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Factors associated with variation in urgency of primary out-of-hours contacts

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ABSTRACT

Objectives: Dutch primary out-of-hours care is provided by general practice cooperatives (GPCs). Although most GPCs use the same standardised triage system, differences between GPCs exist in the urgency assigned to patients' health problems. This cross-sectional study aims to provide insight into factors associated with the variation in assigned urgency levels between GPCs.

Design and methods: Data were derived from routine electronic health records of 895,253 patients who attended 17 GPCs in 2012. Patients' gender, age, travel distance to the GPC, and the use of a computer-based decision support system for triage were investigated as possibly affecting the variation in urgency levels between GPCs. Multilevel linear regression analyses were executed for the three most frequently presented health problems (cystitis/other urinary infection, laceration/cut, and fever).

Results: Variation in urgency levels between GPCs was significant for the selected health problems (p=0.00). Urgency levels were mainly related to patient gender and age. They were not associated with the use of a computer-based decision support system, nor with travel distance to the GPC. Most variation (93.4-96.7%) could be ascribed to patient characteristics.

Conclusions: There is significant variation in urgency levels between GPCs, even for the same health problem. This variation can mainly be ascribed to differences in characteristics of individuals contacting the GPCs, rather than to clinically irrelevant variables such as patients' travel distance or the use of a computer-based decision support system. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

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Strengths and limitations of this study

- To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and multiple factors associated with this variation.
- Comparison with Dutch population data and data reported by the national association for out-of-hours care underlines the representativeness of our data.
- Our finding that the variation in urgency levels between GPCs can mainly be ascribed to patient characteristics provides support for the adequate functioning of the triage system used in almost all Dutch GPCs.
- We studied factors associated with the variation in urgency for three selected health problems. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems.

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INTRODUCTION

As in several other Western countries, primary out-of-hours care in the Netherlands is provided by large scale general practice cooperatives (GPCs).[1,2] A GPC consists of one or more locations at which primary out-of-hours care is being provided. GPCs can be contacted by patients living in a specified postal code area surrounding the GPC (catchment area) at hours when the patient's own general practice is closed (i.e. at weekdays from 5 p.m. till 8 a.m., in weekends and during public holidays).

Patients must seek contact with the GPC by telephone before attending. Trained nurses execute telephone triage and decide what type of consultation the patient requires. These nurses are supervised by general practitioners, who may be consulted in case of doubt and who have to check and authorise all calls handled by the triage nurses.[1] The triage is executed by using a standardised six-level triage system, the Netherlands Triage System (NTS).[3] When vital functions are threatened, urgency level 0 is applicable. If this is not the case, the triage nurse selects the patient's main health problem out of a list of 48 problems and indicates its main discriminators (triage criteria). Based on these data, one of the remaining five urgency levels is recommended by the system, ranging from urgency level 1 (life-threatening) to urgency level 5 (self-care advise) (Table 1).

In 2012, there were 54 GPCs in the Netherlands.[4] Almost all cooperatives (96%) used the NTS or a triage system that is comparable in content.[4] The NTS is also available as paper guideline, but most GPCs (62%) use a computer-based decision support system to assist triage nurses in using the NTS. The use of a standardised triage system is expected to lead to more uniformity in the assignment of urgency to patients' health problems. Still, differences between GPCs exist in the urgency of primary out-of-hours contacts.[5]. Assigned urgency levels may be affected by factors other than the triage system.[5]

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Table 1. Urgency levels of the Netherlands Triage System

Urgency level	Classification of health problem and recommended care
U0	Failure of vital functions (airway, breathing, circulation, disability), resuscitation
U1	Life-threatening, immediate care
U2	Acute, evaluation within one hour
U3	Urgent, evaluation within a few hours
U4	Non-urgent, no time pressure, evaluation at the same day and/or within the same working shift
U5	Self-care advice, evaluation can be postponed to regular primary care

First, differences in characteristics of the population contacting the GPCs may lead to differences in urgency levels between GPCs. Previous research has shown that the distribution of urgency levels is associated with patient gender and age. Women have been shown to contact the GPC more frequently than men, except for life-threatening health problems.[6] This may imply that urgency levels are generally lower for women than for men.[cf. 5] Contacts for life-threatening health problems have been shown to increase with patient age, whereas non-urgent contacts most frequently occur for young children.[5,6]

Secondly, the distance between patients' homes and the GPC may affect the variation in urgency levels between GPCs. Patients living further away may experience barriers to consult the GPC, which may cause them to consult the GPC only for more urgent health problems. A previous study showed that an increasing travel distance between the patient's home and the out-of-hours service was associated with lower utilization of out-of-hours care,[7] a phenomenon known as distance decay.[8] This was particularly the case for non-urgent health problems.[7] Thus, GPCs in densely populated areas, with relatively short

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distances between patients' homes and the GPC, may have relatively more contacts with low urgency levels. The effect of distance is likely to be most pronounced for face-to-face consultations, and is less likely to occur for telephone consultations.[cf. 8,9]

Thirdly, the use of a computer-based decision support system may affect the assignment of urgency levels. A common problem with traditional paper-based triage is the reliance on memory, which is affected by experience and may be negatively affected by lack of time or recall.[10] Computer-based decision support tools, which guide the triage nurse through each step of the triage process, may improve the reliability of the triage and thereby increase its uniformity. Indeed, a study which compared computer-supported triage with standard triage at the emergency department, showed that variation in assigned urgency levels between triage nurses was higher when using standard triage.[10]

Differences between GPCs with regard to the factors mentioned above may lead to variation between cooperatives in the urgency levels assigned to patients' health problems. This study aims to provide insight into factors associated with the variation in assigned urgency between GPCs. Is this variation associated with relevant patient characteristics such as patient age and gender? Or is it associated with variables which are clinically less relevant for the assignment of urgency levels, such as patients' travel distance to the GPC or the use of a computer-based decision support system for triage? In the latter case, the variation in assigned urgency may be regarded as undesirable, and we need to try to improve the uniformity of the urgency assignment.

Although previous studies uncovered some factors that may be associated with the variation in urgency, they mainly focused on single factors. To our knowledge, we are the first to investigate the variation in urgency between GPCs including multiple possibly associated factors, and using a large dataset of nearly 900,000 patients.

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METHODS

Study population

Data were derived from routine electronic health records of patients attending 17 GPCs participating in the NIVEL Primary Care Database in 2012.[11] This database includes longitudinal data on morbidity and treatment of 28 Dutch GPCs. For this study, only data of GPCs with sufficient data quality regarding health problems were used (see below). The population in the catchment area of the included 17 GPCs (N=6,144,649) is representative of the Dutch population with regard to gender and age. A total number of 895,253 patients contacted one of the included GPCs, resulting in 1,350,964 contacts. These contacts included telephone consultations (N=570,915), consultations at the out-of-hours service (N=648,150), and home visits (N=131,899). The data were anonymised by a trusted third party to ensure patients' privacy.[cf. 12]

Electronic health records

Health problems of patients who consulted their GPC were recorded using codes from the International Classification of Primary Care (ICPC).[13]. A GPC was selected for this study if a meaningful ICPC code was recorded in at least 70% of its contacts. ICPC-codes considered to be meaningful range from 01-29 (symptoms) and from 70-99 (diagnoses). Since ICPC codes A97 (no disease) and A99 (other generalised disease/multiple syndromes) are sometimes used when health care providers do not directly know what is wrong with a patient, we do not regard these ICPC codes as meaningful. The same holds for codes in the range 30-69 (procedures).

When more than one ICPC code had been recorded during a contact (in 0.02% of all contacts, N=289 contacts), we included in our analyses only one that was recorded first, assuming that this was the patient's most important health problem.

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Apart from ICPC codes, the extracts of electronic health records used for this study included patients' year of birth, gender and the first four digits of their 6-digit postal code, as well as the postal code of the consulted GPC location. Distance in kilometres between the patient's postal code and the postal code of the GPC location was calculated using the Drive Time Matrix of the Netherlands 2012 (Geodan IT).

Questionnaire

Managers of the participating GPCs were asked to indicate whether or not a computer-based decision support system was being used for triage in their GPC. This question was part of a larger questionnaire. All 17 managers completed the questionnaire.

Analyses

Since we expected urgency levels to be comparable for the same health problem, we chose to perform our analyses for three specific health problems, namely the three health problems most frequently presented at the out-of-hours service: cystitis/other urinary infection (ICPC code U71); laceration/cut (S18); and fever (A03).

Multilevel linear regression analyses with two-level hierarchical structured data (patients within GPCs) were used to investigate whether urgency levels were associated with patients' gender, age, the distance between patient's home and the GPC, and the use of a computer-based decision support system by the GPC. Cases with missing data on any of the study variables were deleted from the analyses. However, as shown in Table 2, there were only few missing data. The null model was used to test whether the distribution of urgency levels was significantly different between the various GPCs.

Because of the ordinal nature of our dependent variable (urgency level), multilevel multinomial analyses would ideally have to be executed. However, we chose to perform

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multilevel linear regression analyses, because this method generates more easily interpretable data. We calculated intraclass correlation coefficients (ICCs), which indicate the proportion of the variation in urgency that can be ascribed to the patient level versus the level of the GPC. All analyses were executed in Stata, version 13. Results with $p<0.001$ are regarded as significant.

RESULTS

Characteristics of the participating GPCs and their patients are presented in Table 2. Table 3 displays the distribution of urgency levels for the total number of contacts, and for the three health problems most frequently presented at out-of-hours services. The ranges of urgency levels (Table 3) show that variation in urgency between GPCs particularly occurs at urgency levels 4 and 5. For each of the three selected health problems, the distribution of urgency levels was significantly different between the various GPCs ($p=0.00$).

The ICCs resulting from our multilevel linear regression analyses showed that the main part of the variation in urgency between GPCs can be ascribed to variation in characteristics of patients. For cystitis/other urinary infection, 93.4% of the variation in urgency could be ascribed to variables at the patient level, and 6.6% to the level of the GPC. Comparable results were found for laceration/cut (95.1% patient level, 4.9% GPC level) and fever (96.7% patient level, 3.3% GPC level).

