Editorial

Measuring costs and outcomes: what are suitable models while implementing value-based healthcare in thoracic surgery?

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Value-based healthcare (VBHC) and patient value (PV): theory and models

VBHC, introduced by Porter and Teisberg in 2006, was conceptualized to enhance the structure and functioning of healthcare systems (1). When implementing VBHC, improving PV should be the overarching goal for all stakeholders which is increasing and optimizing costs and patient-relevant outcomes, which are outcomes that are significant or relevant to patients for a specific medical condition (2). In recent years, there have been worldwide advancements in the development and implementation of VBHC (3). One of the first steps to implement VBHC is to accurately measure and improve clinical outcomes and costs (4). In order to do so, various initiatives from respected institutions have emerged to facilitate the accurate measurement of healthcare outcomes that can ultimately aid in improvement of quality of care. Standard sets of outcomes for specific patient groups have been proposed by, among others, the International Consortium for Health Outcomes Measurement (ICHOM) in order to monitor and benchmark outcomes (5,6). Furthermore, in several countries, VBHC initiatives and outcome measurements have been implemented on a nationwide scale (3,7). Fewer examples of practical implementation on a large scale are available for measuring healthcare costs.

Although multiple cost accounting methods exist, such as relative value unit, diagnosis-related group, and ratio-of-cost-to charges, the preferred method for monitoring costs as part of the VBHC paradigm is the time-driven activity-based costing (TDABC) model, pioneered by Kaplan & Anderson (8,9). TDABC is a modification of the traditional activity-based costing method and assesses direct and indirect costs based on the time required to perform an activity per process step and the indirect costs it requires (8,10,11). The method first identifies all activities involved in a certain process and estimates the resource costs for each activity. Thereafter, the total resource costs are calculated and the time required for each activity is determined. Subsequently, the costs per unit of time for each activity is calculated, which is then used to assign costs to the entire process (10,11). A recent systematic review by Leusder and colleagues [2022] showed that despite

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the clear recommendations on how to conduct TDABC, the application described in clinical research indicates a significant deviation from the preferred methodology (11). This deviation resulted in the omission crucial elements and inconsistencies in results (11). Most importantly, according to previous studies and expert opinions, the practical application of TDABC is restricted due to its complexity, time-intensive and highly laborious nature and its suitability mainly for predictable short-term care and less scalable in healthcare settings with complex patient pathways (11-13). Also, TDABC seems most useful for (financial) managers and contains less relevant information for patients and physicians (13-15). Despite the known shortcomings, a well-documented alternative for cost measurement and subsequent monitoring in healthcare is absent (11,14). Nonetheless, there remains interest in a model that aligns with the principles of VBHC and includes both costs and outcomes as interrelated entities (2).

The key VBHC principles of a model to measure PV

Considering these ongoing challenges and the scarcity of PV models, it is necessary to first identify what key VBHC principles should lay the foundation for a model that can be used to monitor PV. While acknowledging the potential development of new sub-theories that either extend or deviate from the original VBHC framework, this manuscript adopts the VBHC theories as originally developed by Porter and Teisberg. *Table 1* presents an overview of these criteria, while the subsequent text outlines the same criteria with respective letters.

First, according to Porter and Lee's VBHC theory, the model should be patient-centred (a), aimed at improving PV (b) and relevant for physicians (c) (2,4). Additionally, the model ought to be tailored to a specific patient group suffering from the same medical condition (d) and it should include the entire care chain (e) (2).

Regarding the indicators, the model should ensure the inclusion of outcome (f) and cost (i) indicators representing PV that are practically relevant to all stakeholders (2). In terms of clinical outcomes, the three-tiered outcome measure hierarchy should be taken into account (g). This implies that some outcomes, such as outcomes related to health status like mortality (survival), are generally considered more important than others, such as outcomes related to sustainability of health like long-term consequences of therapy (2). In addition, the model should adhere to the quality measurement landscape, i.e., while process indicators, which represent activities during patient care, are relevant, they are primarily supportive to outcome indicators, which signify the results of patient care (h) (2). Concerning cost indicators, the theoretical preference for cost measurement is TDABC (j) (8). In addition, external validation of indicators, often achieved through literature reviews, remains a significant aspect.

Finally, in terms of methodological aspects of the model, the model should be able to facilitate benchmarking between healthcare providers or changes in PV over time (l) (4). Physicians should have the capacity to influence the indicators measured and results should be presented in a comprehensible manner (m) (4). Moreover, data collection should be feasible, without requiring too intense time or resources (n), as a pragmatic approach in the implementation of VBHC principles has been proven successful in measuring and improving outcomes (16-18). The model should also include the organization of care into integrated practice units (IPUs) (o), which translates into ensuring a multidisciplinary perspective in the used methodology (4). Lastly, the model should be broadly applicable and demonstrate the capacity for applicability and translatability across various medical conditions (p).

