


# BMJ Open Multimorbidity and patient-reported diagnostic errors in the primary care setting: multicentre cross-sectional study in Japan

Takuya Aoki ,<sup>1,2</sup> Satoshi Watanuki<sup>3</sup>

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<sup>1</sup>Division of Clinical Epidemiology, The Jikei University School of Medicine, Minato-ku, Tokyo, Japan

<sup>2</sup>Section of Clinical Epidemiology, Department of Community Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan

<sup>3</sup>Division of Emergency and General Medicine, Tokyo Metropolitan Tama Medical Center, Tokyo, Japan

## Correspondence to

Dr Takuya Aoki; [taoki@jikei.ac.jp](mailto:taoki@jikei.ac.jp)

## ABSTRACT

**Objectives** There is lack of evidence for the association between multimorbidity and diagnostic errors. Information on diagnostic errors from patients' perspectives is crucial to improve the diagnostic process. In this study, we aimed to investigate patient-reported diagnostic errors and to examine the relationship between multimorbidity and patient-reported diagnostic errors in the primary care setting.

**Design** Multicentre cross-sectional study.

**Setting** A primary care practice-based research network in Japan (25 primary care facilities).

**Participants** Adult outpatients filled out a standardised questionnaire.

**Primary outcome measure** Patient-reported diagnostic errors.

**Results** Data collected from 1474 primary care outpatients were analysed. The number of participants who reported diagnostic errors was 57 (3.9%). Most of the missed diagnoses were common conditions in primary care, such as cancer, dermatitis and hypertension. After adjustment for possible confounders and clustering within facilities, multimorbidity was positively associated with patient-reported diagnostic errors (adjusted OR=1.83, 95% CI 1.01 to 3.31). The results of the sensitivity analysis were consistent with those of the primary analysis.

**Conclusions** The present study showed a lower proportion of patients reporting experiences of diagnostic errors in primary care than those reported in previous studies in other countries. However, patients with multimorbidity are more likely to report diagnostic errors in primary care; thus, further research is necessary to improve the diagnostic process for patients with multimorbidity.

## INTRODUCTION

The issue of diagnostic errors has become an increasing concern in the primary care setting because primary care providers interact with patients who have undifferentiated and uncertain health problems, including common and uncommon diseases, which tend to be serious and life threatening in the settings with a high number of patients.<sup>1-4</sup> According to the report of the National Academy of Medicine

## Strength and limitations of this study

- This is the first study to examine the association between multimorbidity and patient-reported diagnostic errors, including a large variety of missed diagnoses.
- The study setting included different levels of primary care facilities covering both urban and rural areas.
- The cross-sectional nature of the study precluded any causal inference from being made.
- More methodologically rigorous studies, including longitudinal studies using comprehensive and validated tools for detecting diagnostic errors, are necessary for further investigation to confirm the association between multimorbidity and diagnostic errors.

published in 2015, diagnostic error is defined as the failure to establish an accurate and timely explanation of the patient's health problem or to communicate that explanation to the patient.<sup>5</sup> This new definition frames a diagnostic error from the patient's perspective, recognising that the patient bears the ultimate risk of harm from a diagnostic error. Therefore, the failure of communication in the diagnostic process between healthcare providers and patients is also regarded as a diagnostic error.

As the concept of diagnostic errors is changed to be patient-centred, the patient experience is recognised as a crucial measure to assess diagnostic errors, in addition to the information provided by healthcare providers.<sup>6-12</sup> The recent report of WHO indicates that information from people using healthcare services could significantly contribute in improving safety in primary care.<sup>13</sup> However, there are few studies investigating patient-reported diagnostic errors in the primary care setting, and the evidence is limited worldwide.<sup>6 8 11 12</sup> Kistler *et al* performed a patient survey and reported

that patients perceived mistakes in their diagnostic and treatment care in the ambulatory setting, and these perceptions had an impact on the patient–physician relationship.<sup>6</sup> Ricci-Cabello *et al* conducted a patient survey in general practices and found priority areas for patient safety improvement in general practices include appointments, diagnosis, communication, coordination and patient activation.<sup>8</sup> In a qualitative study of primary care patients conducted by Kuzel *et al*, the errors reported by interviewed patients suggested that breakdowns in access to and relationships with clinicians may be more prominent medical errors than are technical errors in diagnosis and treatment.<sup>11</sup> Fernholm *et al* reported that patients with psychiatric disease were at higher risk of patient-reported preventable harm, including diagnostic errors in primary care.<sup>12</sup> In Japan, there has been no study to investigate diagnostic errors from the patient's perspective in the primary care setting.