Results of the multilevel linear regression analyses are presented in Table 4. When interpreting these results, one should keep in mind that a higher NTS urgency level represents a less urgent health problem (see Table 1). Thus, a positive association between an independent variable and urgency level implies that this variable is associated with a *lower* urgency.

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Table 2. Characteristics of participating GPCs and their patients

GPCs (N=17)	**M**	**Range**
Number of patients in catchment area, per GPC: M (range)	364,548	(106,270-1,452,738)
	%	**N**
Use of computer-based decision support system for triage		
Yes	82.4	14
No	17.6	3
Patients (N=895,253)	**%**	**N**
Gender: %		
Male	45.1	403,381
Female	54.9	491,793
Unknown	0.0	79
Age: %		
0-4 years	14.8	132,425
5-17 years	14.2	126,919
18-44 years	33.0	295,726
45-64 years	19.5	174,240
65-74 years	7.5	67,291
75-84 years	6.8	61,064
≥ 85 years	4.2	37,583
Unknown	0.0	5
Distance between patient's home and GPC in km: M (SD)	11.7 (21.9)*	

GPC=general practice cooperation; M=mean; SD=standard deviation

* data available for 854,119 patients (95.4%)

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Table 3. Urgency of patients' health problems in contacts with primary out-of-hours services, in percentages

U	Contacts (N=1,350,964)			Contacts for ICPC code U71 (N=52,207)			Contacts for ICPC code S18 (N=44,791)			Contacts for ICPC code A03 (N=43,201)		
	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*
0	0.01	0.00	0.15	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.10
1	1.06	0.42	1.90	0.03	0.02	0.12	0.04	0.01	0.17	0.30	0.10	1.52
2	7.99	4.63	12.24	3.63	1.76	8.72	4.43	0.74	14.76	7.32	3.90	11.83
3	37.13	21.58	45.69	27.53	7.34	47.24	60.09	30.72	77.05	34.22	26.37	57.65
4	26.11	16.78	51.46	42.27	24.01	65.25	24.02	10.77	58.45	16.86	6.31	42.09
5	27.69	7.03	46.83	26.53	2.84	51.97	11.43	1.75	32.79	41.29	13.04	57.28

U=urgency level; * Range of percentages between GPCs

U71= cystitis/other urinary infection; S18=laceration/cut; A03=fever

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Table 4. Factors associated with urgency: results of multilevel linear regression analyses

	ICPC code U71		ICPC code S18		ICPC code A03	
	B	**95% CI**	**B**	**95% CI**	**B**	**95% CI**
Female	.48*	.46; .50	.06*	.04; .07	.03	.01; .05
Age:						
5-17 years	.03	-.02; .08	-.05*	-.07; -.03	-.04	-.07; -.00
18-44 years	.25*	.21; .29	-.04*	-.06; -.02	-.12*	-.15; -.08
45-64 years	.26*	.22; .31	-.10*	-.12; -.07	-.40*	-.45; -.36
65-74 years	.20*	.15; .25	-.14*	-.18; -.10	-.62*	-.67; -.56
75-84 years	.15*	.11; .20	-.20*	-.24; -.16	-.75*	-.80; -.69
≥ 85 years	.21*	.16; .26	-.25*	-.29; -.21	-.69*	-.76; -.62
Distance in kilometres**	.00	.00; .00	-.00	-.00; .00	.00	.00; .00
Use of decision support system	.04	-.21; .30	-.13	-.33; .08	.09	-.14; .32

Reference categories: male gender, 0-4 years, no decision support system. A higher NTS urgency level represents a less urgent health problem (see Table 1).

U71=cystitis/other urinary infection; S18=laceration/cut; A03=fever

* significant at p<0.001; ** distance between patient's home and the GPC

The urgency levels for all three selected health problems (cystitis/other urinary infection; laceration/cut; and fever) were mainly related to patient gender and age. For cystitis and laceration/cut, urgency was significantly lower for female patients than for males. Urgency

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levels for cystitis and fever were significantly higher for adult patients (>18 years old) than for young children, whereas urgency levels for lacerations and cuts were significantly higher for patient >5 years old than for young children. The urgency of contacts was not associated with the use of a computer-based decision support system for triage, nor with the distance between the patient's home and the out-of-hours service.

DISCUSSION

Our results show significant variation in urgency levels between GPCs, even for the same health problem. At first glance, this may be regarded as an undesirable finding, since we would expect equal urgency levels to be assigned to similar cases. However, most of this variation (93.4-96.7%) could be ascribed to individual patient characteristics. Apparently, the variation in urgency levels between GPCs can mainly be ascribed to variations in the population contacting these cooperatives. A relatively small part of the variation in assigned urgency (3.3-6.6%) could be ascribed to variables at the level of the GPC. However, the variable that we included at this level (i.e. the use of a computer-based decision support tool for triage) had no significant effect.

Patient age was found to be an important factor associated with assigned urgency levels. Previous studies also showed urgency levels to be generally higher for older patients, whereas non-urgent contacts most frequently occur for young children.[5,6] GPCs with many elderly patients may therefore have more highly urgent contacts than GPCs which operate in a younger population.

Previous research has shown women to contact the GPC more frequently than men, except for life-threatening health problems.[6] Urgency levels may therefore generally be lower for women than for men.[cf. 5] Our results confirmed this hypothesis for cystitis and lacerations/cuts. Since cystitis predominantly occurs in women,[14] one can expect contacts

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for cystitis in men to be regarded as more urgent than contacts for cystitis in women. This association is less clear for lacerations and cuts.

In contrast with previous research by Raknes et al.,[7] we did not find a significant main effect of patients' travel distance to the out-of-hours service on the assigned urgency levels. However, the previous study was conducted in Norway, in which the distance between patients' homes and the out-of-hours service is much larger than in the Netherlands. Giesen et al.[15] found that Dutch patients have to travel a maximum of 30 kilometres to attend the out-of-hours service, whereas the travel distance for Norwegian patients may be more than 130 kilometres. Apparently, the variation in assigned urgency levels between GPCs cannot be ascribed to variations in travel distances between GPCs, i.e. to the urbanisation level of the catchment area of the cooperatives.

To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and factors associated with this variation. The population in the catchment area of the included GPCs was representative of the Dutch population with regard to gender and age. Moreover, the overall distribution of urgency levels found in this study (Table 3) is similar to the distribution reported by the national association for out-of-hours care,[4] which further underlines the representativeness of our data.

Although we tried to discover some of the key variables explaining the variation in urgency between GPCs, other variables deserve attention in future research. A factor of interest may be the collaboration between the GPC and the emergency department of the hospital (ED). Some Dutch GPCs are part of so-called integrated emergency departments, which combine their entrance and triage with the ED.[16] The joint triage is expected to cause patients with less urgent health problems to be diverted to the GPC, and patients with highly urgent health problems to be diverted mainly to the ED. GPCs participating in an integrated

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emergency department may therefore have to deal with more low urgent health problems than GPCs not participating in such a department.[17, Van Gils-van Rooij et al., unpublished]

Another variable that may affect the variation in assigned urgency levels between GPCs is the accessibility of general practices during office hours. A recent study showed that contact rates at the GPC were higher when the associated general practices closed early or were otherwise less accessible.[18] Limited accessibility of patients' general practice may particularly lead to an increase of low urgent health problems presented at the GPC.

Still, since these variables are characteristics of GPCs and our study indicated that only a small part of the variation in urgency levels could be ascribed to the level of the GPC, we expect such variables to only marginally affect the variation in assigned urgency.

We studied factors associated with the variation in urgency for the three health problems most frequently presented at the out-of-hours service. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems.

In sum, we showed that the variation in urgency levels between GPCs cannot be ascribed to clinically irrelevant variables such as patients' travel distance to the GPC or the use of a computer-based decision support system for triage, but rather to differences in characteristics of individuals contacting the GPCs. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

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KEY MESSAGES

What is already known about this subject

- Most Dutch general practice cooperatives (GPCs) use the same standardised triage system. Still, differences between GPCs exist in the urgency assigned to patients' health problems.
- Insight into factors associated with the variation in assigned urgency levels is scarce.

What this study adds

- The variation in urgency levels between GPCs can mainly be ascribed to variations in characteristics of individuals contacting the GPCs, rather than to differences in characteristics of GPCs.
- Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

Contributors

MZ designed the study and formulated the research questions. MN and MZ performed the data analyses. MZ drafted the manuscript. All authors critically reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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Ethics approval

Participating GPCs were contractually obliged to inform their patients about their participation in the NIVEL Primary Care Database and to inform patients about the possibility to opt-out if they objected to their data being included in the database.

Dutch law allows the use of extracts of electronic health records for research purposes under certain conditions. According to Dutch legislation, neither obtaining informed consent nor approval by a medical ethics committee is obligatory for this kind of observational studies (Dutch Civil Law, Article 7:458; http://www.dutchcivillaw.com/civilcodebook077.htm).

Data sharing statement

No additional data are available.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract - *page 1*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – *page 1*
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – *pages 3-5*
Objectives	3	State specific objectives, including any prespecified hypotheses – *page 5*
Methods		
Study design	4	Present key elements of study design early in the paper – *page 6*
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection – *page 6*
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants – *pages 6,7*
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable – *pages 6-7, and Table 2 (page 9)*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group – *pages 6-7*
Bias	9	Describe any efforts to address potential sources of bias – *page 6*
Study size	10	Explain how the study size was arrived at – *page 6*
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - *pages 6,7, and Table 2 (page 9)*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding – *pages 7-8*
		(*b*) Describe any methods used to examine subgroups and interactions - *pages 7-8*
		(*c*) Explain how missing data were addressed– *page 7*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy – *not applicable*
		(*e*) Describe any sensitivity analyses – *not applicable*
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed – *pages 6, 9-10*
		(b) Give reasons for non-participation at each stage – *not applicable*
		(c) Consider use of a flow diagram - *not applicable*
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – *page 9*
		(b) Indicate number of participants with missing data for each variable of interest – *page 9*
Outcome data	15*	Report numbers of outcome events or summary measures – *page 10*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included – *page 11*

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		(*b*) Report category boundaries when continuous variables were categorized – *pages 9,11*
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period – *not applicable*
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – *not applicable*
Discussion		
Key results	18	Summarise key results with reference to study objectives – *pages 12-14*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - *pages 14-15*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – *pages 12-14*
Generalisability	21	Discuss the generalisability (external validity) of the study results – *pages 13- 14*
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based – *page 15*

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with variation in urgency of primary out-of-hours contacts

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Factors associated with variation in urgency of primary out-of-hours contacts

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ABSTRACT

Objectives: Dutch primary out-of-hours care is provided by general practice cooperatives (GPCs). Although most GPCs use the same standardised triage system, differences between GPCs exist in the urgency assigned to patients' health problems. This cross-sectional study aims to provide insight into factors associated with the variation in assigned urgency between GPCs.

