Overruling by triage nurse of the Netherlands Triage Standard (NTS) urgency level in patients suspected of acute coronary syndrome (ACS)

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Abstract

Background: The Netherlands Triage Standard (NTS) is a semi-automatic decision support tool for telephone triage at out-of-hours services for primary care (OHS-PC). Triage nurses can overrule this NTS urgency.
The aim of this study is to assess the relation between overruling of the NTS urgency and the diagnosis of acute coronary syndrome (ACS) in people who contact the OHS-PC for chest discomfort.

Methods: An observational study was performed in which triage recordings were analysed of patients with chest discomfort who called the OHS-PC between 2014 and 2016. Information on call characteristics and urgency allocation were collected from the recordings. The final diagnosis was retrieved from the patient's own general practitioner's electronic medical records, including hospital discharge letters. Sensitivity, specificity, positive and negative predicted values were calculated against the outcome ACS for the NTS urgency allocations and the final urgency allocation. The association between eventual urgency and the diagnosis ACS was calculated with univariable and multivariable logistic regression analyses.

Results: Of 2195 patients, 251 (11.4%) had an ACS. In 10.8% of the calls, the triage nurse overruled the NTS urgency, mostly to a higher urgency. The NTS high urgency had a sensitivity of 0.73, specificity of 0.42, positive predictive value of 0.17 and negative predictive value of 0.92 for the outcome ACS. The final high urgency level had a sensitivity of 0.79, specificity of 0.39, positive predictive value of 0.14 and negative predictive value of 0.89 for the outcome ACS. The final high urgency in males was better related to ACS than the NTS high urgency in males (crude OR 1.67 (95% CI 0.89-3.11), p=0.109) and after adjustment for age OR 1.92 (95%CI 1.02-3.62), p=0.044). In females the crude OR was 0.90 (95%CI 0.47-1.73), p=0.744 and the adjusted for age OR 0.81 (95%CI 0.41-1.60), p=0.550, respectively

Conclusion: Triage nurses overruled the NTS generated urgency level in 1:9 cases, most often upgrading. This resulted in a tendency to better urgency allocations in males and worse urgency allocation in females if we consider a high urgency as adequate for those who eventually show to have an ACS.

Introduction

Acute coronary syndrome (ACS) is very common worldwide, with an estimated 774,000 patients suffering from an ACS in 2020 in the Netherlands. It affects more males than females (55.7 versus 33.5 per 1000 persons), and the prevalence increases with age for both sexes.[1] ACS is a life-threatening cardiac disease caused by coronary obstruction of blood flow to the myocardium resulting in myocardial ischemia followed by myocardial necrosis in case of myocardial infarction.[2] Myocardial ischemia causes chest discomfort, which patients may describe differently as pain, discomfort, oppressive feeling, shortness of breath, but also as sudden extreme fatigue or any combination of it. Moreover, it may go

along with radiation of the heavy feeling or pain to the arms, jaw, or between the shoulder blades. In addition, there may be sympathetic nervous system related symptoms, e.g. nausea/vomiting, transpiration, pale face, (near) fainting. This 'complete picture' is not always the presentation to be encountered; symptoms may be more subtle and vague. Nevertheless, adequate triage of patients suspected with ACS is critical because early diagnosis of those with ACS followed by timely treatment improves the patient's prognosis.[3][4][5][6][7]

Around 80% of patients suspected of ACS seen at the emergency department (ED) have been referred by general practitioners (GPs), the other 20% are seen after direct 112 ambulance calls.[8] Apart from day-time practice, GPs also deliver care during out-of-hours in so called out-of-hours services primary care (OHS-PC). In that setting, triage nurses use a semi-automatic decision support tool called the Netherlands Triage System (NTS).[9] The NTS automatically can generate six urgency levels (see table 1). These urgencies may be overruled by the triage nurse.

The NTS was developed to increase safety and efficiency of triage in acute primary care, and for harmonization of the 'acute care chain' from patient via GP and/or ambulance to the ED. This decision support system consists of key questions for any of the 56 defined 'entrance complaints'. It should facilitate telephone triage by nurses who are supervised by GPs.