Multimorbidity, defined as the co-occurrence of multiple chronic or acute diseases and medical conditions in an individual, is becoming increasingly prevalent as a major challenge in primary care. One of the reasons is that patients with multimorbidity are potentially more likely to experience safety incidents due to the complexity of their needs and the frequency of their interactions with health services.<sup>14</sup> In previous studies, the association between multimorbidity and diagnostic errors has been reported; however, the association has been limited to a specific missed diagnosis such as mental or respiratory disease, and these previous studies were almost exploratory.<sup>15–19</sup> Therefore, there is lack of evidence for the association of multimorbidity with diagnostic errors.

Thus, we aimed to investigate patient-reported diagnostic errors without limiting the missed diagnosis to a specific disease and to examine the relationship between multimorbidity and patient-reported diagnostic errors in the primary care setting.

## METHODS

### Design, setting and participants

We used the data collected from the Primary Care Organisations Reciprocal Evaluation Survey Study (PROGRESS) 2018, which was conducted in a primary care practice-based research network (PBRN). The PROGRESS 2018 was a cross-sectional survey to collect data on patient experience, clinical process, healthcare use, health conditions and sociodemographic characteristics of adult outpatients in the primary care setting: community-based offices and small-sized and medium-sized hospitals (online supplementary file).<sup>20</sup> In Japan, primary care services are generally provided in both community-based offices and the primary care departments of small-sized and medium-sized hospitals that are predominantly privately owned and managed.<sup>21</sup> Patients can visit any community-based offices and small-sized and medium-sized hospitals with less than 200 beds without access restriction. However, patients who visit large hospitals without a referral letter

from a primary care physician need to pay an additional fee. This national PBRN comprises primary care facilities to which physician members of the Japan Primary Care Association belong and voluntarily applied for participation in the PROGRESS.

A total of 25 facilities comprising six small-sized or medium-sized hospitals with less than 200 beds and 19 community-based offices distributed in urban and rural areas (Kanto, Chubu, Kinki and Kyushu areas) participated in the PROGRESS 2018. During a week of survey period between February and March 2018, a self-administered questionnaire was distributed to each outpatient aged  $\geq 20$  years and who visited a primary care department in one of the participating facilities. Among adult patients responding to the PROGRESS 2018, eligible participants in this study were individuals who responded to the survey item regarding diagnostic errors in the questionnaire.

## Measurement

### Patient-reported diagnostic errors

The primary outcome measure was patient-reported diagnostic errors. We designed questions for the outpatients to assess diagnostic errors based on a previous study conducted in the primary care setting.<sup>6</sup> The patient-reported diagnostic errors were determined from the question 'In the past 10 years, has a doctor made a wrong diagnosis or misdiagnosed you?' Participants were asked to answer on a binary scale (yes or no). The question was reviewed for content and face validity by primary care researchers in the previous study.<sup>6</sup> If the participants answered 'yes' to the first question, they were then asked the following question about the diagnostic error in detail: 'What was the missed diagnosis?'

### Morbidity status

We collected data on the occurrence of 20 common chronic health conditions using a structured questionnaire. Participants were asked to respond to the question, 'Has a doctor/nurse/paramedic ever told you that you have the following chronic health conditions?' Response options included hypertension, diabetes, dyslipidaemia, stroke, cardiac diseases, chronic respiratory diseases, digestive diseases, hepatobiliary and pancreatic diseases, kidney diseases, urological diseases, arthritis, rheumatism, lumbar diseases, osteoporosis, dementia, neurological diseases, mental disorders, endocrine diseases, malignancy and skin diseases. Participants responded to each option using a binary scale (yes or no). Multimorbidity was defined as the presence of two or more chronic health conditions in an individual.

