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Title: Obstetric emergencies in primary midwifery care in The Netherlands
Issue Date: 2014-06-26

Chapter 4

Ambulance transfer in case of postpartum haemorrhage after birth in primary midwifery care in the Netherlands: a prospective cohort study

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ABSTRACT

Objective

To assess whether the 45 minute pre-hospital limit for ambulance transfer is met in case of postpartum haemorrhage (PPH) after midwifery supervised home birth in the Netherlands and evaluate the process of ambulance transfer, maternal condition during transfer, and outcomes in relation to whether this limit was met.

Design

prospective cohort study

Setting

From April 2008 to April 2010, midwives reported all cases of PPH.

Sample

72 cases of PPH.

Methods

Using ambulance report forms and medical charts, ambulance intervals, urgency coding, clinical condition (using the lowest Revised Trauma Score, RTS) and maternal outcomes were collected. Associations between duration of the ambulance transfer and maternal condition during ambulance transfer and outcomes were analysed.

Main Outcome Measures

Duration of ambulance transfer, RTS score, blood loss, surgical procedures and blood transfusions.

Results

72 cases were reported, 18 (25%) were excluded: 54 cases were analysed. In 63%, the 45-minute pre-hospital limit was met, 75.9% received a RTS score of 12, indicating optimal Glasgow Coma Scale, systolic blood pressure (SBP) and respiratory frequency. In 24.1% a decrease in SBP was found (RTS score 10 or 11). We found no difference in outcomes between women with different RTS scores or in whom the 45-minute pre-hospital limit was or was not met.

Conclusions

We found no relation between the duration of ambulance transfer and maternal condition or outcomes. All women fully recovered. The low-risk profile of women in primary care, well-organised midwifery and ambulance care in the Netherlands are likely to contribute to these findings.

INTRODUCTION

Postpartum haemorrhage (PPH) remains one of the leading causes of severe maternal morbidity and mortality worldwide, particularly in low-resource countries. An increase in PPH has been observed in high-resource countries in the last 15 years. [1] In the Netherlands, 64/1000 births is complicated by PPH, defined as blood loss of more than 1000 mL. In 2010, the incidence of PPH in low-risk primary midwifery care was 34/1000. [2] Almost one third of the women at low-risk of obstetric complications (32.7%) give birth under care of a midwife (98%) or general practitioner (GP) (2%). If complications occur during pregnancy, delivery or puerperium, women are referred to secondary care. Indications for referral are laid out in an obstetric indication list. [3] This list is revised regularly by a project group consisting of midwives, obstetricians, paediatricians, and general practitioners. Women in primary care at term can choose to give birth at home or in hospital assisted by their primary care midwife. Roughly one third of all women commencing labour in primary care are transferred to secondary care. Meconium stained liquor, failure to progress during labour, fetal distress, PPH or retained placenta are reasons for transfer to secondary care. [4] When birth proceeds without complications, approximately 60% of women give birth at home and 40% in hospital or birthing clinic.

Midwives are trained to identify and manage obstetric emergencies and are required to attend regular continuing medical education sessions. [5] Similar post-graduate courses such as the Pre-Hospital Obstetric Emergency Course (Dutch acronym: 'CAVE') and Pre-hospital Obstetric Emergency Training ('POET') both focus on identification and management of obstetric emergencies, including timely and adequate referral. [6;7]

Guidelines and protocols concerning ambulance transfer in obstetric emergencies are available for both ambulance personnel and birth attendants. [8;9] The Dutch government has set the statutory limit to ambulance referral time, from dispatcher call to hospital arrival, to 45 minutes. [9-12] Evidence suggests that the geographic characteristics and the excellent road network in the Netherlands theoretically allows 99.7% of patients to reach a hospital with an obstetric department within 45 minutes. [13]

The study objective was to acquire insight into ambulance referral in case of PPH after midwifery-supervised home birth. We aimed to evaluate the entire process of ambulance referral, from dispatcher call to hospital arrival. We measured maternal condition during ambulance transfer and maternal outcomes to assess the safety of women who sustained PPH after home birth in the Netherlands.

METHODS

Study design

This study received ethical approval from the Leiden University Medical Centre ethical board (study code: P11.105).

We performed a prospective cohort study of ambulance reports and medical charts of women suffering from PPH after midwifery-supervised home birth. PPH was defined as more than 1000 mL of blood loss after childbirth, as assessed by the midwife upon referral. Primary care midwives who participated in the pre-hospital emergency course 'CAVE' were requested to report all cases of PPH in their practice.