Underestimation of urgency may result in late recognition of ACS and thus a poorer prognosis, while overestimation of urgency may result in unnecessary ambulance calls and work overload of emergency care. But also in unsafety because those who really need urgent care can potentially be managed too late. Depending on the urgency, the condition of the patient, and the environmental circumstances, a triage nurse may call an ambulance, arrange a GP home visit, invite the patient for consultation at the GP post or give the patient a self-care telephone advice (see also table 1).[9]

The aim of this study is to assess the relation between overruling of the NTS urgency by the triage nurse and the diagnosis of ACS in people who call the OHS-PC for symptoms suggestive of ACS. These correlations will be assessed separately in males and females.

Table 1: NTS urgency levels

NTS urgency level	Definition	Response time	Action
U0- Resuscitation	Loss of vital functions	Immediately	Ambulance
U1- Life threatening	Unstable vital functions	Within 15 minutes	Ambulance
U2- Emergent	Vital functions in danger	Within one hour	Appointment at OHS-PC or GP home visit
U3- Urgent	Possible risk of damage	Within three hours	Appointment at OHS-PC or GP home visit
U4- Non-urgent	Marginal risk of damage	Within 24 hours	Appointment at OHS-PC or telephone advice
U5- Advice	No risk of damage	No time related	Telephone advice

GP: general practitioner; NTS: Netherlands Triage Standard; OHS-PC: out-of-hours services in primary care.

Methods

The study design of Safety First has been published elsewhere.[10] In short, Safety First is an observational study in which telephone triage conversations was evaluated of 3,630 adult patients with chest discomfort (pressure, pain, shortness of breath, or tightness) who contacted one of nine OHS-PCs in the Netherlands between 2014 and 2016. The calls were selected on the basis of the International Classification of Primary Care (ICPC) codes (K01, K02, K03, K24, K74, K75, K76, K77, K93, L04, P74, R02, R98) and keyword such as chest pain, thoracic pain, heart attack, myocardial infarction and their abbreviations. The researchers used electronic health record data of OHS-PC (call manager) and listened to the triage recordings to collect information about the medical history, symptom presentation, triage information (such as urgency allocation), caller and call characteristics. The final diagnoses were retrieved from the patient's own GP, based on their electronic medical files including hospital discharge letters with cardiologist's diagnoses. In 1435 patients the GP refused to provide the final diagnosis, and therefore we restricted our analyses to 2195 participants.

The Medical ethics committee of the University Medical Center Utrecht approved the Safety First study.

Data analysis

Categorical variables are described as numbers and percentages. Continuous values are presented as means with standard deviation (SD). Patients' characteristics were compared between those who had overruling of the level of NTS urgency and patients in whom the original NTS urgency remained in place. The frequency and direction of the overruling was calculated, separately for men and women. Univariable and multivariable logistic regression analyses were used to assess the relation between overruling and ACS. For multivariable analysis we corrected for age. The Chi Square test was used to compare proportions of categorical variables and the independent sample t-test for continuous variables. The odds ratio (OR) and its 95% confidence intervals (CIs) were calculated. We considered urgency U1 and U2 as a high urgency level and U3-U5 as low urgency when calculating the accuracy of the NTS against the outcome ACS. Sensitivity, specificity, positive and negative predictive values were calculated. A p-value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 27.0.

Results

Baseline characteristics

Of the 2195 patients, the mean age was 59.1 (SD 19.5) years, 55.4% were females, and 11.4% had an ACS. In 238 (10.8%) calls, the triage nurse overruled the NTS urgency. In the ‘overruled group’ compared to the ‘not overruled group’ a similar number of patients had an ACS (9.7% vs. 11.7%, p= 0.363). Symptoms and CVD history were similar in both groups, with the exception of hypercholesterolemia which was more common in ‘overruled patients (14.8% vs. 27.0%, p=0.013). ‘Overruled’ patients had significantly less high urgencies (U1; 43.4% vs. 29.4%, p<0.001 and U2; 18.4% vs. 10.1%, p=0.001) than those in whom the NTS urgency remained in place. Most often these high urgencies ended in a telephone advice (U5) (21.8% vs. 6.0%, p<0.001).

NTS urgency allocation versus the ‘final’ urgency

When the NTS urgency was overruled, this was in 63.9% upgrading to a higher urgency, mainly driven by a change of U3 to U2 (see table 4), and in 36.1% downgrading, mainly driven by a switch from U1 to U2.