Design and methods: Data were derived from routine electronic health records of 895,253 patients who attended 17 GPCs in 2012. Patients' gender, age, travel distance to the GPC, and the use of a computer-based decision support system for triage were investigated as possibly affecting assigned urgency. Multilevel linear regression analyses were executed for the three most frequently presented health problems (cystitis/other urinary infection, laceration/cut, and fever).

Results: Variation in urgency levels between GPCs was significant for the selected health problems (p=0.00). Assigned urgency was mainly related to patient gender and age. It was not associated with the use of a computer-based decision support system, nor with travel distance to the GPC. Most variation in urgency (93.4-96.7%) could be ascribed to variation in patient characteristics.

Conclusions: There is significant variation in urgency levels between GPCs, even for the same health problem. This variation is mainly associated with differences in characteristics of individuals contacting the GPCs, rather than with variables such as patients' travel distance or the use of a computer-based decision support system. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

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Strengths and limitations of this study

- To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and multiple factors associated with assigned urgency.
- Comparison with Dutch population data and data reported by the national association for out-of-hours care underlines the representativeness of our data.
- Our finding that the variation in urgency can mainly be ascribed to variation in patient characteristics provides support for the adequate functioning of the triage system used in almost all Dutch GPCs.
- We studied factors associated with assigned urgency for three selected health problems. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems.

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INTRODUCTION

As in several other Western countries, primary out-of-hours care in the Netherlands is provided by large scale general practice cooperatives (GPCs).[1,2] A GPC consists of one or more locations at which primary out-of-hours care is being provided. GPCs can be contacted by patients living in a specified postal code area surrounding the GPC (catchment area) at hours when the patient's own general practice is closed (i.e. at weekdays from 5 p.m. till 8 a.m., in weekends and during public holidays).

Patients must seek contact with the GPC by telephone before attending. Trained nurses execute telephone triage and decide what type of consultation the patient requires. These nurses are supervised by general practitioners, who may be consulted in case of doubt. All calls handled by the triage nurses have to be checked and authorised by a general practitioner,[1] who subsequently records the patient's health problem using codes from a standardised classification system (see Methods). The triage is executed by means of a standardised six-level triage system, the Netherlands Triage System (NTS).[3] When vital functions are threatened, urgency level 0 is applicable. If this is not the case, the triage nurse selects the patient's main health problem out of a list of 48 problems and indicates its main discriminators (triage criteria). Based on these data, one of the remaining five urgency levels is recommended by the system, ranging from urgency level 1 (life-threatening) to urgency level 5 (self-care advise) (Table 1). As can be seen in Table 1, a *higher* NTS urgency level represents a clinically *less urgent* health problem. To clarify this difference, the term 'urgency' will be used throughout this paper, to indicate the clinical urgency instead of the NTS urgency level.

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Table 1. Urgency levels of the Netherlands Triage System

Urgency level	Classification of health problem and recommended care
U0	Failure of vital functions (airway, breathing, circulation, disability), resuscitation
U1	Life-threatening, immediate care
U2	Acute, evaluation within one hour
U3	Urgent, evaluation within a few hours
U4	Non-urgent, no time pressure, evaluation at the same day and/or within the same working shift
U5	Self-care advice, evaluation can be postponed to regular primary care

In 2012, there were 54 GPCs in the Netherlands.[4] Almost all cooperatives (96%) used the NTS or a triage system that is comparable in content.[4] The NTS is also available as paper guideline, but most GPCs (62%) use a computer-based decision support system to assist triage nurses in using the NTS. The use of a standardised triage system is expected to lead to more uniformity in the assignment of urgency to patients' health problems. Still, differences between GPCs exist in the distribution of assigned urgency of primary out-of-hours contacts.[5]. Assigned urgency may be affected by factors other than the triage system.[5]

First, differences in characteristics of the population contacting the GPCs may lead to differences in assigned urgency between GPCs. Previous research has shown that the distribution of urgency is associated with patient gender and age. Women have been shown to contact the GPC more frequently than men, except for life-threatening health problems.[6] This may imply that assigned urgency is generally lower for women than for men.[cf. 5] Contacts for life-threatening health problems have been shown to increase with patient age, whereas non-urgent contacts most frequently occur for young children.[5,6]

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Secondly, the distance between patients' homes and the GPC may affect the variation in urgency between GPCs. Patients living further away may experience barriers to consult the GPC, which may cause them to consult the GPC only for more urgent health problems. A previous study showed that an increasing travel distance between the patient's home and the out-of-hours service was associated with lower utilization of out-of-hours care,[7] a phenomenon known as distance decay.[8] This was particularly the case for non-urgent health problems.[7] Thus, GPCs in densely populated areas, with relatively short distances between patients' homes and the GPC, may have relatively more contacts with low urgency. The effect of distance is likely to be most pronounced for face-to-face consultations, and is less likely to occur for telephone consultations.[cf. 8,9]

Thirdly, the use of a computer-based decision support system may affect the assignment of urgency. A common problem with traditional paper-based triage is the reliance on memory, which is affected by experience and may be negatively affected by lack of time or recall.[10] Computer-based decision support tools, which guide the triage nurse through each step of the triage process, may improve the reliability of the triage and thereby increase its uniformity. Indeed, a study which compared computer-supported triage with standard triage at the emergency department, showed that variation in assigned urgency between triage nurses was higher when using standard triage.[10]

Differences between GPCs with regard to the factors mentioned above may lead to variation between cooperatives in the urgency assigned to patients' health problems. This study aims to provide insight into factors associated with the variation in assigned urgency between GPCs. Is assigned urgency associated with relevant patient characteristics such as patient age and gender? Or is it associated with variables which are clinically less relevant, such as patients' travel distance to the GPC or the use of a computer-based decision support system for triage? In the latter case, the variation in assigned urgency may be regarded as

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undesirable: it may hamper adequate communication and collaboration between health care providers, and may thereby negatively affect the quality and safety of care. This may require actions to improve the uniformity of the urgency assignment.

METHODS

Study population

Data were derived from routine electronic health records of patients attending GPCs participating in the NIVEL Primary Care Database in 2012.[11] This database includes longitudinal data on morbidity and treatment of 28 Dutch GPCs. For this study, only data of GPCs with sufficient data quality regarding health problems were used (see below). All patient contacts of these GPCs (telephone consultations, consultations at the out-of-hours service, and home visits) in 2012 were used in this study. The data were anonymised by a trusted third party to ensure patients' privacy.[cf. 12]

Electronic health records

Health problems of patients who consulted their GPC were recorded using codes from the International Classification of Primary Care, version 1 (ICPC).[13]. This version of the ICPC is used by all Dutch GPs. A GPC was selected for this study if a meaningful ICPC code was recorded in at least 70% of its contacts. ICPC codes considered to be meaningful range from 01-29 (symptoms) and from 70-99 (diagnoses). Since ICPC codes A97 (no disease) and A99 (other generalised disease/multiple syndromes) are sometimes used when health care providers do not directly know how to classify the patient's health problem, we do not regard these ICPC codes as meaningful. The same holds for codes in the range 30-69 (procedures).

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When more than one ICPC code had been recorded during a contact (in 0.02% of all contacts, N=289 contacts), we included in our analyses only the one that was recorded first, assuming that this was the patient's most important health problem.

Apart from ICPC codes, the extracts of electronic health records used for this study included patients' year of birth, gender and the first four digits of their 6-digit postal code, as well as the postal code of the consulted GPC location. Distance in kilometres between the patient's postal code and the postal code of the GPC location was calculated using the Drive Time Matrix of the Netherlands 2012 (Geodan IT).

Questionnaire

Managers of the participating GPCs were asked to indicate whether or not a computer-based decision support system was being used for triage in their GPC. This question was part of a more extensive questionnaire. All managers of the included GPCs completed the questionnaire.

Analyses

Since we expected the distribution of urgency levels to be comparable for the same health problem, we chose to perform our analyses for three specific health problems, namely the three health problems most frequently presented at the out-of-hours service: cystitis/other urinary infection (ICPC code U71); laceration/cut (S18); and fever (A03).

First, we investigated the distribution of urgency levels (i.e. the percentage of contacts associated with each of the six urgency levels) for the total number of contacts, and for contacts for the three selected health problems. We also performed these analyses for each GPC separately to obtain insight into the range of percentages for each urgency level.

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Subsequently, multilevel linear regression analyses with two-level hierarchically structured data (patients within GPCs) were used to investigate whether the urgency of contacts was associated with patients' gender, age, the distance between patient's home and the GPC, and the use of a computer-based decision support system by the GPC. Cases with missing data on any of the study variables were deleted from the analyses. However, as shown in Table 2, there were few missing data. The null model was used to test whether the distribution of urgency was significantly different between the various GPCs.