### Statistical analysis

Descriptive statistics were obtained for the data regarding participants' characteristics. We generated descriptive statistics to quantify the frequency of missed diagnoses. In addition, we performed exploratory univariate analyses of the associations of each chronic health condition with

patient-reported diagnostic errors by the Fisher's exact test.

Multivariable analysis was performed using a generalised linear mixed model with a logit link function (a random intercept model) to determine the relationship between multimorbidity and patient-reported diagnostic errors. The models included a random effect for facility and the following possible confounding variables as fixed effects: age, sex, years of education and annual household income. All possible confounding variables were evaluated as categorical variables in the self-administered questionnaire. For each analysis, we used a two-sided significance level of  $p=0.05$ . Missing data on independent and dependent variables were handled by applying multiple imputation using a fully conditional specification. To confirm the robustness of the study findings, a sensitivity analysis was conducted using the number of chronic health conditions (continuous variable) instead of multimorbidity (binary variable) as an independent variable. Statistical analyses were conducted using R V.3.4.2 (R Foundation for Statistical Computing, Vienna, Austria; [www.R-project.org](http://www.R-project.org)) and lme4 and mice packages.

## RESULTS

### Participants' characteristics

A total of 1795 individuals of 2111 adult patients responded to the PROGRESS 2018. Among them, we excluded 321 participants who did not respond to the survey item regarding diagnostic errors. We performed analyses for the remaining 1474 eligible participants (response rate: 69.8%). **Table 1** shows the distribution of individual characteristics of the eligible participants. Among the eligible participants, 848 (57.5%) had multimorbidity and 57 (3.9%) had reported a diagnostic error. The majority of eligible participants were aged  $\geq 60$  years (75.9%) and had no college degree (77.2%). **Table 1** also shows the comparison of the characteristics between eligible participants with and without multimorbidity.

### Frequencies of missed diagnoses

Among the 57 participants who reported diagnostic errors, 48 (84.2%) responded to the detailed question regarding missed diagnosis. **Table 2** shows the frequencies of missed diagnoses. Cancer was the most commonly missed diagnosis (8.3%) followed by dermatitis (6.3%) and hypertension (6.3%). Multiple patients answered acute pancreatitis, appendicitis, ovarian cyst, parotitis, pneumonia, shingles and sinusitis as the missed diagnoses.

### Associations of each chronic health condition with patient-reported diagnostic errors

**Table 3** shows the associations of each chronic health condition with patient-reported diagnostic errors. In the majority of chronic health conditions, the prevalence was higher in the group that reported diagnostic errors compared with the group that did not. In the univariate analyses, mental disorders and hepatobiliary and

**Table 1** Participants' characteristics by multimorbidity: n (%)

Characteristics	Multimorbidity*		
	Total (n=1474)	Present (n=848)	Absent (n=626)
<b>Gender</b>			
Male	651 (44.2)	373 (44.0)	278 (44.4)
Female	768 (52.1)	447 (52.7)	321 (51.3)
Data missing	55	28	27
<b>Age (years)</b>			
20–39	71 (4.8)	17 (2.0)	54 (8.6)
40–59	258 (17.5)	104 (12.3)	154 (24.6)
60–79	899 (61.0)	580 (68.4)	319 (51.0)
$\geq 80$	219 (14.9)	141 (16.6)	78 (12.5)
Data missing	27	6	21
<b>Education</b>			
Less than high school	311 (21.1)	196 (23.1)	115 (18.4)
High school	602 (40.8)	352 (41.5)	250 (39.9)
Junior college	226 (15.3)	125 (14.7)	101 (16.1)
More than or equal to college	285 (19.3)	158 (18.6)	127 (20.3)
Data missing	50	17	33
<b>Annual household income (million yen)</b>			
<3.00 (=US\$27 000r)	665 (45.1)	419 (49.4)	246 (39.3)
3.00–4.99	391 (26.5)	217 (25.6)	174 (27.8)
5.00–6.99	156 (10.6)	87 (10.3)	69 (11.0)
7.00–9.99	89 (6.0)	44 (5.2)	45 (7.2)
$\geq 10.00$	40 (2.7)	18 (2.1)	22 (3.5)
Data missing	133	63	70
<b>Patient-reported diagnostic errors</b>			
Present	57 (3.9)	38 (4.5)	19 (3.0)
Absent	1417 (96.1)	810 (95.5)	607 (97.0)

