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The economic consequences of practice style variation in providing medical interventions: A systematic review of the literature

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Abstract:

The practice style variation (PSV) incurs undesirable clinical and economic consequences for patients and the healthcare system. This review aims to analyze the economic consequences of PSV in medical interventions. A comprehensive electronic search was conducted through PubMed, Web of Sciences, EBSCO, EMBASE, and Cochrane databases to retrieve studies on economic consequences of PSV within 1975–2018. The studies were independently assessed by two reviewers. The quality of studies was assessed by Strengthening the Reporting of Observational Studies in Epidemiology checklist. No language restriction was applied. Only four studies met the eligibility criteria. These studies have been conducted retrospectively in developed countries. Most of the included studies used consumer demand theory to measure the economic consequences of PSV. Findings showed 12%–74% of all variations in healthcare services are related to PSV, thereby incurring up to 23 million dollars for the healthcare system. The PSV is related to the total expenditure, price elasticity, and coefficient of variation of healthcare services. PSV associated with huge inefficiency and inequity in access to healthcare services. To mitigate the consequences of PSV, policymakers should consider PSV in both developing the medical education plans as well as cost management. Using multilevel analysis to investigate the determinants of PSV would be beneficial.

Keywords:

Economics, small area variations, systematic review, welfare

Introduction

Healthcare variation is known as a phenomenon that is related to the different rate of diagnostic and medical services utilization in different healthcare centers or geographical areas. This variation exists at all levels of the healthcare system in all countries.^[1-3] Women living in rural areas of Australia five times more likely to undergo hysterectomy for abnormal uterine bleeding compared with those living in cities.^[4] Some studies have revealed that the area and place of residence are as effective as

the clinical condition of individuals on the probability of receiving various surgeries.^[5]

If the whole healthcare variation was unfavorable, its elimination would not seem so difficult.^[6] In fact, various variables lie at the same level and cause variation in service delivery. The results of studies have addressed that it is not logical to consider the whole variation in healthcare services to the patient's health need. However, a significant number of patients receive less than or above the required diagnostic and therapeutic.^[7-9] Variation in healthcare services also depends on physicians' medical practices. Some scholars argue

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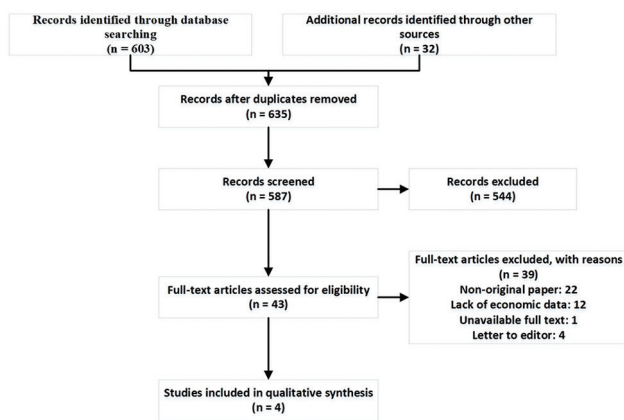


Figure 1: Flowchart of selection included studies for systematic review

that physicians are treated differently in terms of knowledge, experience, and skill they adopt for curing patients.^[10-12] This phenomenon is known as practice style variation (PSV) which is an undesirable and unexplained variation.^[13]

In addition to the adverse effects of PSV on quality of care and patients' health states, inequities in patients' access to diagnostic and medical services and unfair distribution of limited healthcare resources can also be addressed.^[14-16] Departing from the optimal level of service that should be provided to patients leads to inefficiency in the use of health resources. It is assumed that PSV reduction in services can be considered as a way for performance improvement. Addressing the economic consequences of PSV in diagnostic and medical interventions in various studies has resulted in significant findings that can be employed by both doctors to improve clinical performance and policymakers to develop cost management policies.^[17] There is not a comprehensive study to address the effects of the economic consequences of PSV. This study aims to systematically review the economic consequences of PSV on health services.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines were applied as follows:^[18]

Eligibility criteria

The original, case-control and experimental studies (cohort, randomized controlled trials), which investigated the economic consequences of variation in healthcare services were entered into the analysis.