Figure 1: Flowchart study population

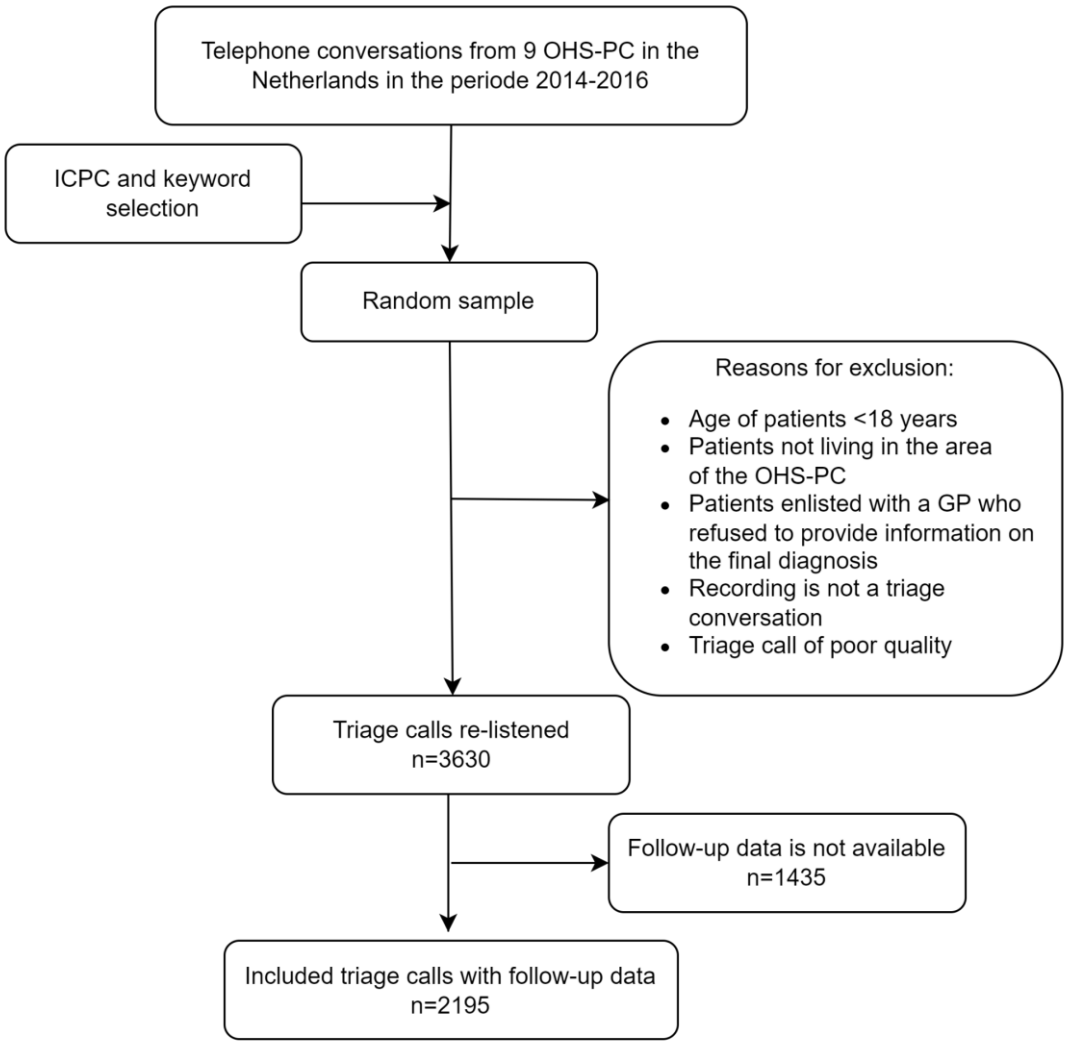

Table 2: Baseline characteristics of patients suspected of ACS who called the OHS-PC, divided into those in whom the urgency was overruled by the triage nurse and those in whom not

