Health Policy 105 (2012) 128–137

Contents lists available at SciVerse ScienceDirect

Health Policy

journal homepage: www.elsevier.com/locate/healthpol

Does healthcare infrastructure have an impact on delay in diagnosis and survival?

Carl Rudolf Blankart*

Hamburg Center for Health Economics, University of Hamburg, Hamburg, Germany

ARTICLE INFO

Article history:
Received 17 October 2011
Received in revised form
20 December 2011
Accepted 9 January 2012

Keywords:
Stomach cancer
Gastric cancer
Hospital volumes
Cox proportional hazard model
Rare disease
Rural–urban differences

ABSTRACT

Introduction: The objectives of this study were to evaluate whether healthcare infrastructure impacts delay in diagnosis, and to determine whether healthcare infrastructure and delay in diagnosis impacts survival in gastric cancer.
Methods: Administrative data from 2175 gastric cancer patients was analyzed using two Cox proportional hazard models with (i) delay in diagnosis and (ii) survival as dependent variables. Density of general practitioners, density of gastroenterologists, characteristics of specialty treatment centers, demographic information, and comorbidities were included in the models. Differentiation was made between urban and rural areas.
Results: The likelihood of being diagnosed increased with an increase in general practitioners ($p < 0.0001$) and gastroenterologists ($p < 0.0001$) in rural areas. In urban areas a higher density of general practitioners reduced delay in diagnosis ($p = 0.0262$), while a higher density of gastroenterologists did not ($p = 0.2480$). The number of gastric cancer cases performed in hospital had a positive impact on survival ($p < 0.0001$), while outpatient infrastructure did not.
Conclusion: Delay in diagnosis can be reduced by higher availability of general practitioners and gastroenterologists in rural areas. Given the already very high density of physicians in urban areas there is no effect of additional gastroenterologists. As learning effects can be observed with increased hospital volumes, minimum volumes for treatment of gastric cancer may be defined.

1. Introduction

The efficient allocation of healthcare resources in healthcare infrastructure is one of the most challenging questions in health policy. Availability of healthcare infrastructure – defined as density of physicians, distances to specialty treatment centers, and specialization of hospitals – is clearly a prerequisite for the use of healthcare resources; the problem for decision makers, however, is to determine if an investment in more healthcare infrastructure will result in better outcomes. Within this context, gastric cancer is used as an example because it is a rare disease which often results in delayed diagnosis. Rare diseases such as gastric cancer may benefit from a richer healthcare infrastructure in two ways: earlier diagnosis and better treatment.

Although incidence of gastric cancer is high, current prevalence-based definitions classify it as a rare disease with a prevalence of 20 per 100,000 [1]. There are, however, large differences between continents. The highest incidence can be found in northeast Asia (69 cases per 100,000 people per year), while Europe has an intermediate rate, and there are low incidence rates in North America, Africa, South Asia, and Oceania with about 4–10 cases

* Correspondence address: Hamburg Center for Health Economics, University of Hamburg, Esplanade 36, D-20354 Hamburg, Germany.
Tel.: +49 40 42838 4677; fax: +49 40 42838 8043.
E-mail address: rudolf.blankart@wiso.uni-hamburg.de

0168-8510/$ – see front matter
doi:10.1016/j.healthpol.2012.01.006

per 100,000 people [2]. In Germany, gastric cancer is the eighth most common – though still rare – cancer site for women and the fifth most common cancer site for men [3]. Both incidence and mortality for gastric cancer have been decreasing steadily in all developed countries for about thirty years. In Germany, the annual age-standardized mortality rate per 100,000 decreased from 25.3 to 7.4 for males (13.0–3.9 for females) between 1976 and 2006 [4].

Gastric cancer is difficult to diagnose in its early stages, because it often progresses asymptomatically or causes only nonspecific symptoms. In addition, physicians tend to misinterpret symptoms and treat the patient for acid reflux disease. However, the longer the disease goes undiagnosed, the more advanced the tumor stage becomes and the poorer the prognosis [5,6]. The primary choice in treatment of gastric cancer is gastric resection of the primary tumor and regional lymph nodes. Surgery may only be performed if the tumor is local and not metastasized. In some cases, neo-adjuvant chemo- and/or radiotherapy is performed to reduce the tumor to an operable size before surgery. Adjuvant chemo- and/or radiotherapy may also be applied to slow progression of the disease. In late stages of the disease, treatment of gastric cancer is palliative or symptomatic only [5,7].