Economic consequences of PSV can be demonstrated as an increase in resource utilization, the length of stay in the hospital, out-of-pocket costs, and welfare loss. The

economic consequences can be directly or indirectly reported to monetary units. To be included in the analysis, the studies should have examined the variation in the category of healthcare services. It should be noted that language restrictions, limitations on the study design, country of residence, gender, and ethnic were not applied in the present study. In addition, original studies were included in the present study, regardless of the level of their analyses (e.g., country-level or hospital-level).

Information sources

The PubMed databases, web of science, Scopus, EMBASE EBSCO, and Cochrane databases were systematically searched. To complete the search, the reference list of marker studies was searched. The international databases such as the World Health Organization, the European Health Organization and the Atlas of the variation web site were also searched manually. All potential studies carried out within 1975–2018 were included. To ensure the comprehensiveness of the search, the dissertation which investigates the variation of healthcare services through the ProQuest Database was reviewed. In addition, the Scopus database and web of sciences were also searched to retrieve abstract articles from the related scientific conferences. The authors and scholars of studies focusing on healthcare variations were also electronically requested to send more of their related studies.

Search strategy

With regard to the research questions, a broad search strategy was developed in two compartments. First, through the words MESH and other related terms, the search strategy for retrieving articles in PubMed was developed. Then, the search strategy was modified and used for other databases. The initial search strategy was as follows:

1. Variation pattern (Title/Abstract) OR diagnosis variation (Title/Abstract) OR surgical variation (Title/Abstract) OR practice variation (Title/Abstract) OR practice style (Title/Abstract) OR unexplained variation (Title/Abstract) OR medical variation (Title/Abstract) OR surgical variation (Title/Abstract) OR health professional practice style (Title/Abstract) OR unwarranted practice variation (Title/Abstract) OR warranted variation OR clinical variation OR observation (Title/Abstract) OR intra-class variation (Title/Abstract), proportional variation (Title/Abstract) OR small area variation (Title/Abstract) OR atlas of variation (Title/Abstract) OR geographic distribution (Title/Abstract).
2. Consequences (Title/Abstract) OR impact (Title/Abstract) OR utilization (Title/Abstract) OR adverse effect (Title/Abstract) OR Iatrogenic impacts (Title/Abstract) OR cost (Title/Abstract) OR economic consequences (Title/Abstract) OR welfare

loss (Title/Abstract) OR monetary unit (Title/Abstract) OR expenditure (Title/Abstract) OR financial (Title/Abstract)

3. 1 AND 2.

Study selection

The studies were independently reviewed by two reviewers. In the first step, the titles and abstracts of retrieved studies were examined. Then, the full texts of the remaining studies were carefully examined in terms of compliance with the inclusion and exclusion criteria, and the remaining studies entered the final analysis. Any disagreement between the two reviewers was discussed in consultation with a third reviewer until reach a consensus.

Quality of studies

To assess the methodological quality of the studies, quality assessment questionnaires were used by the Strengthening the Reporting of Observational studies in Epidemiology checklists according to the study design appropriate checklist for measuring the quality of studies. In this checklist, there are several questions relating to the design of studies and various biases that allow for comparing studies based on their methodological quality. Two reviewers independently assessed the quality of included studies. Any disagreement between reviewers was resolved through consulting a third reviewer.

Extraction and management of evidence

The information about each of the studies was extracted in a predesigned form, which included not only the basic information such as the year of publication, the type of study design, the name of the authors and the country but also specific information such as the population under study, the type of statistical method, the study perspective, findings and evidence analysis were considered. For each study, a code was assigned to ease the analysis.

Evidence analysis

The data from qualitative data extraction, which were based on the methodology for calculating economic consequences, identifying the unwarranted variation from warranted variation, and determinants of variation was investigated.

Results

In the present study, 603 papers were retrieved electronically and 32 other studies were retrieved manually [Figure 1]. After reading the titles and abstracts of the studies, 43 articles were selected. Then, the full texts of the remaining studies were examined. Finally, four studies have met the eligibility criteria which

economic consequences were examined in these studies. Main reasons for excluding studies were the studies that were not original data (22 items) and those which did not report the economic consequences (12 studies). Among the included studies, only one of them^[19] examined the economic consequences of health service (cesarean section), whereas the three other studies examined the economic consequences of a set of diagnostic and medical services.^[20-22] Quality of the included studies was assessed as good quality. Three studies examined the effects of PSV on diagnostic and therapeutic services,^[19,21,22] whereas only one study examined the economic consequences of PSV in the codes used in the diagnosis-related group (DRG) system.^[20] Table 1 gives a more detailed description of the characteristics of the included studies.