Because of the ordinal nature of our dependent variable (urgency of primary out-of-hours contacts), multilevel multinomial analyses would ideally have to be executed. However, we chose to perform multilevel linear regression analyses, because this method generates more easily interpretable data. Apart from unstandardised regression coefficients and 99.99% confidence intervals, we calculated intraclass correlation coefficients (ICCs), which indicate the proportion of the variation in urgency that can be ascribed to the patient level versus the level of the GPC. We have added diagnostic plots (q-q plots), which show the distribution of residuals versus the normal distribution, in a Supplementary file. All analyses were executed in Stata, version 13. Because of our large sample size, we chose to adjust our p-value and regarded results with $p<0.001$ as significant.

RESULTS

Seventeen GPCs met our criteria for sufficient data quality regarding health problems. The population in the catchment area of these GPCs (N=6,144,649) is representative of the Dutch population with regard to gender and age. A total number of 895,253 patients contacted one of the included GPCs, resulting in 1,350,964 contacts. These contacts included telephone consultations (N=570,915), consultations at the out-of-hours service (N=648,150), and home

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visits (N=131,899). Characteristics of the participating GPCs and their patients are presented in Table 2.

Table 2. Characteristics of participating GPCs and their patients

GPCs (N=17)		
Number of inhabitants in catchment area, per GPC: M, range	364,548	106,270-1,452,738
Use of computer-based decision support system for triage: %, N		
Yes	82.4	14
No	17.6	3
Patients (N=895,253)		
Gender: %, N		
Male	45.1	403,381
Female	54.9	491,793
Unknown	0.0	79
Age: %, N		
0-4 years	14.8	132,425
5-17 years	14.2	126,919
18-44 years	33.0	295,726
45-64 years	19.5	174,240
65-74 years	7.5	67,291
75-84 years	6.8	61,064
≥ 85 years	4.2	37,583
Unknown	0.0	5
Distance between patient's home and GPC in km: M, SD	11.7	21.9*

GPC=general practice cooperation; M=mean; SD=standard deviation

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* data available for 854,119 patients (95.4%)

Table 3 displays the distribution of urgency levels for the total number of contacts, and for the three health problems most frequently presented at out-of-hours services. The ranges of urgency levels (Table 3) show that variation in urgency between GPCs particularly occurs at urgency levels 4 and 5. For each of the three selected health problems, the distribution of urgency levels was significantly different between the various GPCs (p=0.00).

The ICCs resulting from our multilevel linear regression analyses showed that the main part of the total variation in urgency can be ascribed to variation in characteristics of patients. For cystitis/other urinary infection, 93.4% of the variation in urgency could be ascribed to variation in patient characteristics, and 6.6% to the level of the GPC. Comparable results were found for laceration/cut (95.1% patient level, 4.9% GPC level) and fever (96.7% patient level, 3.3% GPC level).

Results of the multilevel linear regression analyses are presented in Table 4. When interpreting these results, one should keep in mind that a higher NTS urgency level represents a less urgent health problem (see Table 1). Thus, a positive association between an independent variable and urgency level implies that this variable is associated with a lower clinical urgency.

The urgency of all three selected health problems (cystitis/other urinary infection; laceration/cut; and fever) were mainly related to patient gender and age. For cystitis and laceration/cut, urgency was significantly lower for female patients than for males. Urgency for cystitis was significantly lower for adult patients (>18 years old) than for young children, whereas urgency for fever was significantly higher for adult patients than for young children. Urgency for lacerations and cuts was significantly higher for patients >5 years old than for young children. The urgency of contacts was not associated with the use of a computer-based

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decision support system for triage, nor with the distance between the patient's home and the out-of-hours service.

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Table 3. Urgency of patients' health problems in contacts with primary out-of-hours services, in percentages

U	Contacts (N=1,350,964)			Contacts for ICPC code U71 (N=52,207)			Contacts for ICPC code S18 (N=44,791)			Contacts for ICPC code A03 (N=43,201)		
	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*
0	0.01	0.00	0.15	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.10
1	1.06	0.42	1.90	0.03	0.02	0.12	0.04	0.01	0.17	0.30	0.10	1.52
2	7.99	4.63	12.24	3.63	1.76	8.72	4.43	0.74	14.76	7.32	3.90	11.83
3	37.13	21.58	45.69	27.53	7.34	47.24	60.09	30.72	77.05	34.22	26.37	57.65
4	26.11	16.78	51.46	42.27	24.01	65.25	24.02	10.77	58.45	16.86	6.31	42.09
5	27.69	7.03	46.83	26.53	2.84	51.97	11.43	1.75	32.79	41.29	13.04	57.28

U=NTS urgency level; * Range of percentages between GPCs

U71= cystitis/other urinary infection; S18=laceration/cut; A03=fever

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Table 4. Factors associated with urgency: results of multilevel linear regression analyses

	ICPC code U71			ICPC code S18			ICPC code A03		
	B	**99.99% CI**	**p**	**B**	**99.99% CI**	**p**	**B**	**99.99% CI**	**p**
Female	.48*	.44; .52	.000	.06*	.03; .08	.000	.03	-.00; .07	.001
Age:									
5-17 years	.03	-.07; .13	.238	-.05*	-.09; -.00	.000	-.04	-.10; .03	.024
18-44 years	.25*	.17; .34	.000	-.04*	-.08; .00	.000	-.12*	-.19; -.05	.000
45-64 years	.26*	.18; .35	.000	-.10*	-.14; -.05	.000	-.40*	-.49; -.32	.000
65-74 years	.20*	.11; .29	.000	-.14*	-.21; -.07	.000	-.62*	-.73; -.51	.000
75-84 years	.15*	.06; .25	.000	-.20*	-.27; -.12	.000	-.75*	-.85; -.64	.000
≥ 85 years	.21*	.12; .31	.000	-.25*	-.33; -.17	.000	-.69*	-.82; -.56	.000
Distance in kilometres**	.00	-.00; .00	.002	-.00	-.00; .00	.307	.00	-.00; .00	.016

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Use of decision support system	.04	-.47; .55	.749	-.13	-.54; .28	.227	.09	-.37; .54	.452

Reference categories: male gender, 0-4 years, no decision support system. A higher NTS urgency level represents a clinically less urgent health problem (see Table 1).

U71=cystitis/other urinary infection; S18=laceration/cut; A03=fever; B=unstandardised regression coefficient; CI=confidence interval

* significant at p<0.001; ** distance between patient's home and the GPC

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DISCUSSION

Our results show significant variation in assigned urgency between GPCs, even for the same health problem. At first glance, this may be regarded as an undesirable finding, since we would expect equal urgency to be assigned to similar cases. However, most of the total variation in assigned urgency (93.4-96.7%) could be ascribed to variation in individual patient characteristics. Apparently, the variation in urgency can mainly be ascribed to variations in the population contacting the GPCs. A relatively small part of the variation in assigned urgency (3.3-6.6%) could be ascribed to variables at the level of the GPC. However, the variable that we included at this level (i.e. the use of a computer-based decision support tool for triage) had no significant association with assigned urgency.

Patient age was found to be an important factor associated with assigned urgency. Previous studies also showed urgency to be generally higher for older patients, whereas non-urgent contacts most frequently occur for young children.[5,6] GPCs with many elderly patients may therefore have more highly urgent contacts than GPCs which operate in a younger population.

Previous research has shown women to contact the GPC more frequently than men, except for life-threatening health problems.[6] Assigned urgency may therefore generally be lower for women than for men.[cf. 5] Our results confirmed this hypothesis for cystitis and lacerations/cuts. Since cystitis predominantly occurs in women,[14] one can expect contacts for cystitis in men to be regarded as more urgent than contacts for cystitis in women. This association is less clear for lacerations and cuts.

In contrast with previous research by Raknes et al.,[7] we did not find a significant association between patients' travel distance to the out-of-hours service and the assigned urgency. However, the previous study was conducted in Norway, where the distance between patients' homes and the out-of-hours service is much larger than in the Netherlands. Giesen et

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al.[15] found that Dutch patients have to travel a maximum of 30 kilometres to attend the out-of-hours service, whereas the travel distance for Norwegian patients can be more than 130 kilometres. Apparently, the variation in assigned urgency between GPCs is not associated with variations in travel distances between GPCs. However, from the patient's perspective, the time needed to travel to the GPC may be more important than the travel distance per se. It would be interesting to investigate whether there is an association between patients' travel time and the assigned urgency.

To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and factors associated with assigned urgency. The population in the catchment area of the included GPCs was representative of the Dutch population with regard to gender and age. GPCs that used a computer-based decision support system for triage were overrepresented in our sample (82% in our sample versus 62% in the Netherlands). The overall distribution of urgency levels found in this study (Table 3) is similar to the distribution reported by the national association for out-of-hours care,[4] which underlines the representativeness of our data.

Although we tried to discover some of the key variables associated with the variation in urgency between GPCs, other variables deserve attention in future research. Patient characteristics like socioeconomic status, comorbidity, the use of medication, living conditions, strategy to cope with physical symptoms, and perceptions about the ease to visit a GPC may also be associated with assigned urgency.

A factor of interest on the GPC level may be the collaboration between the GPC and the emergency department of the hospital (ED). Some Dutch GPCs are part of so-called integrated emergency departments, which combine their entrance and triage with the ED.[16] The joint triage is expected to cause patients with less urgent health problems to be diverted to

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the GPC, and patients with highly urgent health problems to be diverted mainly to the ED. GPCs participating in an integrated emergency department may therefore have to deal with more low urgent health problems than GPCs not participating in such a department.[17, Van Gils-van Rooij et al., unpublished]

Another variable that may affect the variation in assigned urgency between GPCs is the accessibility of general practices during office hours. A recent study showed that contact rates at the GPC were higher when the associated general practices closed early or were otherwise less accessible.[18] Limited accessibility of patients' general practice may particularly lead to an increase of low urgent health problems presented at the GPC.

Still, since these variables are characteristics of GPCs and our study indicated that only a small part of the variation in urgency for the three selected health problems could be ascribed to variation at the level of the GPC, we expect such variables to only marginally affect the variation in assigned urgency.