		All patients (%) (n=2195)	Overruled (%) (n=238)	Not overruled (%) (n=1957)	P- value
Patient characteristics	Age in years (SD) (n=2195)	59.1 (19.5)	59.8 (19.5)	59.0 (19.5)	0.537
	Males (n=980)	980 (44.6)	117 (49.2)	863 (44.1)	0.138
	Females (n=1215)	1215 (55.4)	121 (50.8)	1094 (55.9)	0.138

History of cardiovascular disease	CVD in history (n=1847)	1195 (64.7)	133 (63.6)	1062 (64.8)	0.733
	CAD in history (n=1153)	389 (33.7)	47 (35.3)	342 (33.5)	0.657
	Hypertension (n=894)	323 (36.1)	41 (38.7)	282 (35.8)	0.561
	Diabetes mellitus (n=905)	180 (19.9)	15 (13.8)	165 (20.7)	0.087
	Hypercholesterolemia (n=825)	212 (25.7)	13 (14.8)	199 (27.0)	**0.013**
Symptoms	Shortness of breath (n=1699)	1096 (64.5)	108 (61.4)	988 (64.9)	0.357
	Chest pain (n=2118)	1982 (93.6)	213 (91.0)	1769 (93.9)	0.091
	SNS-related symptoms* (n=1737)	1072 (59.1)	104 (53.3)	923 (59.9)	0.081
Final diagnosis	ACS (n=2195)	251 (11.4)	23 (9.7)	228 (11.7)	0.363
Urgency levels NTS	U1 (n=919)	919 (41.9)	70 (29.4)	849 (43.4)	**<0.001**
	U2 (n=384)	384 (17.5)	24 (10.1)	360 (18.4)	**0.001**
	U3 (n=709)	709 (32.3)	90 (37.8)	619 (31.6)	0.054
	U4 (n=13)	13 (0.6)	2 (0.8)	11 (0.6)	0.597
	U5 (n=170)	170 (7.7)	52 (21.8)	118 (6.0)	**<0.001**

SD: standard deviation
CVD: cardiovascular disease; CAD: coronary artery disease (history of percutaneous coronary intervention. coronary artery bypass, angina pectoris); ACS: acute coronary syndrome; NTS: Netherlands Triage system.
*SNS-related symptoms: nausea, vomiting, sweating, pallor, ashen skin)
U: urgency

Table 3: Urgency level NTS versus final urgency level including overruling by the triage nurse, and the direction of the overruling (n=2195)

Urgency level NTS	Final U1 (%)	Final U2 (%)	Final U3 (%)	Final U4 (%)	Final U5 (%)	Direction of overruled urgency (%)
U1 (n=919)	849 (92.4)	52 (5.7)	13 (1.4)	0 (0.0)	5 (0.5)	Lower: 70 (7.6)
U2 (n=384)	13 (3.4)	360 (93.8)	8 (2.1)	0 (0.0)	3 (0.8)	Lower: 11 (2.9) Higher: 13 (3.4)
U3 (n=709)	24 (3.4)	62 (8.7)	619 (87.3)	0 (0.0)	4 (0.6)	Lower: 4 (0.6) Higher: 86 (12.1)
U4 (n=13)	0 (0.0)	0 (0.0)	1 (7.7)	11 (84.6)	1 (7.7)	Lower: 1 (7.7) Higher: 1 (7.7)
U5 (n=170)	7 (4.1)	16 (9.4)	12 (77.1)	17 (10.3)	118 (69.4)	Higher: 52 (30.6)
	893	490	653	28	131	Lower: 86 (36.1) Higher: 152 (63.9)

Dark gray: triage nurse overruled urgency to a lower urgency.
Light gray: triage nurse overruled urgency to a higher urgency.

Table 4 shows the urgency levels versus the final urgency level and the direction of overruling selectively in patients with a diagnosis of ACS. 73.9% of the overruled NTS urgencies were downgrading to a lower urgency level. In case of upgrading, the triage nurse maximally used one level.

The tables 5A and 5B show the same comparison as table 4, but now for males and females separately. The triage nurse tends to increase urgency more in females than males (83.3% in females and 66.7% in males).

