

# Positive predictive value of peptic ulcer diagnosis codes in the Danish National Patient Registry

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**Background:** Diagnoses of peptic ulcer are registered in the Danish National Patient Registry (DNPR) for administrative as well as research purposes, but it is unknown whether the coding validity depends on the location of the ulcer.

**Objective:** To validate the International Classification of Diseases, 10<sup>th</sup> revision diagnosis codes of peptic ulcer in the DNPR by estimating positive predictive values (PPVs) for gastric and duodenal ulcer diagnoses.

**Methods:** We identified all patients registered with a hospital discharge diagnosis of peptic ulcer from Aarhus University Hospital, Denmark, in 1995–2006. Among them, we randomly selected 200 who had an outpatient gastroscopy at the time of ulcer diagnosis. We reviewed the findings from these gastroscopies to confirm the presence of peptic ulcer and its location. We calculated PPVs and corresponding 95% confidence intervals (CIs) of gastric and duodenal ulcer diagnoses, using descriptions from the gastroscopic examinations as standard reference.

**Results:** In total, 182 records (91%) were available for review. The overall PPV of peptic ulcer diagnoses in DNPR was 95.6% (95% CI 91.5–98.1), with PPVs of 90.3% (95% CI 82.4–95.5) for gastric ulcer diagnoses, and 94.4% (95% CI 87.4–98.2) for duodenal ulcer diagnoses. PPVs were constant over time.

**Conclusion:** The PPV of uncomplicated peptic ulcer diagnoses in the DNPR is high, and the location of the ulcers is registered correctly in most cases, indicating that the diagnoses are useful for research purposes.

**Keywords:** peptic ulcer, validation, positive predictive value, diagnosis, Danish National Patient Registry

## Introduction

Peptic ulcer disease is common in the general population, with a reported annual incidence of 0.03%–0.19%,<sup>1</sup> and a lifetime prevalence of approximately 5% in Danish citizens aged 30–60 years.<sup>2</sup> Studies of risk factors, incidence, and prognosis are therefore important and often based on data from registries.<sup>3–7</sup> Previous studies using register-based data from the US, Canada, and UK have found positive predictive values (PPVs) of peptic ulcer diagnoses ranging from 57%–100%.<sup>8–10</sup> Discharge diagnosis codes in the Danish National Patient Registry (DNPR) generally have a high validity,<sup>11</sup> but the validity of uncomplicated peptic ulcer diagnoses (without bleeding or perforation) is uncertain,<sup>12,13</sup> and no previous studies have aimed to investigate the validity according to the location of the ulcer, ie, duodenal or gastric. The aim of this quality assessment study is to examine the validity of peptic ulcer diagnosis codes in the DNPR overall, and by location of ulcer, by examining gastroscopic records from a Danish hospital.

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## Methods

### Data sources

The Danish Civil Registration system contains a unique 10-digit identifier for all Danish citizens, given at birth or immigration. The identifier provides information on the birth-date and sex of each citizen and allows linkage of patients between health care databases including the DNPR and the Aarhus Endoscopy Registry (AER).<sup>14</sup>

The DNPR contains discharge diagnoses from all hospital admissions in Denmark since 1977, and from emergency room and hospital outpatient visits since 1995. Through 1993, diagnoses were coded according to the International Classification of Diseases, 8<sup>th</sup> revision (ICD-8), and thereafter the 10<sup>th</sup> revision (ICD-10) has been used. After each admission, up to 20 diagnoses codes are recorded, one as primary and additional ones as secondary, as well as surgical procedures performed, and the date of admission and discharge.<sup>11</sup> Endoscopies were recorded according to Danish Classification of Surgical Procedures from 1977 to 1995, and since 1996 according to the NOMESCO (Nordic Medico-Statistical Committee) classification of surgical procedures.<sup>15</sup>

AER is a research database containing records of endoscopic procedures performed at Aarhus University Hospital (AUH) in the period 1975–2007. The registry covers all gastroscopies, endoscopic retrograde cholangiopancreatography, and colonoscopies performed in the outpatient clinic at AUH. The registry comprises paper records with detailed descriptions of the endoscopic procedure and of findings of biopsies.

