

An Interrater Reliability Study on the Gothenburg Obstetric Triage System- a New Obstetric Triage System

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Abstract

Background Triage, identifying patients with critical and time-sensitive disorders, is an integrated process in general emergency medicine. Obstetric triage is more specialised, requiring assessment of both woman, fetus and labour status. Failure to identify severely ill obstetric patients has repeatedly led to maternal morbidity and mortality. Reliable triage systems, adapted to obstetric patients as well as local conditions, are thus essential. The study aims to assess the interrater reliability (IRR) of the Gothenburg Obstetric Triage System (GOTS).

Methods Midwives (n=6) and registered nurses with no experience in managing obstetric patients (n=7), assessed 30 paper cases based on actual real-life cases, using the GOTS. Furthermore, a consensus group consisting of two midwives and two obstetricians, with extensive experience in obstetric care, determined the correct triage level in order to enable analysis of over- and undertriage. IRR was assessed, both with percentage of absolute agreement and with intra-class correlation coefficients (ICC) with 95% confidence intervals (CI).

Results A total of 418 assessments were performed, comprising all five levels of acuity in the GOTS. Absolute agreement was found in 69.6% of the assessments. The overall IRR was good, with a Kappa value of 0.78 (0.69 – 0.87, 95% CI) for final triage level. Comparison with consensus group assessments established that over- and undertriage had occurred in 9% and 21% of the cases, respectively. The main reasons for undertriage were “not acknowledging abnormal vital sign parameters” and “limitations in study design”.

Conclusion The GOTS is a reliable tool for triaging obstetric patients. It enables a standardized triage process unrelated to the assessors' level of experience in assessing and managing obstetric patients and is applicable for triaging obstetric patients presenting for emergency care at obstetric or emergency units.

Background

Triage, aiming at identifying patients with critical and time-sensitive conditions, is an integrated process in managing patients seeking care at emergency departments (EDs) worldwide. It is crucial in order to achieve medically safe prioritization.(1–3) However, triage has been shown to be the most error-prone activity at the ED.(2, 4, 5) A vast number of triage systems exist, but the absolute majority lack components for triaging obstetric patients. Failure to adequately assess women during pregnancy and the puerperium has repeatedly led to avoidable maternal morbidity and mortality.(6, 7)

Obstetric triage is more complicated and specialised than general triage, requiring assessment of both woman and fetus, as well as of labour status.(8, 9) Moreover, obstetric patients' physiology differs from that in the non-obstetric population, and obstetric patients may present with either pregnancy-related complaints or with symptoms of disorders unrelated to pregnancy. Depending on the location and the hospital, pregnant women seeking emergency care are assessed in EDs, in obstetric triage units or in maternity (delivery) units.

A small number of obstetric triage systems (OTS) have been introduced internationally since the early 2010s. These OTSs all have adequate interrater reliability, assessed in obstetric settings.(10–14) To the best of our knowledge, their implementation in a general ED setting has not been evaluated. To ensure that the system is adequate for assessing obstetric patients, the IRR must be established for both staff that are trained and untrained in obstetrics.

Until 2017, there was no OTS for assessment of obstetric patients seeking emergency care in Sweden. Patients have traditionally been assessed according to “who came first” or with triage systems that were not adapted to the physiological changes and spectrum of disease associated with pregnancy. The Gothenburg Obstetric Triage System (GOTS), developed in 2016 and in clinical use since 2017, has similarities with other OTS such as the Obstetrical Triage Acuity Scale (OTAS). It is a five-level triage scale with cut-off levels for vital signs adapted to the physiological changes of pregnancy.(12, 15) The GOTS includes 14 chief complaint algorithms (CCA) and the triage assessment is a construct based on the chief complaint and vital sign parameters. If two different acuity levels emerge from the chief complaint and the vital signs, the patient is allocated to the higher level. Previous research on the GOTS has shown a substantial ability to identify and adequately triage patients requiring admittance to hospital.(15) The GOTS differs from other OTS in that it has embedded recommendations for initial management, such as laboratory analyses, as well as brief information on both obstetric and non-obstetric possible causes of symptoms. Moreover, it has an attached documentation form.