For our analyses, we could only use the ICPC codes that were recorded in the GPCs' electronic health records. We could not test the validity of these ICPC codes with respect to patients' health problems. Therefore, we cannot completely rule out the possibility that the variation in assigned urgency in fact reflects different ICPC coding practices between GPCs. However, our multilevel analyses showed that only a small part of the variation in assigned urgency can be ascribed to the level of the GPCs, which argues against this possibility.

We studied factors associated with assigned urgency for the three health problems most frequently presented at the out-of-hours service. This strategy was chosen because it would guarantee a sufficient number of contacts for our analyses. However, our choice to focus on these specific health problems also has some limitations. First, two of the selected ICPC codes (fever, A03; and laceration/cut, S18) are symptoms, which are less specific than diagnoses. Fever, for instance, can be a sign of a variety of diagnoses (e.g. pneumonia,

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tuberculosis, acute myocardial infarction, a malignancy, arthritis), most likely to be associated with different urgency levels. Information about such diagnoses is not included in our study. Secondly, selecting three specific health problems obviously does not provide the full picture of the variety in urgency for health problems presented in primary out-of-hours care. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems. It would also be interesting to investigate the variation in assigned urgency in association with the reason for encounter recorded by the triage nurse.

In sum, we showed that the variation in assigned urgency is not associated with one aspect of accessibility (i.e. travel distance), nor with one of the core facilities of GPCs (i.e. the use of a computer-based decision support system for triage), but rather with differences in characteristics of individuals contacting the GPCs. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system. Although this is a promising result, additional research is needed to shed more light on the sensitivity and specificity of the triage system.

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KEY MESSAGES

What is already known about this subject

- Most Dutch general practice cooperatives (GPCs) use the same standardised triage system. Still, differences between GPCs exist in the urgency assigned to patients' health problems.
- Insight into factors associated with the variation in assigned urgency levels is scarce.

What this study adds

- The variation in urgency can mainly be ascribed to variations in characteristics of individuals contacting the GPCs, rather than to differences in characteristics of GPCs.
- Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

Contributors

MZ designed the study and formulated the research questions. MN and MZ performed the data analyses. MZ drafted the manuscript. All authors critically reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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Ethics approval

Participating GPCs were contractually obliged to inform their patients about their participation in the NIVEL Primary Care Database and to inform patients about the possibility to opt-out if they objected to their data being included in the database.

Dutch law allows the use of extracts of electronic health records for research purposes under certain conditions. According to Dutch legislation, neither obtaining informed consent nor approval by a medical ethics committee is obligatory for this kind of observational studies (Dutch Civil Law, Article 7:458; http://www.dutchcivillaw.com/civilcodebook077.htm).

Data sharing statement

No additional data are available.

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Supplementary file 1: Diagnostic plots (q-q plots)

Figure 1. Quantiles of residuals versus quantiles of normal distribution for cystitis/other urinary infection (ICPC code U71)

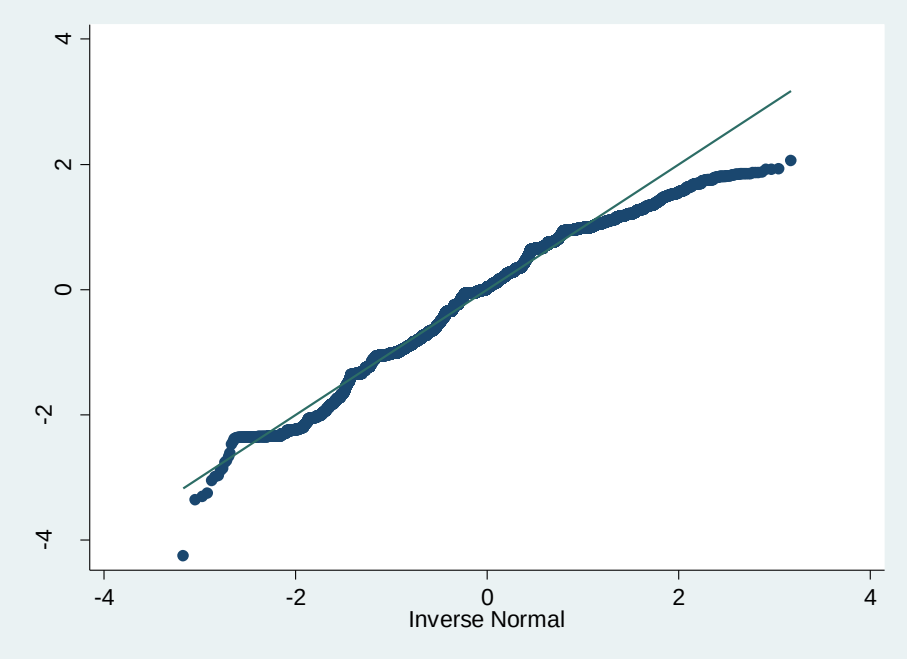

Figure 2. Quantiles of residuals versus quantiles of normal distribution for laceration/cut (ICPC code S18)

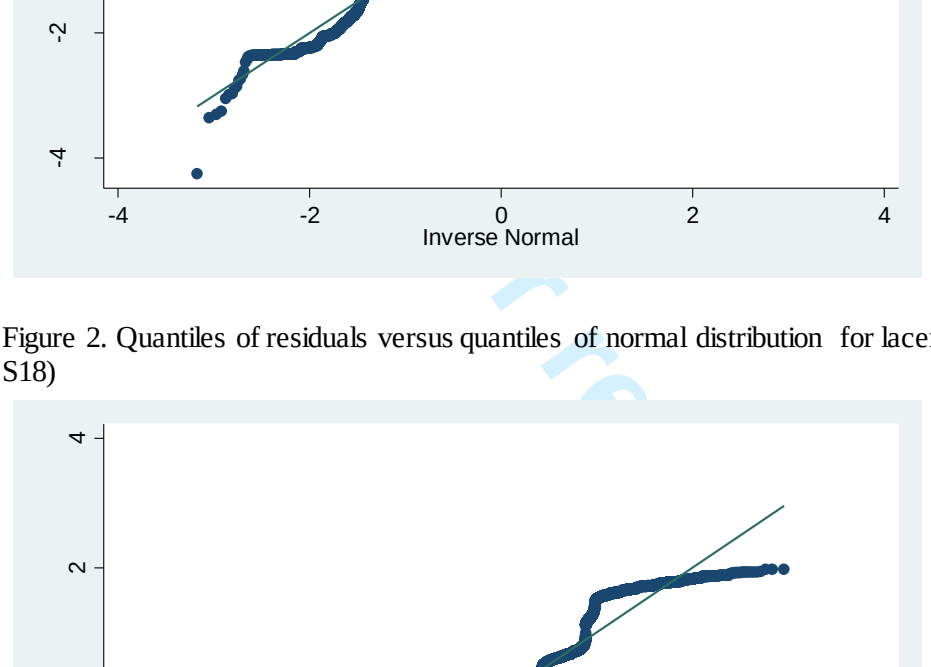

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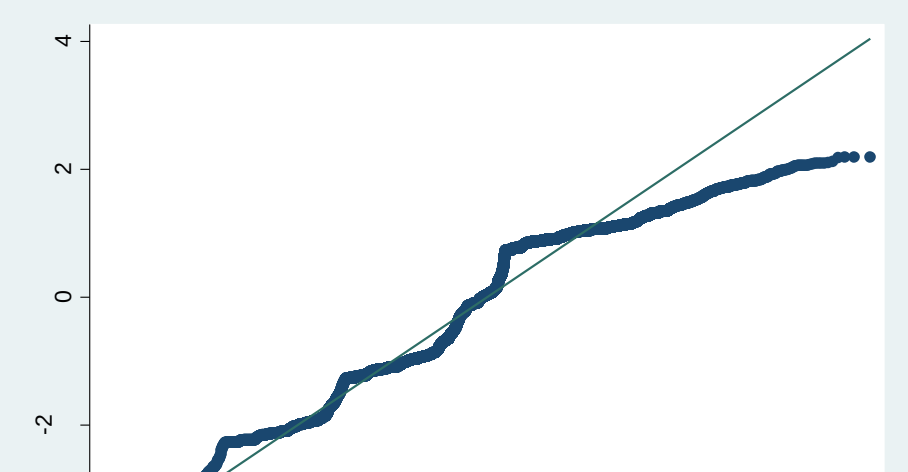
Figure 3. Quantiles of residuals versus quantiles of normal distribution for fever (ICPC code A03)



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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract - *page 1*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – *page 1*
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – *pages 3-6*
Objectives	3	State specific objectives, including any prespecified hypotheses – *page 5*
Methods		
Study design	4	Present key elements of study design early in the paper – *page 6*
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection – *page 6*
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants – *pages 6,7*
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable – *pages 6-7, and Table 2 (page 9)*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group – *pages 6-7*
Bias	9	Describe any efforts to address potential sources of bias – *page 6*
Study size	10	Explain how the study size was arrived at – *page 6-7*
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - *pages 6,7, and Table 2 (page 9)*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding – *pages 7-8*
		(*b*) Describe any methods used to examine subgroups and interactions - *pages 7-8*
		(*c*) Explain how missing data were addressed– *page 8*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy – *not applicable*
		(*e*) Describe any sensitivity analyses – *not applicable*
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed – *pages 8, 9-11*
		(b) Give reasons for non-participation at each stage – *not applicable*
		(c) Consider use of a flow diagram - *not applicable*
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – *page 9*
		(b) Indicate number of participants with missing data for each variable of interest – *page 9*
Outcome data	15*	Report numbers of outcome events or summary measures – *page 11*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included – *page 12*

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		(*b*) Report category boundaries when continuous variables were categorized – *pages 9,12*
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period – *not applicable*
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – *not applicable*
Discussion		
Key results	18	Summarise key results with reference to study objectives – *pages 14-15*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - *pages 15-17*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – *pages 14-17*
Generalisability	21	Discuss the generalisability (external validity) of the study results – *pages 15- 17*
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based – *page 18*

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with variation in urgency of primary out-of-hours contacts in the Netherlands: a cross-sectional study

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Keywords:	PRIMARY CARE, ACCIDENT & EMERGENCY MEDICINE, Protocols & guidelines < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Factors associated with variation in urgency of primary out-of-hours contacts in the Netherlands: a cross-sectional study

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Keywords: Out-of-hours services, primary care, triage, urgency

Word count: 4405 (excluding title page and abstract)

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ABSTRACT

Objectives: Dutch primary out-of-hours care is provided by general practice cooperatives (GPCs). Although most GPCs use the same standardised triage system, differences between GPCs exist in the urgency assigned to patients' health problems. This cross-sectional study aims to provide insight into factors associated with the variation in assigned urgency between GPCs.