### Study population

We searched for all patients with a first-time ulcer diagnosis (K25 and K26) at AUH in the endoscopic outpatient clinic, registered between 01.01.1995 and 31.12.2006. We excluded patients with previous diagnoses of peptic ulcer disease before the start of our inclusion period (see Supplementary materials for diagnosis codes). We then restricted the cohort to patients with at least one gastroscopic examination in relation to the contact leading to the ulcer diagnosis. We identified 382 patients with gastric ulcer and 271 patients with duodenal ulcer. Among them, we randomly selected 100 patients with gastric ulcer, and 100 with duodenal ulcer using the SAS RANUNI function (SAS Institute Inc., Cary, NC, USA). We obtained information on the date of admission, and the type of diagnosis code (primary or secondary). Ulcer diagnosis codes were further categorized as acute or chronic, and as uncomplicated or complicated (ie, bleeding or perforated ulcers).

### Record review

We reviewed records of gastroscopic examinations performed during the hospital contact for peptic ulcer. We considered the diagnosis confirmed if the endoscopist described gastric or duodenal ulcers, or ulcer cicatrices to indicate recent peptic ulcer disease.<sup>16</sup> Ulcers of the fundus, corpus, or antrum were considered as gastric, and ulcers in the pyloric canal or duodenum as duodenal. If both gastric and duodenal ulcers were described, we classified the ulcer as combined,<sup>16</sup> and we considered the diagnosis code confirmed whether it was a code for gastric ulcer or duodenal ulcer. If several gastroscopic examinations had been performed during the same admission, information from all the examinations was obtained. All gastroscopic records were thoroughly investigated by SV, who was blinded to the diagnosis codes recorded in the DNPR. In case of uncertainty about the true diagnosis, the endoscopic description was discussed with an experienced surgeon.

According to Danish law at the time the study was conducted, quality assessment studies such as this did not require informed consent to review patients' medical records. All records were reviewed with confidentiality and discretion, as required.

### Statistical analyses

The main outcome of the study was PPV of peptic ulcer diagnoses, defined as the proportion of patients with a peptic ulcer discharge diagnosis in the DNPR who had ulcer disease confirmed by endoscopy. We stratified ulcers by location (gastric or duodenal), complication (uncomplicated or complicated ulcer), time of diagnosis (1995–1998, 1999–2002, 2003–2006), and type of diagnosis (primary or secondary). We calculated binomial exact 95% confidence intervals (CIs) corresponding to the PPVs. Data were analyzed with Stata software (version 13.0; StataCorp LP, College Station, TX, USA).

## Results

### Review process

We located and reviewed the endoscopic records of 182 (91%) patients, 93 patients with gastric and 89 patients with duodenal ulcers (Table 1). The remaining 18 patients without an endoscopic record were left out of the analyses, but the characteristics of all 200 sampled patients are listed in Table 1.

### Patient characteristics

Among the 182 included patients the median age at peptic ulcer diagnosis was 60 years (interquartile range: 48–71

**Table 1** Characteristics of 200 outpatients with a first-time diagnosis of peptic ulcer disease endoscopically examined at Aarhus University Hospital, Denmark during 1995–2006

Characteristics	Patients sampled, n (%)	Patients included, n (%)
<b>All</b>	200 (100)	182 (100)
<b>Sex</b>		
Female	85 (43)	79 (43)
Male	115 (58)	103 (57)
<b>Age at ulcer diagnosis</b>		
0–39 years	33 (17)	27 (15)
40–59 years	70 (35)	65 (36)
60+ years	97 (49)	90 (49)
<b>Year of diagnosis</b>		
1995–1998	69 (35)	62 (34)
1999–2002	69 (35)	59 (32)
2003–2006	62 (31)	61 (34)
<b>Recorded location of ulcer</b>		
Gastric	100 (50)	93 (51)
Duodenal	100 (50)	89 (49)
<b>Recorded status of ulcer in the DNPR</b>		
Acute	79 (40)	71 (39)
Chronic	63 (32)	57 (31)
Unspecified	58 (29)	54 (30)
<b>Complicated ulcer</b>		
Yes	2 (1)	1 (1)
No	198 (99)	181 (99)