\*Multimorbidity was defined as the presence of two or more chronic health conditions in an individual.

pancreatic diseases were statistically significantly associated with patient-reported diagnostic errors.

### Association between multimorbidity and patient-reported diagnostic errors

**Table 4** shows the results of the multivariable analysis, modelling the association between multimorbidity and patient-reported diagnostic errors. After adjustment for possible confounders and clustering within facilities, multimorbidity was positively associated with patient-reported diagnostic errors (adjusted OR (aOR)=1.83, 95% CI, 1.01 to 3.31). All other associations between the eligible participants' characteristics as covariates and patient-reported diagnostic errors were not statistically

**Table 2** Frequencies of missed diagnoses (N=48)

Diagnostic error	Missed diagnoses (n)
Cancer	4
Dermatitis	3
Hypertension	3
Acute pancreatitis	2
Appendicitis	2
Ovarian cyst	2
Parotitis	2
Pneumonia	2
Shingles	2
Sinusitis	2
Achilles tendon rupture	1
Bronchitis	1
Cerebral infarction	1
Endometriosis	1
Fracture	1
Gallstone	1
Gout	1
Hives	1
Influenza	1
Otosclerosis	1
Meningitis	1
Myocardial infarction	1
Osteoarthritis	1
Peritonitis	1
Plantar fasciitis	1
Polyneuropathy	1
Retinal detachment	1
Rheumatoid arthritis	1
Sacroiliac arthritis	1
Streptococcal infection	1
Upper respiratory infection	1
Urinary stone	1
Uterine fibroid	1
Uveitis	1

significant. Table 5 shows the results of the sensitivity analysis using the number of chronic health conditions (continuous variable) as an independent variable. Findings were similar to those of the primary analysis, with the number of chronic health conditions being significantly positively associated with patient-reported diagnostic errors (aOR=1.24, 95% CI 1.06 to 1.45).

## DISCUSSION

Our results showed that 3.9% of patients in primary care experienced diagnostic errors during the past 10 years. Among those with multimorbidity, it rose to 4.5%,

**Table 3** Univariate analyses of associations of each chronic health condition with patient-reported diagnostic errors

Chronic health condition	Patient-reported diagnostic errors		P value*
	Present (n=57)	Absent (n=1417)	
Hypertension	28 (49.1)	758 (53.5)	0.589
Diabetes	15 (26.3)	260 (18.3)	0.163
Dyslipidaemia	14 (24.6)	395 (27.9)	0.653
Stroke	0 (0.0)	21 (1.5)	1.000
Cardiac diseases	7 (12.3)	130 (9.2)	0.481
Chronic respiratory diseases	8 (14.0)	147 (10.4)	0.376
Digestive diseases	12 (21.1)	176 (12.4)	0.067
Hepatobiliary–pancreatic diseases	8 (14.0)	82 (5.8)	0.020
Kidney diseases	2 (3.5)	51 (3.6)	1.000
Urological diseases	8 (14.0)	117 (8.3)	0.140
Arthritis	3 (5.3)	121 (8.5)	0.623
Rheumatism	1 (1.8)	19 (1.3)	0.548
Lumbar diseases	9 (15.8)	180 (12.7)	0.542
Osteoporosis	5 (8.8)	129 (9.1)	1.000
Dementia	2 (3.5)	26 (1.8)	0.295
Neurological diseases	0 (0.0)	9 (0.6)	1.000
Mental disorders	7 (12.3)	52 (3.7)	0.006
Endocrine diseases	3 (5.3)	52 (3.7)	0.468
Malignancy	4 (7.0)	65 (4.6)	0.337
Skin diseases	3 (5.3)	65 (4.6)	0.744

