

# Positive predictive values of the International Classification of Disease, 10th edition diagnoses codes for diverticular disease in the Danish National Registry of Patients

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**Objective:** To investigate the accuracy of diagnostic coding for diverticular disease in the Danish National Registry of Patients (NRP).

**Study design and setting:** At Aalborg Hospital, Denmark, with a catchment area of 640,000 inhabitants, we identified 100 patients recorded in the NRP with a diagnosis of diverticular disease (International Classification of Disease codes, 10th revision [ICD-10] K572–K579) during the 1999–2008 period. We assessed the positive predictive value (PPV) as a measure of the accuracy of discharge codes for diverticular disease using information from discharge abstracts and outpatient notes as the reference standard.

**Results:** Of the 100 patients coded with diverticular disease, 49 had complicated diverticular disease, whereas 51 had uncomplicated diverticulosis. For the overall diagnosis of diverticular disease (K57), the PPV was 0.98 (95% confidence intervals [CIs]: 0.93, 0.99). For the more detailed subgroups of diagnosis indicating the presence or absence of complications (K573–K579) the PPVs ranged from 0.67 (95% CI: 0.09, 0.99) to 0.92 (95% CI: 0.52, 1.00). The diagnosis codes did not allow accurate identification of uncomplicated disease or any specific complication. However, the combined ICD-10 codes K572, K574, and K578 had a PPV of 0.91 (95% CI: 0.71, 0.99) for any complication.

**Conclusion:** The diagnosis codes in the NRP can be used to identify patients with diverticular disease in general; however, they do not accurately discern patients with uncomplicated diverticulosis or with specific diverticular complications.

**Keywords:** diverticulum, colon, diverticulitis, validation studies

## Introduction

Danish health care, disease, and population registries are recognized as being amongst the best population-based data sources in the world,<sup>1</sup> and among these is the Danish National Registry of Patients (NRP) covering all nonpsychiatric hospitals in Denmark. It has recorded 99% of all discharges since 1977.<sup>2</sup> The registry is well suited to contribute to evidence-based medicine including the epidemiological research of diverticular disease. Diverticular disease is extremely common in the Western world with a prevalence of 30%, and roughly between 10% and 30% of patients will develop complications such as bleeding, diverticulitis, and perforation.<sup>3,4</sup> The NRP enables large-scale, inexpensive, and rapid investigations of diverticular disease, and since data are collected for administrative purposes unrelated to research objectives, certain biases are reduced or eliminated (eg, recall bias and nonresponse bias).<sup>5</sup> However, using data in research primarily collected

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for administrative purposes also causes several limitations, of which the issue of misclassification is pivotal. A number of validation studies of the diagnosis recorded in the NRP have been conducted, but no study has addressed the accuracy of the registration of diverticular disease.<sup>6,7</sup> Therefore, we decided to examine the accuracy of administrative coding for the diagnosis of diverticular disease in the NRP using the physician diagnosis as the reference standard.

## Method

Data for this validation study were obtained in the period from January 1, 1999 to December 31, 2008 using NRP data and hospital discharge abstracts and outpatient notes from Aalborg Hospital, Denmark, with a catchment area of approximately 640,000 inhabitants.

The NRP records the civil registration number of the patient, dates of admission and discharge, surgical procedures carried out, and up to 20 discharge diagnoses coded by doctors according to the International Classification of Disease (ICD), eighth revision (ICD-8) until the end of 1993 and the 10th revision (ICD-10) thereafter, on each hospital admission since 1977 (since 1995 for all hospital outpatient visits and emergency room visits).<sup>2</sup> The ICD-10 codes used for diverticular disease were K572–K579 (see Table 1 for details).