**Abbreviation:** DNPR, Danish National Patient Registry.

years), and more men (57%) than women (43%) were examined. According to the DNPR, 71 patients (39%) had acute ulcers, 57 (31%) had chronic ulcers, and 54 (30%) had unspecified ulcers, whereas only one patient had a complicated ulcer (Table 1).

## Validity of peptic ulcer diagnosis codes

In total, 174 of 182 patients diagnosed with peptic ulcer had endoscopically confirmed ulcer disease, corresponding to a PPV of 95.6% (91.5–98.1) (Table 2). However, not all diagnoses were correctly classified regarding location of the ulcer. The PPV of gastric ulcer diagnoses was 90.3% (82.4–95.5), and the PPV of duodenal ulcer diagnosis was 94.4% (87.4–98.2). The validity of peptic ulcer diagnoses was constant over time, and primary diagnoses were highly valid (96.5% [92.6–98.7]). The PPV of the ten secondary diagnoses was imprecisely estimated (80.0% [44.4–97.5]) (Table 2). Among the confirmed peptic ulcers, we found ulcer cicatrices indicating recent peptic ulcer disease in ten patients (5.5%) (Table S1). The eight patients (4.4%) with no peptic ulcer disease had gastritis (n=7) and esophagitis (n=1) (Table S1).

## Discussion

We found outpatient peptic ulcer diagnosis codes in the DNPR to be highly valid in terms of presence and location of the ulcer. A minor part of the ulcer diagnoses covered ulcer cicatrices and no active ulcer disease. The high validity was constant over time.

Several studies previously elucidated validity of register-based diagnoses of peptic ulcer disease. A study from Canada found PPVs of hospital-based peptic ulcer diagnoses ranging from 57% to 70%,<sup>8</sup> which is substantially lower than our estimates, possibly caused by differences in study populations or quality of registries. Also, a study from the US reported PPVs of 61%–66%,<sup>9</sup> but they did not restrict inclusion to patients who were examined endoscopically, and diagnoses were only confirmed in case of active ulcer disease. In agreement with our findings, peptic ulcer disease diagnoses from a UK primary health care database, were confirmed endoscopically or visually during surgical procedures among 92%–100% of patients.<sup>10</sup> While the PPV of a given condition depends on its prevalence in the study population, the 1-year ulcer prevalence is comparable in the UK and Denmark and therefore unlikely to explain the difference in PPV.<sup>1</sup> Two previous studies reported the validity of ulcer diagnoses in the DNPR. The first was designed to examine incidence and mortality rates in patients with complicated and uncomplicated peptic ulcers. It reported PPVs of uncomplicated gastric ulcer (75%) and uncomplicated duodenal ulcer (71%),<sup>12</sup> but the inclusion criteria and criteria for confirmation of ulcers were not reported. The second study reported an overall PPV of ulcer disease of 98%, but they did not report confirmation criteria, nor did they validate the diagnoses by location.<sup>13</sup>

Our study has several strengths. In Denmark, we have universal and equal access to health care services, which minimizes the risk of referral and selection bias, and DNPR is generally of high completeness and quality.<sup>11</sup> The reviewer of the endoscopic records was blinded to the location of ulcer according to the DNPR, minimizing the risk of observer bias.<sup>17</sup>

Our study has several potential limitations. We had access to endoscopic records only from one gastroenterology department at a university hospital, and we restricted inclusion to endoscopically examined patients. Possibly, some patients are diagnosed with peptic ulcer in the DNPR without gastroscopic confirmation, which is why the high PPV we found may not be applied to all diagnoses recorded in the DNPR.<sup>11</sup> In addition, because our sample only included patients diagnosed at an endoscopic outpatient clinic, the