\*P value by Fisher's exact test.

compared with 3.0% in those without multimorbidity. Most of the missed diagnoses were common chronic health conditions, including cancer, dermatitis and hypertension. Moreover, the results of our multivariable analysis revealed that multimorbidity was positively associated with patient-reported diagnostic errors. In recent years, although the guideline on the assessment and management of multimorbidity has been published,<sup>22</sup> evidence of effective approaches to prevent diagnostic errors for patients with multimorbidity remains scarce. Further research is necessary to improve the diagnostic process for patients with multimorbidity from both the technical and communication perspectives.

One of the important results was the lower proportion (3.9%) of patients reporting experiences of diagnostic errors in primary care than those reported in previous studies in other countries (16% and 17% in the USA and the UK, respectively).<sup>6,8</sup> These differences may be caused by healthcare system-related factors, especially the accessibility to services. In Japan, patients can visit any

**Table 4** Association between multimorbidity and patient-reported diagnostic errors (N=1474)

	Adjusted OR (95% CI)	P value
<b>Multimorbidity*</b>		
Absent	Reference	
Present	1.83 (1.01 to 3.31)	0.045
<b>Gender</b>		
Male	Reference	
Female	1.09 (0.61 to 1.95)	0.769
<b>Age (years)</b>		
20–39	Reference	
40–59	1.17 (0.37 to 3.70)	0.790
60–79	0.43 (0.14 to 1.36)	0.152
≥80	0.51 (0.14 to 1.87)	0.308
<b>Education</b>		
Less than high school	Reference	
High school	1.13 (0.49 to 2.58)	0.777
Junior college	1.49 (0.56 to 3.96)	0.425
More than or equal to college	2.10 (0.84 to 5.30)	0.115
<b>Annual household income (million yen)</b>		
<3.00 (=US\$27 000)	Reference	
3.00–4.99	0.59 (0.29 to 1.20)	0.145
5.00–6.99	0.70 (0.28 to 1.75)	0.451
7.00–9.99	0.38 (0.10 to 1.39)	0.142
≥10.00	0.88 (0.23 to 3.43)	0.859

\*Multimorbidity was defined as the presence of two or more chronic health conditions in an individual.

of the healthcare facilities except for large-sized hospitals without access restriction or additional out-of-pocket costs.<sup>21</sup> In the system with high accessibility to services, even if a technical diagnostic error occurs, it may be difficult for patients to recognise the diagnostic error if the diagnosis is corrected immediately by the same or another physician. Another possibility is the issue of cross-cultural validity of the survey tool for detecting diagnostic errors. Although we translated the tool which was used in the previous study, there might be challenges in the conceptual and semantic equivalence of the tool for use in the Japanese context.

Concordant with previous studies, most of the missed diagnoses identified in the present study were a wide range of common conditions, as opposed to rare diseases that tend to be difficult to diagnose by primary care physicians.<sup>2 23</sup> Furthermore, our finding indicates that patients with multimorbidity are more likely to report diagnostic errors in primary care. In concordance with the finding, Panagioti *et al* found that patients with multimorbidity were more likely to report experiences of patient safety

**Table 5** Sensitivity analysis of association between number of chronic health conditions and patient-reported diagnostic errors (N=1474)