Design and methods: Data were derived from routine electronic health records of 895,253 patients who attended 17 GPCs in 2012. Patients' gender, age, travel distance to the GPC, and the use of a computer-based decision support system for triage were investigated as possibly affecting assigned urgency. Multilevel linear regression analyses were executed for the three most frequently presented health problems (cystitis/other urinary infection, laceration/cut, and fever).

Results: Variation in urgency levels between GPCs was significant for the selected health problems (p=0.00). Assigned urgency was mainly related to patient gender and age. It was not associated with the use of a computer-based decision support system, nor with travel distance to the GPC. Most variation in urgency (93.4-96.7%) could be ascribed to variation in patient characteristics.

Conclusions: There is significant variation in urgency levels between GPCs, even for the same health problem. This variation is mainly associated with differences in characteristics of individuals contacting the GPCs, rather than with variables such as patients' travel distance or the use of a computer-based decision support system. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

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Strengths and limitations of this study

- To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and multiple factors associated with assigned urgency.
- Comparison with Dutch population data and data reported by the national association for out-of-hours care underlines the representativeness of our data.
- Our finding that the variation in urgency can mainly be ascribed to variation in patient characteristics provides support for the adequate functioning of the triage system used in almost all Dutch GPCs.
- We studied factors associated with assigned urgency for three selected health problems. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems.

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INTRODUCTION

As in several other Western countries, primary out-of-hours care in the Netherlands is provided by large scale general practice cooperatives (GPCs).[1,2] A GPC consists of one or more locations at which primary out-of-hours care is being provided. GPCs can be contacted by patients living in a specified postal code area surrounding the GPC (catchment area) at hours when the patient's own general practice is closed (i.e. at weekdays from 5 p.m. till 8 a.m., in weekends and during public holidays).

Patients must seek contact with the GPC by telephone before attending. Trained nurses execute telephone triage and decide what type of consultation the patient requires. These nurses are supervised by a general practitioner (GP), who may be consulted in case of doubt. All calls handled by the triage nurses have to be checked and authorised by a GP,[1] who subsequently records the patient's health problem using codes from a standardised classification system (see Methods). This coding is not necessarily done after a consultation with the GP. The GP can also record a diagnostic code based on the information provided by the triage nurse.

The triage is executed by means of a standardised six-level triage system, the Netherlands Triage System (NTS).[3] When vital functions are threatened, urgency level 0 is applicable. If this is not the case, the triage nurse selects the patient's main health problem out of a list of 48 problems and indicates its main discriminators (triage criteria). Based on these data, one of the remaining five urgency levels is recommended by the system, ranging from urgency level 1 (life-threatening) to urgency level 5 (self-care advise) (Table 1). As can be seen in Table 1, a *higher* NTS urgency level represents a clinically *less urgent* health problem. To clarify this difference, the term 'urgency' will be used throughout this paper, to indicate the clinical urgency instead of the NTS urgency level.

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Table 1. Urgency levels of the Netherlands Triage System

Urgency level	Classification of health problem and recommended care
U0	Failure of vital functions (airway, breathing, circulation, disability), resuscitation
U1	Life-threatening, immediate care
U2	Acute, evaluation within one hour
U3	Urgent, evaluation within a few hours
U4	Non-urgent, no time pressure, evaluation at the same day and/or within the same working shift
U5	Self-care advice, evaluation can be postponed to regular primary care

In 2012, there were 54 GPCs in the Netherlands.[4] Almost all cooperatives (96%) used the NTS or a triage system that is comparable in content.[4] The NTS is also available as paper guideline, but most GPCs (62%) use a computer-based decision support system to assist triage nurses in using the NTS. The use of a standardised triage system is expected to lead to more uniformity in the assignment of urgency to patients' health problems. Still, differences between GPCs exist in the distribution of assigned urgency of primary out-of-hours contacts.[5]. Assigned urgency may be affected by factors other than the triage system.[5]

First, differences in characteristics of the population contacting the GPCs may lead to differences in assigned urgency between GPCs. Previous research has shown that the distribution of urgency is associated with patient gender and age. Women have been shown to contact the GPC more frequently than men, except for life-threatening health problems.[6] This may imply that assigned urgency is generally lower for women than for men.[cf. 5] Contacts for life-threatening health problems have been shown to increase with patient age, whereas non-urgent contacts most frequently occur for young children.[5,6]

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Secondly, the distance between patients' homes and the GPC may affect the variation in urgency between GPCs. Patients living further away may experience barriers to consult the GPC, which may cause them to consult the GPC only for more urgent health problems. A previous study showed that an increasing travel distance between the patient's home and the out-of-hours service was associated with lower utilization of out-of-hours care,[7] a phenomenon known as distance decay.[8] This was particularly the case for non-urgent health problems.[7] Thus, GPCs in densely populated areas, with relatively short distances between patients' homes and the GPC, may have relatively more contacts with low urgency. The effect of distance is likely to be most pronounced for face-to-face consultations, and is less likely to occur for telephone consultations.[cf. 8,9]

Thirdly, the use of a computer-based decision support system may affect the assignment of urgency. A common problem with traditional paper-based triage is the reliance on memory, which is affected by experience and may be negatively affected by lack of time or recall.[10] Computer-based decision support tools, which guide the triage nurse through each step of the triage process, may improve the reliability of the triage and thereby increase its uniformity. Indeed, a study which compared computer-supported triage with standard triage at the emergency department, showed that variation in assigned urgency between triage nurses was higher when using standard triage.[10]

Differences between GPCs with regard to the factors mentioned above may lead to variation between cooperatives in the urgency assigned to patients' health problems. This study aims to provide insight into factors associated with the variation in assigned urgency between GPCs. Is assigned urgency associated with relevant patient characteristics such as patient age and gender? Or is it associated with variables which are clinically less relevant, such as patients' travel distance to the GPC or the use of a computer-based decision support system for triage? In the latter case, the variation in assigned urgency may be regarded as

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undesirable: it may hamper adequate communication and collaboration between health care providers, and may thereby negatively affect the quality and safety of care. This may require actions to improve the uniformity of the urgency assignment.

METHODS

Study population

Data were derived from routine electronic health records of patients attending GPCs participating in the NIVEL Primary Care Database in 2012.[11] This database includes longitudinal data on morbidity and treatment of 28 Dutch GPCs. For this study, only data of GPCs with sufficient data quality regarding health problems were used (see below). All patient contacts of these GPCs (telephone consultations, consultations at the out-of-hours service, and home visits) in 2012 were used in this study. The data were anonymised by a trusted third party to ensure patients' privacy.[cf. 12]

Electronic health records

Health problems of patients who consulted their GPC were recorded using codes from the International Classification of Primary Care, version 1 (ICPC).[13]. This version of the ICPC is the standard for coding and classification of complaints, symptoms and disorders in Dutch general practice. ICPC-1 forms an integral part of the training of Dutch GPs and is included in all electronic health records in general practice. A GPC was selected for this study if a meaningful ICPC code was recorded in at least 70% of its contacts. ICPC codes considered to be meaningful range from 01-29 (symptoms) and from 70-99 (diagnoses). Since ICPC codes A97 (no disease) and A99 (other generalised disease/multiple syndromes) are sometimes used when health care providers do not directly know how to classify the patient's health problem,

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we do not regard these ICPC codes as meaningful. The same holds for codes in the range 30-69 (procedures).

When more than one ICPC code had been recorded during a contact (in 0.02% of all contacts, N=289 contacts), we included in our analyses only the one that was recorded first, assuming that this was the patient's most important health problem.

Apart from ICPC codes, the extracts of electronic health records used for this study included patients' year of birth, gender and the first four digits of their 6-digit postal code, as well as the postal code of the consulted GPC location. Distance in kilometres between the patient's postal code and the postal code of the GPC location was calculated using the Drive Time Matrix of the Netherlands 2012 (Geodan IT).

Questionnaire

Managers of the participating GPCs were asked to indicate whether or not a computer-based decision support system was being used for triage in their GPC. This question was part of a more extensive questionnaire. All managers of the included GPCs completed the questionnaire.

Analyses

Since we expected the distribution of urgency levels to be comparable for the same health problem, we chose to perform our analyses for three specific health problems, namely the three health problems most frequently presented at the out-of-hours service: cystitis/other urinary infection (ICPC code U71); laceration/cut (S18); and fever (A03).

First, we investigated the distribution of urgency levels (i.e. the percentage of contacts associated with each of the six urgency levels) for the total number of contacts, and for

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contacts for the three selected health problems. We also performed these analyses for each GPC separately to obtain insight into the range of percentages for each urgency level.

Subsequently, multilevel linear regression analyses with two-level hierarchically structured data (patients within GPCs) were used to investigate whether the urgency of contacts was associated with patients' gender, age, the distance between patient's home and the GPC, and the use of a computer-based decision support system by the GPC. Cases with missing data on any of the study variables were deleted from the analyses. However, as shown in Table 2, there were few missing data. The null model was used to test whether the distribution of urgency was significantly different between the various GPCs.

Because of the ordinal nature of our dependent variable (urgency of primary out-of-hours contacts), multilevel multinomial analyses would ideally have to be executed. However, we chose to perform multilevel linear regression analyses, because this method generates more easily interpretable data. Apart from unstandardised regression coefficients and 99.99% confidence intervals, we calculated intraclass correlation coefficients (ICCs), which indicate the proportion of the variation in urgency that can be ascribed to the patient level versus the level of the GPC. We have added diagnostic plots (q-q plots), which show the distribution of residuals versus the normal distribution, in a Supplementary file. All analyses were executed in Stata, version 13. We applied the Bonferroni method to correct for multiple comparisons, resulting in a p-value <0.002 being regarded as significant.