Two recently developed models

Recently, Orlandi and colleagues [2023] published an innovative PV model that provides an approach to measuring and monitoring both costs and clinical outcomes (19). We have read the article with utmost interest and would like to congratulate the authors on their novel method for analysing and evaluating organisational improvements in thoracic surgery using a VBHC approach. The authors developed the patient value in thoracic surgery (PVTS) score based on indicators that are selected by literature review and estimates the overall PV for lung cancer patients undergoing lung resection. The PVTS has a theoretical framework and is an aggregate score of 55 key performance indicators (KPIs) which are derived through extensive literature review. The tool has been partially applied into practice in the past three years of the Monza ASST thoracic surgery department with an overall positive performance, improving clinical efficacy. The authors believe the application of the PVTS score, after longitudinal validation, can be used to introduce improvement actions with equal attention to both outcomes and costs, making it an initial stride towards integrating a VBHC approach.

In another recent advancement, van Steenbergen and

Table 1 Evaluation of the key principles of a VBHC model: a comparison between the models presented by Orlandi *et al.* and van Steenbergen *et al.*

Criteria	No.	Orlandi *et al.*	van Steenbergen *et al.*
General principles			
Patient centred	a	Somewhat present	Present
		Patient related indicators are included, but patient involvement in the selection process is absent	Patient related indicators are included and patient representatives were involved in the selection process of indicators
Aimed at improving PV	b	Somewhat present	Present
		The model aims to improve PV, however, it does not provide explicit details regarding several aspects of the methodology of the model	The model aims to improve PV with clinical outcomes weighted against patient-driven costs pre- and post-intervention
Relevant for physicians (physician-driven)	c	Somewhat present	Present
		Some indicators are physician-driven but selected based on literary findings only	Indicators are physician-driven and selected by physicians
Includes defined patient population	d	Somewhat present	Somewhat present
		Model targets a defined patient population, but centres a specific intervention	Model targets a defined patient population, but centres a specific intervention
Includes the entire care chain	e	Somewhat present	Somewhat present
		Model includes complete care trajectory but healthcare prior to intervention and diagnostic/preparatory care remains absent (data includes intervention and follow-up). Model is limited to hospital care	Model includes complete care trajectory (data includes 12 months before and after healthcare intervention). Model is limited to hospital care
Indicators			
Includes clinical outcomes	f	Present	Present
		Model includes several outcome indicators	Model includes several outcome indicators
Complies to the outcome measure hierarchy	g	Absent	Somewhat present
		Both process and outcome indicators are combined in one final score	Separate indicators are present but there is no clear hierarchy
Complies to the quality measurement landscape	h	Present	Present
		Process indicators that are related to outcomes are included in the model	Process indicators that are related to outcomes are included in the model
Includes costs of care	i	Present	Present
		Model includes several cost indicators	Model includes several cost indicators
Cost measurement via TDABC	j	Absent	Absent
		Authors developed their own method to calculate costs	Authors developed their own method to calculate costs
Validation of indicators via literature	k	Present	Somewhat present
		Both outcome and costs indicators are retrieved from literature	Outcome indicators are retrieved from a national clinical quality registry (in literature), cost indicators are not validated in literature

Table 1 (*continued*)

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Criteria	No.	Orlandi *et al.*	van Steenbergen *et al.*
Methodological aspects			
Facilitation of benchmarking (between healthcare providers or changes in PV over time)	l	Somewhat present	Present
		The PVTS score can be used to monitor and benchmark PV, although it has not been applied yet	The spiderchart can be used to monitor and benchmark PV, indicators are shown for multiple cohorts
Visualisation of model	m	Present	Present
		Results are concluded in one value (PVTS score)	Results are demonstrated in a spiderchart
Pragmatic applicability in daily practice	n	Somewhat present	Present
		Indicators are selected by literature review, however indicators are included that lack corresponding real-world data	Model only uses cost indicators based on readily available in-hospital data and outcome indicators based on data that is already collected for CQR
IPU in multidisciplinary setting	o	Somewhat present	Present
		Multidisciplinary indicators are included, but there was no multidisciplinary selection process	Multidisciplinary indicators are included and a multidisciplinary selection process is used
Applicability and translatability of the model to other medical conditions	p	Absent	Present
		The methodology, primarily based on literature research focused on thoracic surgery, lacks detailed information, making its application in other fields challenging	Methodology is a systematical approach and described in great detail