**Table 2** Positive predictive values of ICD-10 codes of recent peptic ulcers among 200 selected patients at Aarhus University Hospital, Denmark during 1995–2006, validated using descriptions from the gastroscopic examinations as standard reference

	Patients sampled, n	Patients included, n	Confirmed diagnoses, n	PPV (%)	95% CI
Overall <sup>a</sup>	200	182	174	95.6	91.5–98.1
<b>Location of ulcer<sup>b</sup></b>					
Gastric	100	93	84	90.3	82.4–95.5
Duodenal	100	89	84	94.4	87.4–98.2
<b>Type of diagnosis</b>					
Primary	188	172	166	96.5	92.6–98.7
Secondary	12	10	8	80.0	44.4–97.5
<b>Time of diagnosis</b>					
1995–1998	69	62	60	96.8	88.8–99.6
1999–2002	69	59	55	93.2	83.5–98.1
2003–2006	62	61	59	96.7	88.7–99.6

**Notes:** <sup>a</sup>All confirmed patients with peptic ulcers (not all were correctly classified by location). <sup>b</sup>Only ulcers correctly classified by location were confirmed.

**Abbreviations:** PPV, positive predictive value; CI, confidence interval; ICD-10, International Classification of Diseases, 10<sup>th</sup> revision.

frequency of complicated ulcers was low. Accordingly, we were unable to conclude on the validity of complicated ulcer diagnoses. Future studies need to investigate the validity of complicated peptic ulcer diagnosis codes, as well as any potential differences in quality of coding between specialist and non-specialist clinics.

## Conclusion

Finally, we conclude that outpatient diagnosis codes of uncomplicated peptic ulcer disease in the DNPR are highly valid for patients examined with gastroscopy. We found a high PPV of peptic ulcer diagnoses including localization as gastric or duodenal. The high PPVs indicate that the diagnoses have high specificity and are suitable for research purposes.

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## Author contributions

KKS conceived the idea for the study. All authors designed the study. SV collected, managed, and analyzed the data. All authors interpreted the results, drafted the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

## Disclosure

The authors report no conflicts of interest in this work.

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## Supplementary materials

### Hospital, department, diagnosis and procedure codes

- Hospital code: 7003 (Aarhus District General Hospital, Nørrebrogade 44, 8000 Aarhus C, Denmark).
- Department codes: 7003287 (Endoscopic Outpatient Clinic, Aarhus District General Hospital).
- We included patients with the following International Classification of Diseases, 10<sup>th</sup> revision (ICD-10) peptic ulcer diagnoses: all peptic ulcers (K25 or K26). Specifically gastric ulcers (K25) and duodenal ulcers (K26). Specifically uncomplicated ulcers (K25.3, K25.7, K25.9, K26.3, K26.7, K26.9) and complicated ulcers (K25.0, K25.1, K25.2, K25.4, K25.5, K25.6, K26.0, K26.1, K26.2, K26.4, K26.5, K26.6).
- We used the following ICD-8 diagnosis codes to exclude patients with an ulcer diagnosis before 01.01.1995: 531 gastric ulcer, 532 duodenal ulcer, 533 peptic ulcer site unspecified, 534 gastrojejunal ulcer.
- Procedure codes for gastroscopic examination: ICD-8: 91010 and ICD-10: KUJD.

**Table S1** Description of endoscopic findings among 182 patients with a diagnosis code of gastric or duodenal ulcer

Discharge diagnosis	Endoscopic description, n (%)							
	Gastric ulcer	Duodenal ulcer	Gastric ulcer and duodenal ulcer	Gastric cicatrices	Duodenal cicatrices	Gastritis	Esophagitis	Total
Gastric ulcer	72 (77)	2 (2)	3 (3)	9 (10)	0 (0)	6 (6)	1 (1)	93 (100)
Duodenal ulcer	4 (4)	81 (91)	2 (2)	0 (0)	1 (1)	1 (1)	0 (0)	89 (100)

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