Table 4: Urgency level NTS versus final urgency level of the triage nurse and the direction of overruling by the triage nurse in patients with ACS (n=251)

Urgency level NTS	Final U1 (%)	Final U2 (%)	Final U3 (%)	Final U4 (%)	Final U5 (%)	Direction of the overruled urgency (%)
U1 (n=150)	146 (97.3)	4 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 4 (2.7)
U2 (n=33)	1 (3.0)	30 (90.9)	2 (6.1)	0 (0.0)	0 (0.0)	Lower: 2 (6.1) Higher: 1 (3.0)
U3 (n=53)	5 (9.4)	6 (11.3)	42 (79.2)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 11 (20.7)
U4 (n=0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 0 (0.0)
U5 (n=15)	4 (2.7)	1 (6.7)	0 (0.0)	0 (0.0)	10 (66.7)	Higher: 5 (9.4)
	156	41	44	0	10	Lower: 6 (26.1) Higher: 17 (73.9)

Dark gray: wrongly overruled
Light gray: correctly overruled

Table 5A: Urgency level NTS versus final urgency level and the direction of overruling by the triage nurse in males with ACS (n=150).

Urgency level NTS	Final U1 (%)	Final U2 (%)	Final U3 (%)	Final U4 (%)	Final U5 (%)	Direction of the overruled urgency (%)
U1 (n=84)	81 (96.4)	3 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 3 (3.6)
U2 (n=26)	1 (3.8)	24 (92.3)	1 (3.8)	0 (0.0)	0 (0.0)	Lower: 1 (3.8) Higher: 1 (3.8)
U3 (n=32)	3 (9.4)	2 (6.3)	27 (84.4)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 5 (15.6)
U4 (n=0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 0 (0.0)
U5 (n=8)	2 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (75.0)	Higher: 2 (25.0)
	87	29	28	0	6	Lower: 4 (33.3) Higher: 8 (66.7)

Dark gray: wrongly overruled
Light gray: correctly overruled

Table 5B: Urgency level NTS versus final urgency level of the triage nurse and the direction of overruling by the triage nurse in females with ACS (n=101).

Urgency level NTS	Final U1 (%)	Final U2 (%)	Final U3 (%)	Final U4 (%)	Final U5 (%)	Direction of the overruled urgency (%)
U1 (n=66)	65 (98.5)	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 1 (1.5)
U2 (n=7)	0 (0.0)	6 (85.7)	1 (14.3)	0 (0.0)	0 (0.0)	Lower: 1 (14.3) Higher: 1 (0.0)
U3 (n=21)	2 (9.5)	4 (19.0)	15 (71.4)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 6 (28.5)
U4 (n=0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	Lower: 0 (0.0) Higher: 0 (0.0)
U5 (n=7)	2 (28.6)	1 (14.3)	0 (0.0)	0 (0.0)	4 (57.1)	Higher: 3 (42.9)
	69	12	16	0	4	Lower: 2 (16.7) Higher: 10 (83.3)

Dark gray: wrongly overruled
Light gray: correctly overruled

Accuracy of the NTS and final urgency

The NTS high urgency level (U1 and U2) had a sensitivity of 0.73, specificity of 0.42, a positive predictive value of 0.17 and a negative predictive value of 0.92 for the outcome ACS (table 6). For the final high urgency the sensitivity was 0.79, specificity 0.39, positive predictive value 0.14 and negative predictive value 0.89.

Association between overruling and ACS

Table 7 shows the association between those who had an overruled urgency and ACS, separately for males and females. There was a significant association in males; crude OR 1.67 (95% CI 0.89-3.11) and adjusted for age OR 1.92 (95% CI 1.02-3.62) times higher risk to have ACS than males This was for females; crude OR 0.90 (95%CI 0.47-1.73), and adjusted for age OR 0.81 (95%CI 0.41-1.60).

Table 6: Accuracy outcomes of the high urgencies of NTS and final urgency against ACS as the outcome (prevalence ACS 11.4%)

Accuracy	NTS high urgency	Final high urgency
Sensitivity	0.73	0.79
Specificity	0.42	0.39
Positive predictive value	0.14	0.14
Negative predictive value	0.92	0.89

Table 7: Univariable and multivariable analyses of the association between overruling of NTS and the final diagnosis ACS with the crude, and adjusted odd ratios after correction for age, separately for males and females.