The aim of this study was to determine the IRR of the GOTS in obstetric and non-obstetric emergency care staff. A comparison with a consensus group was also performed to assess the clinical accuracy and relevance of the IRR.

Methods

Setting

The study was carried out in 2019 at a tertiary care hospital in western Sweden with approximately 10 000 deliveries/year. The hospital has an obstetric ED, annually facilitating about 14 000 obstetric emergency care visits between gestational week 18 + 0 and 12 weeks postpartum. Triage is based on the GOTS and performed by midwives with experience in antenatal care and delivery. Obstetric patients with severe circulatory and/or respiratory failure, or suspicion of stroke with severe neurological symptoms, are directed to the general ED, according to hospital routines. At the time of the study, the general ED facilitated about 55 000 emergency visits annually. The Rapid Emergency Triage and Treatment System (RETTTS) is used for triage in medical and surgical emergencies.

Study design

A sample of 30 real-life cases were chosen from a two-month period during 2018. The cases were selected to represent all of the 14 GOTS CCAs as well as to cover all five acuity levels. Thus, the cases were not representative of the actual patient spectrum, as only 0,5 – 1 % of patients seeking care at the obstetric ED are triaged as red, i.e., the highest acuity level. The GOTS CCAs comprise *contractions, suspected rupture of*

membranes, vaginal bleeding, reduced fetal movements, suspected hypertensive disorder, neurological symptoms, abdominal/back pain, trauma, postpartum haemorrhage, signs of intra- or postpartum infection, chest pain and/or breathing problems, suspected thromboembolic disease, hyperemesis and suspected mastitis. The real-life cases were converted to paper cases with a description of symptoms, findings at examination and vital sign parameters. All participants, including members of the consensus group, were unaware of the previous real-life assessments of the patients.

Participants

A consensus group was established, consisting of two midwives and two obstetricians employed at the hospital, all of whom had extensive experience in obstetrics. A group of midwives and a group of registered nurses (RNs), respectively performing triage on a daily basis at the hospital's obstetric and general ED, was recruited. Information on the study and an invitation to participate were distributed at workplace meetings. All staff members were eligible for participation. All participants were informed that participation in the study was voluntary and anonymous. Six midwives and seven RNs consented to participate. They received payment equivalent to three hours of salary.

Data collection

A reference triage level for each scenario was established by discussion until complete agreement within the consensus group was reached. In three separate, three-hour sessions, all 30 paper cases were triaged individually by each participating midwife and RN, who were instructed to choose a CCA as part of the assessment. The final triage level and choice of CCA assigned to the case were documented by the participants on the GOTS documentation form. The author LL supervised the sessions in order to ensure that the participants received the same information and did not collaborate in their assessments. The triaging process was concluded with the opportunity to discuss the cases freely, raising questions and reflections.

Statistics

The triage assessments were analysed as follows:

1. the IRR for final triage level within the total group of participants, and within the midwife group and the RN group, respectively
2. the IRR for the individual midwife and RN assessments, compared to the consensus group assessments, presented as a mean of all individual assessments
3. the IRR between the real-life clinical assessments and the consensus group assessments

Measurement of agreement, IRR, is presented both as percentage level of absolute agreement and as a weighted Kappa value calculated by the intra-class correlation coefficient (ICC) with 95% confidence intervals, in order to present the magnitude of difference in assessments as well as to adjust for the possibility of participants guessing the same triage level.⁽¹⁶⁾ Kappa values are interpreted as poor (< 0.5), moderate (0.5–0.75), good (0.75–0.9) or excellent (> 0.90).⁽¹⁷⁾ Missing values (n = 2) for triage level were replaced by the median value for the participant within the same triage level.

Furthermore, an analysis of over- and undertriage, comparing the triage levels assigned by the individual participants to the consensus group's triage level, was performed. The clinically most relevant crossing of the boundary between triage levels orange – yellow, i.e., unstable - stable, was assessed separately and examined regarding the reason for the undertriage. All data were analysed using SPSS Statistics version 27.