Unit of analysis

Three studies were analyzed based on geographic units (e.g., state and county) and considered a study about medical centers as the unit of analysis. Indeed, the analysis unit in studies performed by Parente *et al.*,^[21] Phelps and Parente^[20] and Filippini *et al.*^[22] were based on geographic regions, while in a study conducted by Eckerlund and Gerdtham^[19] the analysis unit was the midwifery centers. Parente *et al.* selected a sample of 5% of Medicare's insurers as the analytical data based on state division.^[21] In a study of Phelps and Parente selected the insured patients of New York for analysis on the basis of different counties.^[20] Filippini *et al.* used the data for 26 cantons and 240 economic regions to measure the PSV economic consequences.^[22] In contrast, Eckerlund and Gerdtham considered 59 midwifery centers, which accounted for 97% of all Swedish deliveries in Sweden.^[19] In addition, three studies applied cross-sectional data^[19-21] and one study used cross-sectional data with three intervals.^[22]

Selecting health services

A wide range of services have been analyzed in included studies. In a study done by Eckerlund and Gerdtham cesarean section was examined as the only treatment intervention.^[19] However, in a study of Parente *et al.*, 116 diagnostic and medical services were analyzed individually.^[21] In the study conducted by Filippini *et al.*, the economic consequences of the administration of antibiotics in the outpatient departments were addressed.^[22] Interestingly enough, Phelps and Parente analyzed the 134 DRGs used in the admissions section rather than the selection of a service or a bunch of services.^[20]

Report the findings

The included studies had been reported PSV in two ways, both monetary and nonmonetary. Parente *et al.* measured the variation in the services and the welfare losses caused

Table 1: Characteristics of included studies regarding economic consequences of practice style variation

Items	Characteristics of included studies			
Authors	Parente <i>et al.</i>	Eckerlund <i>et al.</i>	Phelps <i>et al.</i>	Phelps <i>et al.</i>
Year of publication	2008	1998	1990	1990
Country setting	United States	Sweden	United States	United States
Population (unit of analysis)	5% of claim data of Medicare (state)	59 midwifery centers, 97% of delivery of neonate at 1991 (midwifery center)	Inpatient data of all hospitals in New York (count)	Inpatient data of all hospitals in New York (county)
Selected services or diseases	116 medical interventions	Cesarean section	134 of 470 DRG codes	134 of 470 DRGs codes
Type of variation reporting	Monetary and nonmonetary	Monetary and nonmonetary	Monetary and nonmonetary	Monetary and nonmonetary
Types of dataset	Cross-sectional	Cross-sectional	Cross-sectional	Cross-sectional
Determinants of variation	Age; gender; Medicaid; participation rate; Medicare HMO market penetration; rate; mortality; Medicare supplemental coverage	Cesarean section rate; mother age; parity rate; cesarean indications; well; equipped hospital; delivery per physician; occupancy rate at maternity ward; education; any compliant; gynecological wards admission per physician; gynecological visits per physician	Per capita income; Percent >65 years-old; Percent female; average employee/firm; population density; percent <18 years; percent female headed household; hospital bed per capita; percent of population in poverty; percent with college education	Per capita income; percent >65 years old; percent female; average employee/firm; population density; percent <18 years; percent female headed household; hospital bed per capita; percent of population in poverty; percent with college education
Analytical techniques	OLS regression	Logit model regression; weighted least square regression	OLS regression	OLS regression
Percentage of unwarranted variation (monetary unit)	From 14.7% to 73.2%; (from 3.4 thousand dollars to 29.3 million dollars)	73% (13-16 million crowns per year)	From 11.9% to 72.8% (from 530 thousand dollars to 62.3 million dollars)	From 11.9% to 72.8% (from 530 thousand dollars to 62.3 million dollars)
Sensitivity analysis	No	Yes	No	No
Methodological quality	Satisfactory	Satisfactory	Satisfactory	Satisfactory