Gender		OR (95% CI)	P-value
Male	Crude OR (95% CI)	1.67 (0.89-3.11)	0.109
	Adjusted OR (95% CI) *	1.92 (1.02-3.62)	**0.044**
	Age (year)	1.03 (1.02-1.04)	**<0.001**
Female	Crude OR (95% CI)	0.90 (0.47-1.73)	0.744
	Adjusted OR (95% CI) *	0.81 (0.41-1.60)	0.550
	Age (year)	1.05 (1.03-1.06)	**<0.001**
All patients	Crude OR (95% CI)	1.23 (0.79-1.94)	0.364
	Adjusted OR (95% CI) *	1.28 (0.81-2.03)	0.295
	Age (year)	1.04 (1.03-1.04)	**<0.001**

Discussion

In this study we evaluate overruling of the NTS urgency by the triage nurse against the final diagnosis ACS, in patients suspected of ACS who contacted OHS-PC. In 10.8% the triage nurse overruled the NTS urgency level, more often upgrading than downgrading (63.9% and 36.1%, respectively). Upgrading was mainly driven by changing the NTS U3 level to U2, and the downgrading as mainly driven by a switch from the NTS U1 to U2.

'Over-ruled' males had a 1.67 times higher risk (1.92 times higher after correction for age) of ACS than males not overruled. In females this was 0.90 times and 0.81 times, respectively.

Overall, the accuracy of both NTS and final urgency was moderate. The prior risk of ACS (prevalence) changed from 11.4% to a posterior risk of ACS of 14% in those who got an U1U2, and 8% and 11% in those who received a low urgency (U3-U5), respectively.

If considering the 251 patients with an ACS, the NTS generated a high urgency (U1/U2) in 73.0%, while this was 79.0% with the final high urgency taking overruling by the triage nurse into account. This means that in 27% and 21%, the urgency level was too low in patients with an ACS; they were not seen within 1 hour (U1 or U2).

Comparison with literature

In the domain of patients suspected of neurological deficit and also within the Safety First project, the accuracy of NTS urgency allocation was compared to the 'final urgency' against the outcome Transient Ischaemic Attack (TIA) or stroke. In this domain, and in the same OHS-PCs in the Netherlands, the rate of overruling, was much higher, namely 42.6%, but similar to our results, also more upgrading (67.3%) than downgrading (32.7%).[11] In our study, in the domain suspected ACS, the NTS generated already often a high urgency (U1 or U2 in 59.4%), and this decreased the room for upgrading.[12][13] Of course, this is related to the fact that chest discomfort is well known as an alarming symptom among both lay people and triagists as being caused by the diagnosis ACS which is potentially life-threatening. Moreover, 'time is muscle' is well recognized and thus the need of timely diagnosis followed by referral and (invasive) treatment. In a way, the triage nurses response on an all-or-nothing basis which requires immediate action and as a result, the high urgency level is less likely to be overruled in the direction of downgrading such patients.[14][15]

This study showed that the overall accuracy of the final urgency was not better than of the NTS, and as such there was no clear improvement of the urgency allocation by overruling by the triage nurse. This is in contrast with the study of Erkelens et al.[11] Because triage nurses seem to apply clinical reasoning elements and interpret vital information and vocal elements in communication such as shortness of breath and tone of voice to create a mental image of the patient's condition, this could help improve urgency allocation if it aliens with the NTS.[18][19]

Strengths and limitations

In this study we were able to relisten to the original conversation between the patient and the triage nurse without knowledge of the final diagnosis and therefore without the risk of recall or hindsight bias. Also, we used data from nine OHS-PC, making the study population a representative sample of patients in Dutch primary care. We excluded patients in whom the final diagnosis was unknown because the patient's GP did not provide this information. This created selection, but not necessarily selection bias because this unwillingness of GPs seems not to be related to either urgency allocation or final outcome. Another limitation is missing data on some determinants, a common problem in observational studies.

Conclusion

Triage nurses overruled the NTS generated urgency level in 1:9 cases, most often upgrading. This resulted in a tendency to better urgency allocations in males and worse urgency allocation in females if we consider a high urgency as adequate for those who eventually show to have an ACS.

