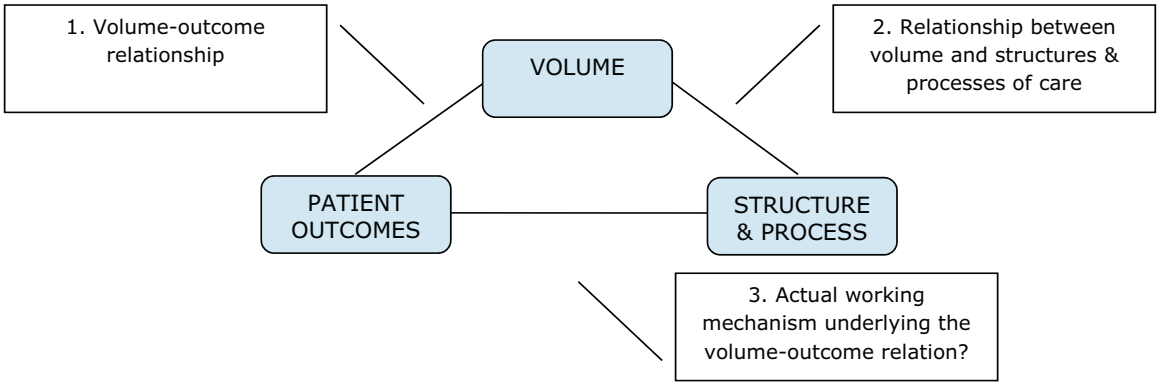

Fig. 1. Conceptual framework for the volume–outcome relationships.

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