HMO=Health Maintenance Organization, DRGs=Diagnosis-Related Groups

by this variation based on monetary units.^[21] Eckerlund and Gerdtham in their study reported on percentage of unexplained PSV. They reported the economic consequences through multiplying the differences between the payment for cesarean and normal delivery tariffs in the number of unnecessary cesarean sections.^[19] Phelps and Parente and Filippini *et al.* also investigated economic consequences of variation through focusing on the degree of demand elasticity of healthcare services, along with percentage of unexplained variation.^[20,22]

Identifying the unwarranted variation from warranted variation

To identify the unwarranted variation from warranted variation, the econometric analysis approach was used by included studies. To this end, the sets of variables that explain the PSV were identified and specified in the econometric model. In all of the included studies the amount of variation which could not be explained by the variables entered into the econometric model was regarded as an unwarranted variation which might be due to physicians' style practice. This can be easily calculated through measuring the distance of R², which demonstrated from result of the regression model, from one (1-R²). These variables were patient-related variables such as age, sex, and type of patient's insurance,

physician-related variables such as surgical history and skills, and variables related to the analysis unit. Parente *et al.* used seven variables, five of which were related to the patient, and two other variables were related to the degree of insurance penetration in the analysis unit.^[21] Eckerlund and Gerdtham introduced 13 variables into the econometric model, of which five variables were related to the pregnant mother and the other variables were related to the analysis unit.^[19] In the study conducted by Phelps and Parente out of the total of 10 variables included in the econometric model, except for a patient-related variable, the remaining variables were related to the analysis unit.^[20] In the study performed by Filippini *et al.*, out of the nine variables under study in the model, two variables were related to the person and seven of them were related to the analysis unit.^[22]

Econometric methods

In a study done by Eckerlund and Gerdtham the Logit model was used to explain the causes of variation. Performing or not performing surgery was introduced as a dummy variable.^[19] In studies done by Parente *et al.* and Phelps and Parente the ordinary least squares (OLS) Method was used to estimate the coefficients of variables.^[20,21] In addition, in the study performed by Philippines *et al.*, according to the type of data

which included three-period cross-sectional data, the S-2SLS Method was used to estimate the coefficients of variables.^[20,21] Except for Eckerlund and Gerdtham study,^[19] in the other study, sensitivity analysis was not used to investigate the uncertainty in findings.^[20-22]

The percentage of unwarranted variation and its economic consequences

Parente *et al.* reported that the unwarranted variation in services ranged from 14.7% in major small and large bowel operations to 73.4% in the context of conization for malignancy. This disparity caused welfare losses of \$ 3.3,000 to \$ 29.3 million.^[21] The incidence of variation in the cesarean section was 73% in the study done by Eckerlund and Gerdtham, which lead to welfare losses of 13–16 million Swedish krona per year.^[19] In a study conducted by Phelps and Parente, the incidence of variation in services ranged from 11.9% in cesarean section to 72.8% in dental extraction and restoration, and it caused welfare losses from \$ 530 thousand to \$ 62.3 million.^[20] Filippini *et al.* reported that 12% of the variation in the appointment of an antibiotic outpatient was due to physicians' practices, thereby leading to a disproportionate economic loss of 6.8 million euros a year.^[22]

Discussion

The variation phenomenon in health services is well-known, and considerable variation has been reported about hospital admission rates,^[23] length of stay,^[9] frequencies in surgery,^[24] and the provision of diagnostic and laboratory tests over the past decades.^[25] One of the ways to examine the incidence of variation in health services is the small area variation (SAV) method. The results of SAV studies in different geographic regions demonstrated that practice variation in healthcare services did not change much over the years.^[26] The variation in health services is closely related to variation in mortality and morbidity in different regions.^[27]