RESULTS

Seventeen GPCs met our criteria for sufficient data quality regarding health problems. The population in the catchment area of these GPCs (N=6,144,649) is representative of the Dutch population with regard to gender and age. A total number of 895,253 patients contacted one of the included GPCs, resulting in 1,350,964 contacts. These contacts included telephone

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consultations (N=570,915), consultations at the out-of-hours service (N=648,150), and home visits (N=131,899). Characteristics of the participating GPCs and their patients are presented in Table 2.

Table 3 displays the distribution of urgency levels for the total number of contacts, and for the three health problems most frequently presented at out-of-hours services. The ranges of urgency levels (Table 3) show that variation in urgency between GPCs particularly occurs at urgency levels 4 and 5. For each of the three selected health problems, the distribution of urgency levels was significantly different between the various GPCs (p=0.00).

The ICCs resulting from our multilevel linear regression analyses showed that the main part of the total variation in urgency can be ascribed to variation in characteristics of patients. For cystitis/other urinary infection, 93.4% of the variation in urgency could be ascribed to variation in patient characteristics, and 6.6% to the level of the GPC. Comparable results were found for laceration/cut (95.1% patient level, 4.9% GPC level) and fever (96.7% patient level, 3.3% GPC level).

Results of the multilevel linear regression analyses are presented in Table 4. When interpreting these results, one should keep in mind that a higher NTS urgency level represents a less urgent health problem (see Table 1). Thus, a positive association between an independent variable and urgency level implies that this variable is associated with a lower clinical urgency.

The urgency of all three selected health problems were mainly related to patient gender and age. For cystitis and laceration/cut, urgency was significantly lower for female patients than for males. Urgency for cystitis was significantly lower for adult patients (>18 years old) than for young children, whereas urgency for fever was significantly higher for adult patients than for young children. Urgency for lacerations and cuts was significantly higher for patients >5 years old than for young children. The urgency of contacts was not

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associated with the use of a computer-based decision support system for triage, nor with the distance between the patient's home and the out-of-hours service.

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Table 2. Characteristics of participating GPCs and their patients

GPCs (N=17)		
Number of inhabitants in catchment area, per GPC: M, range	364,548	106,270-1,452,738
Use of computer-based decision support system for triage: %, N		
Yes	82.4	14
No	17.6	3
Patients (N=895,253)		
Gender: %, N		
Male	45.1	403,381
Female	54.9	491,793
Unknown	0.0	79
Age: %, N		
0-4 years	14.8	132,425
5-17 years	14.2	126,919
18-44 years	33.0	295,726
45-64 years	19.5	174,240
65-74 years	7.5	67,291
75-84 years	6.8	61,064
≥ 85 years	4.2	37,583
Unknown	0.0	5
Distance between patient's home and GPC in km: M, SD	11.7	21.9*

GPC=general practice cooperation; M=mean; SD=standard deviation

* data available for 854,119 patients (95.4%)

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Table 3. Urgency of patients' health problems in contacts with primary out-of-hours services, in percentages

U	Contacts (N=1,350,964)			Contacts for ICPC code U71 (N=52,207)			Contacts for ICPC code S18 (N=44,791)			Contacts for ICPC code A03 (N=43,201)		
	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*	%	Min*	Max*
0	0.01	0.00	0.15	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.10
1	1.06	0.42	1.90	0.03	0.02	0.12	0.04	0.01	0.17	0.30	0.10	1.52
2	7.99	4.63	12.24	3.63	1.76	8.72	4.43	0.74	14.76	7.32	3.90	11.83
3	37.13	21.58	45.69	27.53	7.34	47.24	60.09	30.72	77.05	34.22	26.37	57.65
4	26.11	16.78	51.46	42.27	24.01	65.25	24.02	10.77	58.45	16.86	6.31	42.09
5	27.69	7.03	46.83	26.53	2.84	51.97	11.43	1.75	32.79	41.29	13.04	57.28

U=NTS urgency level; * Range of percentages between GPCs

U71= cystitis/other urinary infection; S18=laceration/cut; A03=fever

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Table 4. Factors associated with urgency: results of multilevel linear regression analyses

	ICPC code U71			ICPC code S18			ICPC code A03		
	B	**99.99% CI**	**p**	**B**	**99.99% CI**	**p**	**B**	**99.99% CI**	**p**
Female	.48*	.44; .52	.000	.06*	.03; .08	.000	.03	-.00; .07	.001
Age:									
5-17 years	.03	-.07; .13	.238	-.05*	-.09; -.00	.000	-.04	-.10; .03	.024
18-44 years	.25*	.17; .34	.000	-.04*	-.08; .00	.000	-.12*	-.19; -.05	.000
45-64 years	.26*	.18; .35	.000	-.10*	-.14; -.05	.000	-.40*	-.49; -.32	.000
65-74 years	.20*	.11; .29	.000	-.14*	-.21; -.07	.000	-.62*	-.73; -.51	.000
75-84 years	.15*	.06; .25	.000	-.20*	-.27; -.12	.000	-.75*	-.85; -.64	.000
≥ 85 years	.21*	.12; .31	.000	-.25*	-.33; -.17	.000	-.69*	-.82; -.56	.000
Distance in kilometres**	.00	-.00; .00	.002	-.00	-.00; .00	.307	.00	-.00; .00	.016

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Use of decision support system	.04	-.47; .55	.749	-.13	-.54; .28	.227	.09	-.37; .54	.452

Reference categories: male gender, 0-4 years, no decision support system. A higher NTS urgency level represents a clinically less urgent health problem (see Table 1).

U71=cystitis/other urinary infection; S18=laceration/cut; A03=fever; B=unstandardised regression coefficient; CI=confidence interval

* significant at p<0.002; ** distance between patient's home and the GPC

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DISCUSSION

Our results show significant variation in assigned urgency between GPCs, even for the same health problem. At first glance, this may be regarded as an undesirable finding, since we would expect equal urgency to be assigned to similar cases. However, most of the total variation in assigned urgency (93.4-96.7%) could be ascribed to variation in individual patient characteristics. Apparently, the variation in urgency can mainly be ascribed to variations in the population contacting the GPCs. A relatively small part of the variation in assigned urgency (3.3-6.6%) could be ascribed to variables at the level of the GPC. However, the variable that we included at this level (i.e. the use of a computer-based decision support tool for triage) had no significant association with assigned urgency.

Patient age was found to be an important factor associated with assigned urgency. Previous studies also showed urgency to be generally higher for older patients, whereas non-urgent contacts most frequently occur for young children.[5,6] GPCs with many elderly patients may therefore have more highly urgent contacts than GPCs which operate in a younger population.

Previous research has shown women to contact the GPC more frequently than men, except for life-threatening health problems.[6] Assigned urgency may therefore generally be lower for women than for men.[cf. 5] Our results confirmed this hypothesis for cystitis and lacerations/cuts. Since cystitis predominantly occurs in women,[14] one can expect contacts for cystitis in men to be regarded as more urgent than contacts for cystitis in women. This association is less clear for lacerations and cuts.

In contrast with previous research by Raknes et al.,[7] we did not find a significant association between patients' travel distance to the out-of-hours service and the assigned urgency. However, the previous study was conducted in Norway, where the distance between patients' homes and the out-of-hours service is much larger than in the Netherlands. Giesen et

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al.[15] found that Dutch patients have to travel a maximum of 30 kilometres to attend the out-of-hours service, whereas the travel distance for Norwegian patients can be more than 130 kilometres. Apparently, the variation in assigned urgency between GPCs is not associated with variations in travel distances between GPCs. However, from the patient's perspective, the time needed to travel to the GPC may be more important than the travel distance per se. It would be interesting to investigate whether there is an association between patients' travel time and the assigned urgency.

To our knowledge, we were the first to use a large dataset derived from routine electronic health records of nearly 900,000 patients to analyse the variation in urgency between GPCs and factors associated with assigned urgency. The population in the catchment area of the included GPCs was representative of the Dutch population with regard to gender and age. GPCs that used a computer-based decision support system for triage were overrepresented in our sample (82% in our sample versus 62% in the Netherlands). The overall distribution of urgency levels found in this study (Table 3) is similar to the distribution reported by the national association for out-of-hours care,[4] which underlines the representativeness of our data.

Although we tried to discover some of the key variables associated with the variation in urgency between GPCs, other variables deserve attention in future research. Patient characteristics like socioeconomic status, comorbidity, the use of medication, living conditions, strategy to cope with physical symptoms, and perceptions about the ease to visit a GPC may also be associated with assigned urgency.

A factor of interest on the GPC level may be the collaboration between the GPC and the emergency department of the hospital (ED). Some Dutch GPCs are part of so-called integrated emergency departments, which combine their entrance and triage with the ED.[16] The joint triage is expected to cause patients with less urgent health problems to be diverted to

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the GPC, and patients with highly urgent health problems to be diverted mainly to the ED. GPCs participating in an integrated emergency department may therefore have to deal with more low urgent health problems than GPCs not participating in such a department.[17, Van Gils-van Rooij et al., unpublished]

Another variable that may affect the variation in assigned urgency between GPCs is the accessibility of general practices during office hours. A recent study showed that contact rates at the GPC were higher when the associated general practices closed early or were otherwise less accessible.[18] Limited accessibility of patients' general practice may particularly lead to an increase of low urgent health problems presented at the GPC.

Still, since these variables are characteristics of GPCs and our study indicated that only a small part of the variation in urgency for the three selected health problems could be ascribed to variation at the level of the GPC, we expect such variables to only marginally affect the variation in assigned urgency.

For our analyses, we could only use the ICPC codes that were recorded in the GPCs' electronic health records. We could not test the validity of these ICPC codes with respect to patients' health problems. Therefore, we cannot completely rule out the possibility that the variation in assigned urgency in fact reflects different ICPC coding practices between GPCs. However, our multilevel analyses showed that only a small part of the variation in assigned urgency can be ascribed to the level of the GPCs, which argues against this possibility.