Current literature evaluates delay in diagnosis according to patient-specific factors such as sex, age, socio-economic status, or comorbidities. However, none of the nineteen studies reported in a comprehensive review of delay in diagnosis by Macdonald et al. evaluated the impact of healthcare infrastructure [8]. The available literature on healthcare infrastructure focuses on the relationship between healthcare infrastructure and utilization of healthcare services and healthcare consumption [9,10].

Unlike the relationship between inpatient healthcare infrastructure and outcomes, which has been well researched, the impact of outpatient healthcare infrastructure on survival after diagnosis of gastric cancer seems to be under-researched. Enzinger et al. find that hospital volume has no effect on overall survival [11], whereas Birkmeyer et al. state that there is a significant positive relationship between hospital volume and survival after gastric cancer surgery [12]. Nomura et al. find a significant negative relationship between mortality and hospital volume for hospitals with a very low volume [13]. None of the above-mentioned studies controlled for availability of outpatient healthcare infrastructure at the patient's location.

The objective of this study is to evaluate the impact of healthcare infrastructure in gastric cancer treatment using administrative data from a large German sickness fund. This study examines two research hypotheses. The first concerns the effect of healthcare infrastructure on delay in diagnosis: Model I tests the hypothesis that improved healthcare infrastructure at the patient's location reduces delay in diagnosis. The second concerns the impact on survival of healthcare infrastructure and delay in diagnosis: model II tests the hypothesis that improved healthcare infrastructure and shorter delay in diagnosis has a positive impact on survival.

The paper is organized as follows. Section 2 presents the data used, the study setting, and describes the methodological framework to estimate delay in diagnosis and survival. Section 3 shows the results and in Section 4 the findings are discussed with evidence from existing literature. The final section summarizes the results and gives recommendations for policy implications.

2. Material and methods

2.1. Data and study setting

The study uses data provided by Techniker Krankenkasse, a large German sickness fund that covers about 7.6 million people, i.e., about 9% of Germany's population. The dataset includes all persons insured by the fund who had at least one diagnosis of gastric cancer between January 2004 and September 2009. Patients are considered as initially diagnosed if they had their (a) initial and (b) reliable ICD10-GM (a German modification of the ICD10) diagnosis of gastric cancer (C16) within the period under observation [14]. Patients have been considered as initially diagnosed if they have not been diagnosed with gastric cancer during two year of time before their potential initial diagnosis. Patients that have not been insured during two years before their potential initial diagnosis – and therefore have not been under observation – have been excluded because it could not be ensured that the diagnosis found was their true initial diagnosis. Inpatient diagnosis codes are considered reliable because they are relevant for reimbursement purposes and therefore of a high reporting quality. However, outpatient diagnosis codes are considered as reliable only where they have been coded repeatedly within 180 days.

Patients who were diagnosed with malignant neoplasms of digestive organs (ICD10-GM C15-C26) before the initial diagnosis of gastric cancer have been excluded, because it can be assumed that the gastric cancer is a metastasis and not a primary cancer site. In addition, all patients who relocated during the period under observation have been removed, in order to ensure consistent analysis of healthcare infrastructure. Relocation of a patient was assumed to have occurred if a patient received outpatient diagnoses in more than one main postcode region (Germany is divided into nine main postcode regions) in two consecutive quarters of a year [14]. Finally, patients for whom information was missing that had to be included in the regression model have been excluded.

The dataset includes information on age, sex, the patient's place of residence as a three-digit postcode,[1] outpatient and inpatient care received, and data on the consumption of pharmaceuticals. Outpatient care data includes consultation dates, location of the physician as a three-digit postcode, and diagnoses coded with ICD10-GM codes as well as surgeries and procedures coded with OPS301 codes (a German modification of the International Classification of Procedures in Medicine). Inpatient care data includes date of admission, hospital location (five-digit postcode), diagnoses, and procedures performed.

[1] Germany is subdivided into about 700 different 3-digit and 27,000 5-digit post code areas. A 3-digit post code covers, on average, an area of 500 km^2, and a 5-digit post code an area of 13 km^2.