References:

[1] Coronaire hartziekten. Volksgezondheid en zorg. Available from: https://www.vzinfo.nl/coronaire-hartziekten. Accessed date 02-02-2022.
[2] Luo X, Lv Y, Bai X, et al. Plaque Erosion: A Distinctive Pathological Mechanism of Acute Coronary Syndrome. Front Cardiovasc Med. 2021 Sep 28;8.
[3] Achar SA, Kundu S, Norcross WA. Diagnosis of acute coronary syndrome. Am Fam Physician. 2005 Jul 1;72(1):119-26.
[4] ESC Clinical Practice Guidelines. Acute Coronary Syndromes (ACS) in patients presenting without persistent ST-segment elevation (Management of) Guidelines. European Heart Journal (2021) 42, 12891367.
[5] Singh A, Museedi AS, Grossman SA. Acute Coronary Syndrome. In: StatPearls [Internet]. StatPearls Publishing; 2021. Accessed date 02-02-2022
[6] DeVon HA, Mirzaei S, Zègre- Hemsey J. Typical and Atypical Symptoms of Acute Coronary Syndrome: Time to Retire the Terms? JAHA. 2020 Apr 9;9(7).
[7] Nederlands Huisartsen Genootschap. Acuut coronair syndroom, [Internet]. Available from: https://richtlijnen.nhg.org/standaarden/acuut-coronair-syndroom. Accessed date 01-02-2022.
[8] Mol KA, Smoczynska A, Rahel BM, et al. Non-cardiac chest pain: prognosis and secondary healthcare utilisation. Open Heart. 2018; 5(2): e000859.
[9] Netherlands Triage Standard. Available from: www.de-nts.nl/. Aaccessed date 01-02-2022
[10] Erkelens DCA, Wouters LTCM, Zwart DLM, et al. Optimisation of telephone triage of callers with symptoms suggestive of acute cardiovascular disease in out-ofhours primary care: observational design of the Safety First study. BMJ Open. 2019; 9(7): e027477.
[11] Erkelens DC, Rutten FH, Wouters LT, Dolmans LS, de Groot E, Damoiseaux RA, et al. Accuracy of telephone triage in patients suspected of transient ischaemic attack or stroke: a cross-sectional study. BMC Fam Pract. 2020 Dec;21(1):256
[12] Van der Meer MG, Appelman Y, Rutten KH, van der Graaf Y, Nathoe HM, Doevendans PA, et al. Are there gender disparities in symptom presentation or triage of patients with chest discomfort at primary care out-of-hours services? An observational study. BMJ Open. 2019 Nov;9(11):e031613
[13] Leite L, Baptista R, Leitão J, Cochicho J, Breda F, Elvas L, et al. Chest pain in the emergency department: risk stratification with Manchester triage system and HEART score. BMC Cardiovasc Disord. 2015 Dec;15:48
[14] Pedersen CK, Stengaard C, Friesgaard K, Dodt KK, Søndergaard HM, Terkelsen CJ, et al. Chest pain in the ambulance; prevalence, causes and outcome - a retrospective cohort study. Scand J Trauma Resusc Emerg Med. 2019 Dec;27(1):84
[15] Pelter MM, Riegel B, McKinley S, Moser DK, Doering LV, Meischke H, et al. Are there symptom differences in patients with coronary artery disease presenting to the ED ultimately diagnosed with or without ACS? The American Journal of Emergency Medicine. 2012 Nov;30(9):1822-8.
[16] de Torbal A, Boersma E, Kors JA, et al. Incidence of recognized and unrecognized myocardial infarction in men
and women aged 55 and older: the Rotterdam Study. Eur Heart J. 2006;27(6):729-736.
[17] Khan NA. Sex Differences in Acute Coronary Syndrome Symptom Presentation in Young Patients. JAMA Intern Med. 2013;173(20):1863-1871
[18] Wouters LT, Zwart DL, Erkelens DC, et al. Tinkering and overruling the computer decision support system: Working strategies of telephone triage nurses who assess the urgency of callers suspected of having an acute cardiac event. J Clin Nurs. 2020 Apr;29(7-8):1175-86.
[19] Carayon P, Schoofs Hundt A, Karsh B-T, et al. Work system design for patient safety: the SEIPS model. Qual Saf Health Care 2006;15(Suppl 1):i50–i58.