Results

Baseline characteristics of the participants are presented in Table 1. All participants had at least one year of professional experience and all participants except two midwives had worked with ED triage for at least one year.

Table 1
Baseline data, participants

	Midwife (n = 6)	RN (n = 7)
Age		
20–29	.	2
30–39	3	4
40–49	2	.
50–59	.	.
60-	1	1
Professional experience		
0–6 months	.	.
6–12 months	.	.
1–3 years	2	1
4–9 years	2	3
10–14 years	1	2
> 15 years	1	1
Time working with ED triage		
0–6 months	2	.
6–12 months	.	.
1–3 years	3	2
4–9 years	1	3
10–14 years	.	2
> 15 years	.	.

RN – registered nurse, ED – emergency department

A total of 418 final assessments were made (including real-life assessments but excluding assessments made by the consensus group), with two missing final triage levels as seen in Fig. 1 (see Additional file 1).

Absolute agreement was seen in 69.6% of the assessments. The overall ICC Kappa value for the final triage level was 0.78 in the whole group, classifying the IRR as good. Analysing the midwives' and RNs' final triage level assessments separately revealed a slightly higher Kappa value for the midwives than for the nurses ($\kappa = 0.82$ vs. 0.76) (Table 2).

Table 2
Interrater reliability for the GOTS

	ICC	95 % CI
Midwives	0.82	0.73–0.90
RNs	0.76	0.65–0.86
Overall	0.78	0.69–0.87

ICC – Intra-class correlation (2.1). Kappa values are interpreted as poor (< 0.5), moderate ($0.5–0.75$), good ($0.75–0.9$), and excellent (> 0.90). CI – Confidence interval

While a minor difference was also observed between the midwives' and RNs' assessments, in comparison with the consensus group, the average IRR for the final triage level within both groups was classified as good (Table 3). The IRR for the final triage levels between the real-life assessments and the consensus group assessments was excellent ($\kappa = 0.93$) (Table 3).

Table 3
Interrater reliability, compared to consensus group

	ICC	95 % CI
Real-life assessments ^(a)	0.93	0.86–0.97
Midwives ^(b)	0.88	.
RNs ^(c)	0.83	.

ICC – Intra-class correlation, CI- confidence interval

(a) Real-life assessments compared to consensus group (2.1)

(b) mean of each midwife's assessments, compared to consensus group

(c) mean of each RN's assessments, compared to consensus group

Of the 418 assessments, 82 (21.1%) were undertriaged and 36 (9.3%) were overtriaged, compared to the consensus group's assessments (Table 4). The majority of undertriaged cases ($n = 49$) were observed at the

two highest acuity levels. Of these, 27 cases crossed the unstable/stable barrier in the triage system, i.e., between orange (urgent) and yellow (non-urgent).

Table 4
Triage level agreement, over- and undertriage

Triage level	Correct triage ^(a) n (%)	Undertriage n (%)	1 level	2 levels	3 levels	Overtriage n (%)	1 level	2 levels	3 levels
1 (<i>immediate</i>)	52 (67.5)	25 (32.5)	22	2	1	.	.	.	.
2 (<i>urgent</i>)	65 (71.4)	24 (26.4)	19	4	1	2 (2.2)	2	.	.
3 (<i>non-urgent</i>)	68 (74.7)	15 (16.5)	11	4	.	8 (8.8)	9	.	.
4 (<i>non-urgent</i>)	58 (64.4)	18 (20)	18	.	.	14 (15.6)	9	5	.
5 (<i>non-urgent</i>)	27 (69.2)	.	.	.	.	12 (30.8)	10	2	.
Total	270 (69.6)	82 (21.1)				36 (9.3)			

^(a) Correct triage according to consensus group.

Red = immediate examination; orange = urgent, examination within 20 min; yellow-green-blue = non-urgent, examination within 60, 120 and 240 min, respectively.

Numbers in bold type represent cases crossing the urgent/non-urgent barrier.