During the study period, 2818 patients seen at Aalborg Hospital had an incident ICD-10 code for diverticular disease recorded in the NRP (K572: diverticulosis, diverticulitis coli with perforation and abscess;  $n = 191$ . K573: diverticulosis, diverticulitis coli without perforation and abscess;  $n = 2518$ . K574: diverticulosis in small and large intestine with perforation and abscess;  $n = 4$ . K575: diverticulosis in small and large intestine with perforation and abscess;  $n = 29$ . K578: diverticulosis in intestine with perforation and abscess, location unspecified;  $n = 3$ . K579: diverticulosis in intestine without perforation and abscess, location unspecified;  $n = 73$ ). Of these, we collected the discharge abstracts and outpatient notes of 100 patients. Because the vast majority of the 2818 patients with an ICD-10 code of diverticular disease were recorded with the code K573 (89%), an overall random selection of 100 patients would prevent us from evaluating the accuracy of the other ICD-10 codes for diverticular disease (K572, K574, K575, K578, and K579). Thus, we used a three-step approach to ensure that we would identify patients recorded with the various ICD-10 codes for diverticular disease, ie, even those rarely used. First, we specifically collected the discharge abstracts and outpatient notes from the only four patients with the ICD-10 code K574 and from the only three patients with the ICD-10 code K578. Second, we

randomly selected 10 records from each of the four remaining ICD-10 codes (K572, K573, K575, and K579), and finally, we randomly collected the remaining 53 notes from the Aalborg Hospital population to meet the total of 100 patients that we aimed for. The discharge abstracts and outpatient notes were reviewed by the first author (RE) based on a predefined checklist. The review was conducted without knowledge of the exact ICD-10 code (although the reviewer knew that it was within the K57 group), and diverticular disease and any of its complications had to be clearly stated in the discharge abstracts/outpatient notes.

As a measure of accuracy, the positive predictive value (PPV) was estimated as the proportion of patients recorded with diverticular disease, who also had this according to the physician diagnosis in the discharge abstracts/outpatient notes. For each PPV, we estimated the corresponding 95% confidence intervals (CIs) using the method for binominal proportions. PPVs were calculated on the overall two-digit ICD-10 code level (K57) implying diverticular disease and on the three-digit ICD-10 code levels (K572–K579) implying specific diverticular complications. Because of the lack of details in ICD-10 codes (Table 1), a physician diagnosis of diverticular bleeding was categorized with uncomplicated diverticulosis (no perforation or abscess) in estimating PPVs, while a physician diagnosis of stricture, fistula, and obstruction was categorized with abscess and perforation.

## Results

We were able to retrieve all discharge abstracts and outpatient notes of the 100 patients (median age at diagnosis was 67.8 years, and 53% were females). In total, 49 out of the 100 patients had diverticular disease with complications, eg, bleeding, diverticulitis, or perforation (Table 1). The diagnosis of diverticular disease was confirmed by colonoscopy in 66 patients, computed tomography scan in 12 patients, barium enema in five patients, surgery in 17 patients, and ultrasound in six patients (14 patients had a combination of these procedures). In eight patients, the diagnosis was unconfirmed, based exclusively on medical history, symptoms, and clinical examination. In only two patients, the physician diagnosis did not confirm the two-digit ICD-10 code level (K57) of diverticular disease corresponding to an overall PPV of 0.98 (95% CI: 0.93, 0.99). On the three-digit ICD-10 code level, the PPVs ranged from 0.67 to 0.92 (Table 1). The ICD-10 codes did not allow valid prediction of uncomplicated diverticular disease or diverticular bleeding. However, the combination of ICD-10 codes K572, K574, and K578 had a predictive value of 0.91 (95% CI:

**Table 1** The ICD-10 codes of diverticular disease validated against the physician diagnosis recorded in discharge abstract or outpatient notes in 100 selected patients at Aalborg Hospital, Denmark, 1999–2008

ICD-10 codes in the Danish National Registry of Patients	Physician diagnosis									Positive predictive values <sup>a</sup> (95% CI)
	No diverticulosis/bleeding	Diverticulosis without diverticulitis or bleeding	Diverticulitis without abscess or perforation	Abscess	Perforation	Stricture	Fistula	Obstruction	Diverticular bleeding	
K572: Diverticulosis, diverticulitis coli with perforation and abscess	0	1	1	2	9	0	0	0	2	0.73 (0.45, 0.92)
K573: Diverticulosis, diverticulitis coli without perforation or abscess	2	28	10	1	1	1	0	1	10	0.89 (0.77, 0.96)
K574: Diverticulosis in small and large intestine with perforation and abscess	0	0	0	1	1	0	1	0	1	0.75 (0.19, 0.99)
K575: Diverticulosis in small and large intestine without perforation or abscess	0	11	1	0	0	0	0	0	0	0.92 (0.52, 1.00)
K578: Diverticulosis in intestine with perforation and abscess, location unspecified	0	1	0	1	1	0	0	0	0	0.67 (0.09, 0.99)
K579: Diverticulosis in intestine without perforation or abscess, location unspecified	0	8	2	0	0	0	0	0	2	0.83 (0.52, 0.98)
K57: All (overall diverticular disease)	2	49	14	5	12	1	1	1	15	0.98 (0.93, 1.00)