VBHC, value-based healthcare; PV, patient value; IPU, integrated practice units; TDABC, time-driven activity-based costing; PVTS, patient value thoracic surgery; CQR, clinical quality registry.

colleagues [2023] introduced a PV model to accurately monitor and visually represent both outcomes and costs of aortic valve disease patients undergoing transcatheter aortic valve implantation and to support hands-on learning and implementation of improvement initiatives (20). The clinical outcomes integrated into the model were sourced from the Netherlands Heart Registration (NHR), a clinical quality registry (CQR) that uses outcome indicators that are aligned with the ICHOM sets (21). Cost parameters are selected using readily available financial in-hospital data, such as outpatient clinic visits and intensive care stays (20). This selection process consists of a systematic, stepwise and multidisciplinary approach involving researchers, data analysts, physicians and patient representatives, aiming to ensure patient-centred and physician-driven principles. The first step was to create a comprehensive list of all healthcare activities associated with a specific medical intervention. Activities of minimal cost or negligible occurrence were excluded. Second, the cumulative effect of each activity was calculated by adding the quantity and the price. Third, healthcare activities were ranked by physicians according to their ability to influence activity volume or associated costs. Finally, the relevance of care activities was assessed by patient representatives. Through this collaborative process, fifteen patient-relevant cost drivers were identified, collectively capturing over eighty per cent of the incurred real-world in-hospital costs.

The models presented by Orlandi *et al.* [2023] and van Steenbergen *et al.* [2023] (14,19): strengths, and challenges

In the pursuit of refining PV monitoring, notable contributions have been made by both Orlandi *et al.* and van Steenbergen *et al.* (14,19). Nevertheless, an assessment in the context of the aforementioned VBHC criteria reveals certain areas warranting further consideration and presents certain challenges. *Table 1* demonstrates a summary of the

degree to which both models meet the key principles of a VBHC model, including a short explanation.

Both frameworks present clinical outcomes and costs with a common objective of longitudinal outcome monitoring using a VBHC perspective. The model presented by Orlandi *et al.* includes a total of 37 outcome indicators, categorised into safety, patient experience and clinical efficacy. Additionally, the model includes 18 resource indicators, categorised into revenue costs, capital costs and non-financial costs, such as patient opportunity costs. On the other hand, the model presented by van Steenbergen *et al.* incorporates six clinical outcomes and fifteen patient-relevant cost drivers, categorised into pre-intervention costs, hospitalisation and follow-up costs. The models have common indicators such as readmission rates, complications during follow-up, mortality rates and length of hospital stay. However, the classification of these indicators and the level of detail differ. For instance, in the model proposed by van Steenbergen *et al.*, the indicator 'outpatient visits' is categorised as a pre-intervention cost indicator, whereas in the model designed by Orlandi *et al.*, it is categorised as a clinical outcome. Moreover, Orlandi *et al.* provides indicators on a more detailed level, separating hourly costs for specific job functions, while van Steenbergen *et al.* provides overall cost drivers, such as intervention cost as a whole.

A criticism of both models is the fact that both models target a specific intervention within a defined patient population. Patients with the same medical condition that do not undergo this intervention, are not included. According to the VBHC paradigm developed by Porter [2010], a broad perspective should be used that includes an entire medical condition or patient population (2). In addition, both models focus on hospital costs which deviates from the ideal that advocates for inclusive representation of the entire patient care cycle including, for example, primary healthcare (2). Furthermore, both models do not take a hierarchy of outcome measures into account; Orlandi *et al.* combine both process and outcome indicators while van Steenbergen *et al.* demonstrate separate indicators covering the three tiers of Porter's outcome hierarchy, but do not explicitly prioritize them accordingly. Lastly, both models developed methods for cost calculations, deviating from the use of TDABC as the gold standard for cost measurement, potentially constraining the accuracy and precision.

The authors use different methodologies to select the cost and outcome indicators. The model presented by Orlandi *et al.* is based on extensive literature review, externally validating its indicators. A lack of explicit clarity in the description of the methodology of Orlandi *et al.* raises questions about the comprehensive coverage of relevant indicators. Notably, some indicators endorsed by international reporting guidelines and CQRs for lung cancer patients are absent, like indicators related to diagnostic and preparatory stages (22,23). As the authors note in the discussion section, the feasibility of certain indicators from the literature in daily practice proves to be challenging at a retrospective stage as indicators may be included without corresponding real-world data. As a result, in the model developed by Orlandi *et al.*, a mere one-third of the initial indicators could be analysed. Furthermore, the relationship between these indicators and their potential to improve PV remains relatively unclear. For example: indicators such as 'number of nursing discharge letters' or the process-related indicators such as 'metres covered by the patient inside the hospital' or 'time between referral and outpatient appointment' have uncertain relevance to patients and contribution to improving PV. Despite the crucial role of the patient perspective within VBHC, the paper does not explicitly mention patient involvement in the process of selecting indicators.