Causes for undertriage in the two highest acuity levels are presented in Fig. 2 (see Additional file 2). The predominant causes were “not reacting to vital sign parameters” and difficulties in assessing patient symptoms due to the paper case design.

Of the 21 cases in the “not reacting to vital sign parameters” group, 12 were due to neglecting elevated blood pressure, seven were due to neglecting increased heart rate and two were due to neglecting increased respiratory rate. It was mainly RNs that neglected elevated blood pressure (8/12) and all of the neglected cases of increased heart rate were assessed by midwives. Overtriage occurred especially in cases presenting with bleeding and/or pain that had been triaged as stable i.e., yellow to blue, by the consensus group.

The overall Kappa value for agreement in chosen CCA was 0.75 (see Additional file 3).

Discussion

To the best of our knowledge, this is the first study to explicitly examine the performance of an OTS as applied by midwives, as well as by RNs without experience in obstetrics. Our findings suggest that the GOTS

has good IRR and is a reliable tool for triaging obstetric patients seeking emergency care, regardless of whether assessors have scarce or extensive experience of triaging and managing obstetric patients. It is thus applicable for triaging obstetric patients presenting for emergency care at obstetric units and at general EDs.

The purpose of triage is to identify patients with time-sensitive, severe conditions and distinguish them from less urgent patients. The system facilitating these assessments should be as reliable as possible, enabling reproducibility of assessments made under similar conditions.(18) In this study, there were slight differences in IRR between midwives and RNs. This is to be expected, since the clinical experience of the triage midwife/RN will inevitably play a role in assessment of the patient. Indeed, previous research has shown that the triage process is dependent on both external factors, such as work environment, but also on internal factors, such as individual capacity.(19–21) Triage systems facilitate triage but do not constitute the entire triage process. Reliable triage systems, such as the GOTS, are even more crucial in order to avoid variation in assessment, which in turn decreases the risk of unequal care and of overlooking severely ill patients.

Of the 418 assessments, 82 (21.1%) and 36 (9.3%) were under- and overtriaged, respectively. This highlights that IRR is important in evaluating the system, but it does not necessarily correspond to the clinical significance. The clinical relevance of coherence in assessments must be taken into consideration when interpreting the numerical Kappa value. Failure to reach consensus concerning triage level will result in over- and undertriage, affecting both patient safety and resource allocation. In addition to establishing a good IRR, we thus also analysed the frequency of and the reasons for over- and undertriage. Clinically, the most immediate and severe triage failure is related to undertriaging patients while crossing the unstable/stable barrier i.e., triaging a red or orange patient as yellow or lower in the GOTS. In our study, this type of undertriage was seen in 15.9% (27/170) of the cases that were assessed as red or orange by the consensus group. When analysing these cases, it was evident that undertriage was predominately caused by two key factors - limitation of the paper case study design and failure to apply the system correctly. Several of the undertriaged assessments occurred in cases with bleeding and/or abdominal pain. These cases were also overtriaged by some participants, indicating that these symptoms may be difficult to assess on paper. These difficulties were addressed spontaneously by the participants after completing all assessments. They pointed out that they would have been able to assess the amount of bleeding as well as the level of pain in a clinical setting.

The other main reason for misclassification was not acknowledging abnormal vital sign parameters. This highlights two aspects. Firstly, there is a need for continuous education about the GOTS. Specifically, if a vital sign parameter indicates a higher acuity level, it is this level that must be chosen. Secondly, vital sign parameters may be underestimated and the interpretation of their significance may vary depending on the assessor's background. Previous research has shown that assessing vital sign parameters in the non-obstetric population strengthens the ability to adequately triage patients.(22, 23) However, in obstetrics, it is mainly blood pressure and temperature that have traditionally been taken into account when assessing patients. In this study, although sample size was small, a difference was seen between the midwives and RNs. Midwives tended not to acknowledge the significance of an elevated heart rate while RNs tended not to react to blood pressure exceeding 160/110 mmHg, a blood pressure level that is considered somewhat

elevated in general emergency medicine but of the utmost significance in obstetrics. Addressing all vital sign parameters in obstetric emergency care may challenge assessments previously perceived as correct. This thus generates a potential problem in trusting the system and applying it as intended. Further research is needed to establish whether all vital sign parameters are essential in triaging obstetric patients. As the physiological changes occurring during pregnancy enable obstetric patients to maintain normal vital sign parameters despite being critically ill (24), there is all the more reason to react when vital signs actually deteriorate.