We studied factors associated with assigned urgency for the three health problems most frequently presented at the out-of-hours service. This strategy was chosen because it would guarantee a sufficient number of contacts for our analyses. However, our choice to focus on these specific health problems also has some limitations. First, two of the selected ICPC codes (fever, A03; and laceration/cut, S18) are symptoms, which are less specific than diagnoses. Fever, for instance, can be a sign of a variety of diagnoses (e.g. pneumonia,

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tuberculosis, acute myocardial infarction, a malignancy, arthritis), most likely to be associated with different urgency levels. Information about such diagnoses is not included in our study. Secondly, selecting three specific health problems obviously does not provide the full picture of the variety in urgency for health problems presented in primary out-of-hours care. Further research is needed to investigate whether our results can be generalised to other health problems and to other countries with comparable health care systems. It would also be interesting to investigate the variation in assigned urgency in association with the reason for encounter recorded by the triage nurse.

In sum, we showed that the variation in assigned urgency is not associated with one aspect of accessibility (i.e. travel distance), nor with one of the core facilities of GPCs (i.e. the use of a computer-based decision support system for triage), but rather with differences in characteristics of individuals contacting the GPCs. Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system. Although this is a promising result, additional research is needed to shed more light on the sensitivity and specificity of the triage system.

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KEY MESSAGES

What is already known about this subject

- Most Dutch general practice cooperatives (GPCs) use the same standardised triage system. Still, differences between GPCs exist in the urgency assigned to patients' health problems.
- Insight into factors associated with the variation in assigned urgency levels is scarce.

What this study adds

- The variation in urgency can mainly be ascribed to variations in characteristics of individuals contacting the GPCs, rather than to differences in characteristics of GPCs.
- Since patient characteristics are likely to affect patients' clinical need, our results are an indication of the adequate functioning of the triage system.

Contributors

MZ designed the study and formulated the research questions. MN and MZ performed the data analyses. MZ drafted the manuscript. All authors critically reviewed the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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Ethics approval

Participating GPCs were contractually obliged to inform their patients about their participation in the NIVEL Primary Care Database and to inform patients about the possibility to opt-out if they objected to their data being included in the database.

Dutch law allows the use of extracts of electronic health records for research purposes under certain conditions. According to Dutch legislation, neither obtaining informed consent nor approval by a medical ethics committee is obligatory for this kind of observational studies (Dutch Civil Law, Article 7:458; http://www.dutchcivillaw.com/civilcodebook077.htm).

Data sharing statement

No additional data are available.

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Supplementary file 1: Diagnostic plots (q-q plots)

Figure 1. Quantiles of residuals versus quantiles of normal distribution for cystitis/other urinary infection (ICPC code U71)

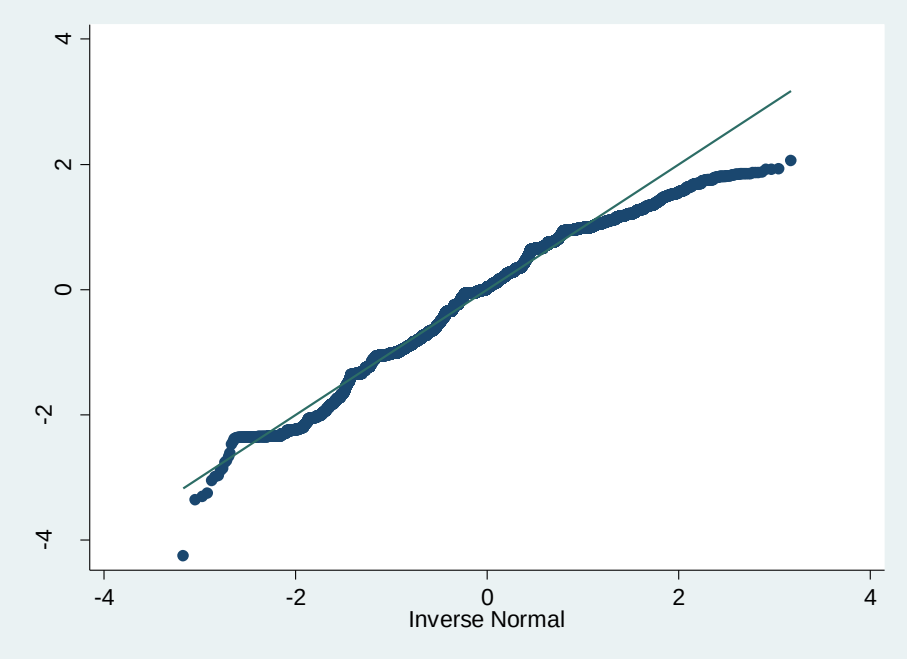

Figure 2. Quantiles of residuals versus quantiles of normal distribution for laceration/cut (ICPC code S18)

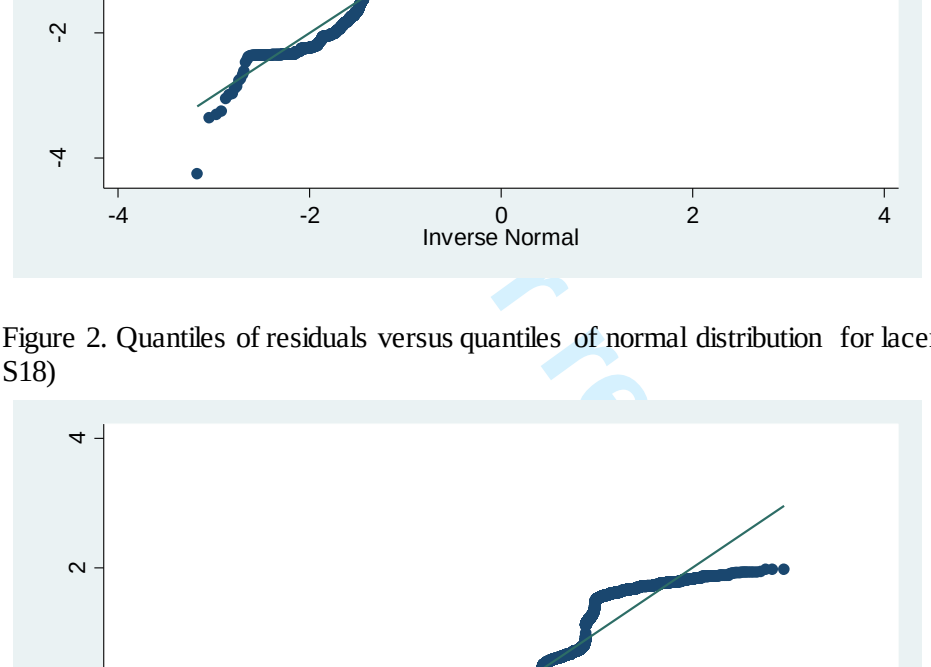

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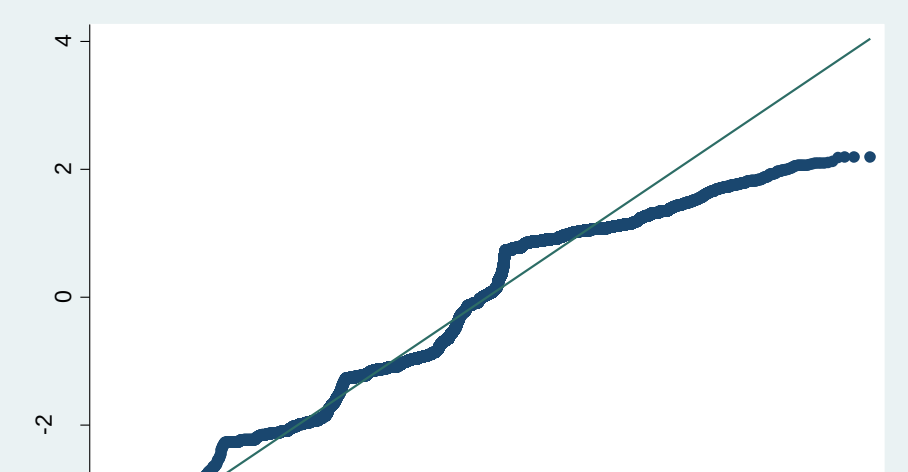
Figure 3. Quantiles of residuals versus quantiles of normal distribution for fever (ICPC code A03)



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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract - *page 1*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – *page 1*
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported – *pages 3-6*
Objectives	3	State specific objectives, including any prespecified hypotheses – *page 5*
Methods		
Study design	4	Present key elements of study design early in the paper – *page 6*
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection – *page 6*
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants – *pages 6,7*
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable – *pages 6-7, and Table 2 (page 11)*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group – *pages 6-7*
Bias	9	Describe any efforts to address potential sources of bias – *page 6*
Study size	10	Explain how the study size was arrived at – *page 6-7*
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why - *pages 6,7, and Table 2 (page 11)*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding – *pages 7-8*
		(*b*) Describe any methods used to examine subgroups and interactions - *pages 7-8*
		(*c*) Explain how missing data were addressed– *page 8*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy – *not applicable*
		(*e*) Describe any sensitivity analyses – *not applicable*
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed – *pages 8, 9, 11*
		(b) Give reasons for non-participation at each stage – *not applicable*
		(c) Consider use of a flow diagram - *not applicable*
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders – *page 11*
		(b) Indicate number of participants with missing data for each variable of interest – *page 11*
Outcome data	15*	Report numbers of outcome events or summary measures – *page 12*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included – *pages 13-14*

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		(*b*) Report category boundaries when continuous variables were categorized – *pages 11,13-14*
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period – *not applicable*
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses – *not applicable*
Discussion		
Key results	18	Summarise key results with reference to study objectives – *pages 15-16*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias - *pages 16-18*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence – *pages 15-18*
Generalisability	21	Discuss the generalisability (external validity) of the study results – *pages 16- 18*
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based – *page 19*

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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