The model presented by van Steenbergen *et al.* is pragmatically designed to enhance its applicability in daily practice, focusing solely on cost indicators derived from readily available in-hospital data and outcome indicators based on data that is already collected for a CQR. A notable limitation of the model is the lack of validation in existing literature regarding the cost indicators. There is a possibility that certain indicators, although theoretically important, such as, sustainability of recovery or patient satisfaction, may be omitted from the model because they are not clinical outcomes used by a CQR and are often not included in the registered in-hospital healthcare activities by default. In addition, as healthcare systems differ per country, the method might not allow for international benchmarking.

An appropriate tool for presenting clinical outcomes and costs is also required. Orlandi *et al.* translated each indicator into a 7-point Likert scale. Since one scale was created for all parameters, so the visualisation overall was simplified for users. On the other hand, van Steenbergen *et al.* took a different approach and visualized the indicators in a spider chart for different cohorts (such as pre-and post-intervention), creating a different scale for each parameter, which complicates the accessibility of the model. A drawback for visualisations by both Orlandi *et al.* and van Steenbergen *et al.* is that translation is required to give individual

indicators significance and retrace the actual score of the specific indicator. A unique addition to the visualisation of the model proposed by Orlandi *et al.* is the PVTS score, which provides an indication of the PV encompassing the treatment pathway for each patient. As noted by Orlandi *et al.*, over time or after implementation of an improvement project, the PVTS score could monitor PV, identify improvements needed and quantify the effectiveness of thoracic surgery. This single metric is straightforward and easily interpretable. However, it should be noted that the calculation of the PVTS score is not explicitly described leaving undisclosed how and in what ratio process and outcome indicators are aggregated. Furthermore, the PVTS score appears to lean towards a cost-effectiveness analysis, where costs and outcomes are expressed in a single measure and a healthcare sector or societal perspective is used while VBHC including PV uses a patient perspective and deliberately does not treat costs and clinical outcomes as separate but as interrelated entities (2,24).

Future perspectives

To summarise, the PV model developed by Orlandi *et al.* employs a theoretical framework, selecting cost and outcome indicators using literature from the last decade providing a representative overview of indicators. On the other hand, van Steenbergen *et al.* provide a multidisciplinary method for pragmatically selecting cost indicators with readily available data while using outcome indicators derived from a CQR. Although the models developed by Orlandi *et al.* and van Steenbergen *et al.* have made significant strides, a careful review highlights the need for continuous refinement and addresses the complexities associated with the practical implementation of VBHC principles in models to measure and monitor PV. An exemplary model fulfilling all VBHC criteria does not yet exist. However, both models represent a step towards incorporating VBHC principles. This leads to the question of what model healthcare providers must choose in their efforts to shift towards a value-driven healthcare system.

In terms of clinical outcomes, a PV model can readily utilise indicators that are included in international reporting guidelines and CQRs. Several studies showed that through systematic monitoring of clinical outcomes, as advocated as the first step within the VBHC theory, improvement of indicators and quality of care can be seen (2,14,16,20,25). Depending on the current status of the implementation of VBHC in a healthcare organisation and the availability of data, different cost measurement methods can be used as feasible alternatives to the TDABC approach. In healthcare domains in which theoretical outcome information is not yet available from literature, the VBHC model by van Steenbergen *et al.* could be applied as this only uses available local, in-hospital data. The model presented by Orlandi *et al.* could be implemented as a methodology for selecting costs, in which a consensus on a standardized set of indicators and parameters is reached in expert groups and literature. This will require optimal and standardized data collection, potentially via CQRs to refine the model's precision and ensure data availability. Aligning and validating the chosen indicators will extend the model's local applicability to other regions, enabling comparison and benchmarking on a broader scale and across countries. In the future, in a system in which data collection for a standardized set of cost parameters is optimized, a push towards the application of TDABC can be made to achieve the highest level of accuracy of cost measurement. By doing this, it is possible to work towards a PV model that adheres to all key principles of VBHC. Given that much development is needed before this can be achieved, we encourage healthcare providers and researchers to take a pragmatic approach. Consider initiating the process, learning and refining the measurement of both outcomes and costs using suitable models such as those developed by Orlandi *et al.* or van Steenbergen *et al.*, and progressively work towards the use of more advanced models that better adapt to real-world healthcare costs.

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