	Adjusted OR (95% CI)	P value
Number of chronic health conditions	1.24 (1.06 to 1.45)	0.008
<b>Gender</b>		
Male	Reference	
Female	1.08 (0.61 to 1.94)	0.783
<b>Age (years)</b>		
20–39	Reference	
40–59	1.13 (0.36 to 3.57)	0.837
60–79	0.42 (0.13 to 1.33)	0.143
≥80	0.47 (0.13 to 1.77)	0.266
<b>Education</b>		
Less than high school	Reference	
High school	1.12 (0.49 to 2.56)	0.790
Junior college	1.51 (0.57 to 4.04)	0.409
More than or equal to college	2.11 (0.83 to 5.34)	0.116
<b>Annual household income (million yen)</b>		
<3.00 (=US\$27 000)	Reference	
3.00–4.99	0.58 (0.28 to 1.20)	0.145
5.00–6.99	0.76 (0.31 to 1.90)	0.561
7.00–9.99	0.42 (0.11 to 1.53)	0.188
≥10.00	0.90 (0.23 to 3.48)	0.882

incidents, including availability and appropriateness of medical tests and prescription of wrong types or doses of medication.<sup>24</sup> Our results are also consistent with previous studies that aimed to investigate a specific missed diagnosis, and these studies showed the same association with multimorbidity.<sup>15–19</sup>

In the present study, we examined the association between multimorbidity and diagnostic errors, including a large variety of diagnoses commonly encountered in the primary care setting. One of the possible causes of diagnostic challenges in patients with multimorbidity may be the high levels of treatment burden, high rates of psychiatric disorders, and poor patient–physician communication.<sup>25–27</sup> In patients with multimorbidity, treatment burden adds to the psychological symptoms and difficulties.<sup>28</sup> The exploratory analyses in our study suggested that mental disorders were associated with patient-reported diagnostic errors. The possible reasons for increased risk of harm in patients with psychiatric disorders include difficulties of communication, different expressions of symptoms, problems in knowledge and information gathering.<sup>12 29 30</sup> On the other hand, for patients with multimorbidity, there is a possibility that repeated interactions with healthcare providers and greater surveillance might



result in the identification of errors. More research is needed to explore the reasons for the increased risk of diagnostic errors in patients with multimorbidity.

To the best of our knowledge, this is the first study to examine the association between multimorbidity and patient-reported diagnostic errors, including a large variety of missed diagnoses in the primary care setting. The study setting included different levels of primary care facilities that were widely distributed throughout Japan, covering both urban and rural areas; therefore, the results of the present study will have a relatively high external validity.

The study has several potential limitations. First, although the content validity of the survey item of diagnostic errors was assessed in the previous study, other assessments of validity have not been performed. Additionally, of the three categories of diagnostic errors, we focused on 'missed diagnosis' and 'wrong diagnosis' and did not assess 'delayed diagnosis'.<sup>5</sup> This may cause an underestimation of diagnostic errors. However, generally, it is not easy to separate delayed diagnosis from missed or wrong diagnosis. Second, our results might be affected by selective non-response bias; nevertheless, the response rate in the present study was higher than that reported in previous similar studies.<sup>6,8</sup> Third, given the data were cross-sectional, a causal relationship between multimorbidity and diagnostic errors cannot be definitely established. Fourth, the study was limited by the fact that the participating facilities belonged to the PBRN, thereby possibly representing facilities that have greater interest in patient safety. This point should also be considered while interpreting the results of the study.

Because our findings were based on the preliminary data, more methodologically rigorous studies, including longitudinal studies using comprehensive and validated tools for detecting diagnostic errors, are necessary to confirm the association between multimorbidity and diagnostic errors. Additionally, qualitative studies have the potential to explore possible mechanisms for diagnostic errors especially in patients with multimorbidity.

## CONCLUSIONS

The present study showed a lower proportion of patients reporting experiences of diagnostic errors in primary care than those reported in previous studies in other countries. However, patients with multimorbidity are more likely to report diagnostic errors in primary care; thus, further research is necessary to improve the diagnostic process for patients with multimorbidity.

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**Competing interests** None declared.

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**Patient consent for publication** Not required.

**Ethics approval** This study was approved by the ethics committee of Kyoto University Graduate School of Medicine (approval number R1342) and was conducted in accordance with the Declaration of Helsinki. We obtained a consent for participation from each participant.

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**Data availability statement** No data are available. Additional unpublished data are still being analysed for another research and are only available to the members of the study team.

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## ORCID ID

Takuya Aoki <http://orcid.org/0000-0002-8232-2155>

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