**Notes:** Diverticular disease in the small intestine was not found in any case. <sup>a</sup>In estimating the positive predictive values, the physician diagnosis of diverticular bleeding is categorized with diverticulosis, while stricture, fistula, and obstruction are categorized with abscess and perforation to meet the definition used in the ICD-10.

**Abbreviations:** ICD-10, International Classification of Disease codes, 10th revision; CI, confidence interval.

0.71, 0.99) for any complication (ie, bleeding, diverticulitis, abscess, perforation, stricture, fistula, and obstruction) of diverticular disease.

The PPVs of the ICD-10 codes were essentially unchanged when analyzing inpatient ( $n = 54$ ) versus outpatient ( $n = 46$ ) visits or first listed ( $n = 74$ ) versus second and subsequent listed ( $n = 26$ ) ICD-10 codes in the NRP (results not shown).

## Discussion

In this study of the NPR, we evaluated the accuracy of administrative diagnosis codes (ICD-10 codes) for diverticular disease. We found that these codes accurately identify patients with a general diagnosis of diverticular disease, but cannot satisfactorily distinguish specific

diverticular complications and uncomplicated diverticular disease.

Diagnostic codes are commonly used to identify patients with diverticular disease for research studies particularly when using population registries or health claims databases.<sup>8–10</sup> However, the accuracy of diagnostic coding for diverticular disease has not been well evaluated, and to our knowledge no study has been published on the accuracy of the ICD-10 coding for diverticular disease in general. In accordance with our findings, a Swedish population-based study of diverticulitis and cancer evaluated the validity of the diagnosis based on ICD-7 and ICD-8 codes in 537 patients out of the study cohort of 7159 patients, and 91% had a diagnosis confirmed by barium enema or surgery, although it is not clear if the confirmation was specific for

each diagnosis or for diverticular disease in general.<sup>9</sup> The ICD-10 codes for perforation (K572, K574, and K578) have previously been shown to have good sensitivity for perforation disease.<sup>11</sup> The finding of an overall high PPV of the diagnosis of diverticular disease in the NRP is on a par with what has been reported for other gastrointestinal diseases such as inflammatory bowel disease,<sup>12</sup> and the pattern with decreasing PPV in subgroups of the diagnosis has also been reported for other diseases.<sup>13,14</sup> However, estimating the PPV for the specific diverticular complications using subcodes is difficult as the ICD-10 codes poorly designate the entire spectrum of diverticular disease (eg, there are no codes specific for diverticular bleeding, uncomplicated diverticulosis or uncomplicated diverticulitis/diverticulitis without abscess).

We were not able to evaluate the proportion of patients with diverticular disease not diagnosed or diagnosed outside the hospital and, thus, not registered in the NRP (ie, the sensitivity/completeness). Diverticulosis is usually asymptomatic.<sup>15</sup> Not surprisingly, in our study, we found a rather high proportion of complications among the study population indicating that it is the more severe diverticular disease patients who seek medical attention and are recorded in the NRP. This needs to be remembered in using these ICD-10 codes in medical research as it may introduce biased estimates.

In conclusion, this study indicates that the ICD-10 codes in the NRP can be used to identify diverticular disease as an overall condition and, by combining a subset of codes, to predict complicated diverticular disease (diverticulitis or bleeding). However, the absence of codes specific for diverticular bleeding, uncomplicated diverticulosis, and uncomplicated diverticulitis complicates the designation of patients with these diagnoses. Therefore, ICD-10 codes should not be used to ascertain cases of uncomplicated disease or any specific complications, particularly bleeding.

## Disclosure

The authors declare no conflicts of interest in this work.

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