Strengths and limitations

Previous research has highlighted the importance of triage nurses' having experience in emergency care for proper implementation of the triage system itself.(21, 25) A strength of this study is assessing the IRR of the GOTS among participants with experience in emergency care but with varying experience in obstetrics. Moreover, assessment by a consensus group enabled an analysis of both over- and undertriage, in order to further assess the clinical significance of the IRR.

However, the study also has several limitations. As previously discussed, paper cases create difficulties in assessing symptoms such as amount of bleeding and level of pain, as confirmed by the participants. However, a previous study by Worster et al. established that there is moderate to high agreement in IRR between real-life and paper cases.(26) As the IRR in the consensus/real-life comparison was excellent, this might also have been the case in this study. On the other hand, IRR has been reported to be worse in paper case-based studies, compared to the same system tested in a live setting. (26)

The paper case design might be considered to be a strength of the study, allowing evaluation of all CCAs, as well as all triage levels. The study design also made it possible to test the assessment of patients triaged as red (immediate) and orange (urgent)– rare in the clinical setting but the most important to identify. Furthermore, the paper cases allowed the system's IRR to be tested among both midwives and RNs, as well as coherent assessment of the patients.

Another limitation is the relatively small sample size, despite invitations being sent out to all staff members at the general ED and the obstetric ED. Triageing more cases would have increased the number of assessments. All study participation must be voluntary and it was hence not possible to include more assessors. It was not feasible to extend the recruitment period.

Like the absolute majority of triage systems, the GOTS was developed within the local context of guidelines and clinical setting, and the generalizability may thus be limited. The fact that the selection of cases did not correspond to the actual patient flow in the real-life setting may have biased the assessors to assess the cases according to the expected percentage of cases within each level of acuity. It was, however, deemed essential to evaluate all levels of acuity.

Conclusions

The GOTS is the first OTS to be implemented and studied in a Swedish emergency setting, aiding the triage and prioritisation of obstetric patients seeking emergency care. Our findings suggest that it is a reliable tool for triaging obstetric patients and enables a safe and standardised triage process unrelated to staff's level of experience in assessing and managing obstetric patients. Implementation of the GOTS may decrease the risk of maternal morbidity and mortality by enabling identification of severely ill obstetric patients. Further studies on validity, as well as on patient and staff satisfaction with the triage process, are needed to establish obstetric triage as a working method.

Abbreviations

IRR – interrater reliability

RNs – registered nurses

GOTS – Gothenburg Obstetric Triage System

ICC – intra-class correlation coefficient

OTS – obstetric triage system

ED – emergency department

CCA – chief complaint algorithm

PP – post partum

CI – confidence interval

Declarations

Ethical approval

The study was approved by the Gothenburg Regional Ethics Committee (783-18).

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed during the current study are available in from the corresponding author on reasonable request.

Competing interests

LL received an emergency medicine research grant from Predicare in 2017. When developing the GOTS, the team decided to create a system that could be integrated into RETTS, the main triage system in Sweden.

RETTTS is owned and distributed by Predicare. Representatives of Predicare had no part in the development of the GOTS, other than providing the layout and general outline of the RETTS. LL, project leader in the development of the GOTS, sold the GOTS copyright to Predicare in January 2019. The transaction was made prior to initiating research on triage and the system itself. Representatives of Predicare had no influence on study design, data collection, analysis or publishing of data. LL has been sporadically consulted by Predicare without any further payment. LL has no other competing interest to declare.

HE, OK and VS have no competing interest to declare.

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Authors' contribution

LL and VS planned the study. LL collected data. LL and VS analysed the data. All authors contributed to interpretation of results. LL wrote the first draft of the manuscript. All authors revised and approved the manuscript for publication.