Dissemination of evidence regarding the tremendous share of PSV from all healthcare variation has affected policymakers because it represents the opportunity to save resources and improve health efficiency. In recent years, there has been a great deal of evidence about the factors affecting the incidence of variation in health services. This evidence suggests that various factors can lead to variation in health services that are related to the characteristics of the patient, such as age, sex, and type of health insurance.^[28,29] On the other hand, a part of the variation of healthcare services in different regions can be due to the distribution of infrastructure for the provision of services such as diagnostic and medical technologies, or the establishment of service centers

in a region. However, there is a significant part of the variation of healthcare which is associated with the practice of physicians. In fact, what has been considered as a pivotal point in the variation of health services is the decision to prescribe and provide diagnostic and medical services that are directly related to the practice of physicians.^[30,31] This part of the variation is also known as "unwarranted variation." Physicians, as agents of patients, play unavoidable roles in delivering healthcare services and its frequency for the patients (clients). Some studies acknowledge that doctors prescribe and provide different services to patients with the same health need even after control role of environmental and structural factors. Not only PSV does adverse clinical effects for patients but also it has its own economic consequences. This study is the first systematic review of investigating the economic consequences of PSV. In the present study, we reviewed the published studies that reported the economic consequences of PSV. The findings showed that the economic consequences of PSV on diagnostic and medical services could be measured. The rate of unwarranted variation was reported to range from 12% to >74%. The studies of monetary and nonmonetary methods reported the effects of PSV. Such a volume of inefficiencies in healthcare provision system is significant. The method developed by Parente *et al.* has been used in most studies for the economic effects of PSV.^[21]

In this method, the economic consequences of the variation of services were addressed through consumer demand theory, which is identified as welfare loss. The fundamental assumption of this innovative method was that when the use of a specific medical service increases, its marginal utility decreases. It was shown that the welfare loss of a community, which is resulted from the deviation from the correct rate of consumption of a medical service, is a function of the total cost of the service, the coefficient of variation of the inappropriate use of the healthcare service, and the price elasticity of the healthcare service.

Econometric studies have been used to measure the economic consequences of PSV. They considered a set of explanatory variables to measure the contribution of each variable in the probability of a healthcare service provision. The explanatory value of each variable is measurable through variable coefficients. The more the variables in the explanation, the higher the R² will be. In the included studies, share of variation that could not be explained by the variables in the model (1-R²) was regarded as the unexplained variation or unwarranted variation. The economic consequences of this variation were measured through multiplying the degree of variation in the price elasticity of the service as well as its coefficient of variation.

However, this method identifies and calculates PSV based on economically and technically valid theory; it also has its own weaknesses. Folland *et al.* argued that the part of variation that was not explained by the variables in the model can only indicate that the other variables are not entered in the model. They argued that this amount could not reflect directly the unexplained variation that arises from PSV.^[32]

On the other hand, some other experts have suggested that instead of using the OLS or 2SLS method, more sophisticated methods, such as multilevel modeling, would be used in estimating share of PSV. The researchers also argue that previous modeling methods cannot accurately reflect the behavior of physicians in prescribing diagnostic and medical services.^[33] Physicians have their own practice style to prescribe healthcare services to their patients. In fact, the patients who were treated with a physician would receive more similar services comparing when they were treated with another physician.^[34] Econometrically speaking, researchers state that explanatory variables cannot be inserted independently, but some variables are nesting in other variables. Therefore, multi-level modeling that addresses this challenge would be useful.^[35-37]

This study was also faced with some limitations. Only studies have been analyzed that examined the direct economic consequences of PSV. However, in most cases, the difference in clinical outcomes such as mortality or disability in patients leads to macroeconomic consequences. This is estimated in studies of the economic burden.^[38-40] In addition, the present study did not address the inequity issued caused by PSV and often focused on the PSV-related efficacy and welfare losses. However, one of the major aspects of health policy is to pay attention to the inequity dimension and the effects of PSV management on reducing inefficiencies in patient clinical outcomes both.

Conclusion

PSV is recognized as one of the causes of inefficiency in the healthcare system. The findings of this study showed that this variation is significant. Most of the included studies have used the demand theory to capture PSV, while it is necessary to look at the issue by institutional and behavioral economics approaches. Hence, methodological challenges to measure PSV has yet to be settled. In the area of policy-making in the healthcare system, correcting policies for training physicians as well as cost management policies can help to reduce PSV. Using multivariate modeling approach in analyzing PSV in future studies can be useful.

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Conflicts of interest

There are no conflicts of interest.

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