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Figures

	<i>C.gr</i>	<i>LC</i>	<i>M</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>						
Constant abdominal pain, high uterine tone, elevated fetal heart rate, gw 36															
Severe hypertension/preeclampsia, gw 37															
Undetectable fetal heartbeat, gw 36															
Severe abdominal pain and fever, 5 days pp															
Back pain, 2 days pp. Pain on breathing															
Declining general condition and nausea, gestational diabetes, gw 33															
Painful contractions, initially heavy bleeding that diminishes, gw 31															
Neurological symptoms, decreased sensation right half of body, dysarthria, gw 39															
Sudden swelling at back of the knee, elevated blood pressure, 5 days pp															
Fever, 2 days pp															
Heavy vaginal bleeding without contractions, gw 38															
Vomiting, diabetes type 1, gw 28															
Severe bleeding, 2 days pp															
Abdominal pain, recurring at intervals, gw 27															
Abdominal pain for 3-4 days, cramping and sensation of pressure radiating towards vagina, gw 30															
Unspecific symptoms - headache, malaise. Blood pressure 158/103, gw 34															
Redness, tenderness and heat at back of knee, 2 days pp															
Severe hyperemesis, gw 20															
Suspected premature rupture of membranes after amniocentesis, gw 33															
Breathlessness, chest pain and dizziness for 2 days, gw 33															
Tenderness and redness around caesarean scar, 8 weeks pp															
Spotting, no other symptoms, gw 30															
Reduced fetal movements, twins, gw 31															
Pain in left breast and fever, 11 weeks pp															
Increased, fresh vaginal bleeding, 6 days pp															
Trauma, car crash at low speed, gw 38															
Headache, gw 31															
Abdominal pain and anxiety, gw 36															
Suspected rupture of membranes, gw 41															
Pain in left breast and left side of neck, 14 days pp															

Figure 1

Cases and final triage level. Final triage level is a construct based on chief complaint and vital sign parameters. Triage levels range from red (immediate examination) through orange (urgent, examination within 20 min) to yellow-green-blue (non-urgent, examination within 60, 120 and 240 min, respectively) C.gr = Consensus group (reference for over- and undertriage), LC = live cases, M = midwife, N = nurse, pp = postpartum, gw = gestational week. Data missing for two assessments (white).

	C.gr	UT 1 level (n)	UT 2 levels (n)	UT 3 levels (n)	Proportion of undertriage	Predominant CCA-nr, (%)
System not applied as intended						
<i>Not reacting to vital sign parameters</i>					43%	
Severe hypertension/preeclampsia, gw 37		2				205 (92)
Severe abdominal pain and fever, 5 days pp		2				210 (77)
Declining general condition and nausea, gestational diabetes, gw 33		2	1			214 (69)
Sudden swelling at back of knee, elevated blood pressure, 5 days pp		9		1		215 (92)
Fever, 2 days pp		2				210 (85)
Vomiting, diabetes type 1, gw 28		2				214 (69)
<i>Not reacting to symptoms specified in CCA</i>					14%	
Constant abdominal pain, high uterine tone, elevated fetal heart rate, gw 36		5				207 (92)
Undetectable fetal heartbeat, gw 36			1			204 (85)
Neurological symptoms, decreased sensation in right half of body, dysarthria, gw 39				1		206 (100)
Limitations in study design						
<i>Impossible to evaluate amount of vaginal bleeding and/or level of pain</i>					43%	
Painful contractions, initially heavy bleeding that diminishes, gw 31		11		1		201 (54)
Heavy vaginal bleeding without contractions, gw 38		1	1			203 (92)
Suspected premature rupture of membranes after amniocentesis, gw 33		5	2			202 (85)

Figure 2

Undertriage of immediate and urgent cases, including cases crossing the urgent/non-urgent barrier. C.gr – Consensus group, UT – undertriage, CCA – chief complaint algorithm, pp – postpartum, gw – gestational week. Numbers in bold type represent cases crossing the urgent/non-urgent barrier.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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