Study setting

There are 25 regional ambulance services in the Netherlands. Each region consists of one or more local ambulance services and dispatch centers in order to arrive at the patient within 15 minutes after dispatcher call. When a midwife requests -ambulance assistance, the dispatcher in the control room assesses the severity of the situation and subsequently assigns an urgency code. A1 is assigned when urgent transport in a possibly life-threatening situation is required: the ambulance must arrive at the patient's location within 15 minutes. An A2 urgency code is assigned when prompt ambulance assistance is required but the patient's life is not in acute danger: the ambulance must arrive within 30 minutes. [10]

Data collection

We collected cases of women suffering from PPH after home birth in primary care from April 2008 to April 2010. During twelve consecutive months, every midwife participating in the study received a monthly e-mail linked to a password-protected website. When a case of PPH was reported, the midwife was asked to fill out a detailed case report form (CRF) and send in anonymised medical files, discharge letters and laboratory results. If data were incomplete or inconclusive, midwives were contacted for the missing information. Cases were included if, in addition to midwifery medical files, ambulance reports with time intervals, and RTS scores were available (see below). Ambulance reports were supplied by the midwife or ambulance services. When, despite repeated attempts information remained incomplete, cases were excluded from further analysis.

Baseline characteristics, ambulance intervals, RTS scores, and maternal outcomes (total blood loss, admission to the intensive care unit (ICU), procedures to reduce blood loss, Packed Red Blood Cells (PRBC), and discharge day) were recorded.

Data on blood loss prior to ambulance arrival (as noted by the midwife), during ambulance transfer (if noted by paramedics or midwife), and measures taken by the midwife to treat

PPH (such as administering uterotonics, uterine massage, bladder catheterisation) were collected. Also, information on established intravenous access (IV) (by the midwife or paramedic) and the total amount of blood loss (as noted in the discharge letter from the obstetrician) was collected.

For data collection of ambulance time intervals we applied the "interval model" as developed by Spaite et al. [14-17] On this model, *total pre-hospital interval* is defined as the duration of ambulance transfer from dispatch call to arrival at the hospital. The total pre-hospital interval is divided into three sub-intervals: *response interval* (from dispatch call to arrival on scene), *on-scene interval* (from ambulance arrival on scene to departure to the hospital) and *transport interval* (from departure from the scene to arrival at the hospital). Intervals were calculated using the recorded time in minutes (Figure 1). [8]

The statutory limit stating that the total pre-hospital interval should not exceed 45 minutes, as set by the Dutch government, is referred to as "the 45-minute pre-hospital limit" in this article.

To determine the clinical condition of a patient, the Revised Trauma Score (RTS) is used by ambulance personnel. This physiologic scoring system is a reliable numeric indicator for outcome evaluations in all trauma patients and is widely used by ambulance teams worldwide. [18-20] This score combines the Glasgow Coma Scale (GCS), respiratory frequency (Rf), and systolic blood pressure (SBP). The prognostic value of combining these parameters is significantly higher than GCS, Rf and SBP alone. [20] Scores range from 0 to 12 with 0 being the worst possible score and 12 indicating no physiologic derangement (Figure 2). [19] The RTS score is assessed upon arrival of the ambulance personnel and regularly reassessed if indicated. For analysis, we used the *lowest* RTS score reported on the ambulance report form.

Analysis

Basic characteristics, interventions of the midwife to treat PPH, maternal condition using RTS score and maternal outcomes were described. Nominal and ordinal variables were expressed in frequencies and proportions and for continuous variables median and range were calculated. The research questions were analyzed using univariate statistical techniques.

First, we analysed the ambulance intervals for A1 and A2 urgency indications. The ambulance intervals were expressed in minutes, median duration and range. Additionally, we categorised the total of the intervals in those dispatches meeting the statutory 45-minute pre-hospital limit and those who did not. To analyse the contribution of the separate ambulance intervals (response, on-scene, transport) in relation to the statutory 45-minute pre-hospital limit, we analysed the differences between the intervals of A1 and A2 urgencies using the Mann-Whitney-U test. An odds ratio (OR) was calculated to

express the odds of arriving in the hospital within the 45-minute pre-hospital limit when the ambulance is sent with an A1 urgency indication versus an A2 indication.
Secondly, we analysed the maternal condition using the RTS score in relation to the on-scene and transport interval. Particularly, we were interested whether RTS score was associated with a prolonged or shortened on-scene and/or transport interval. To analyse this, we applied the Mann-Whitney-U test. If RTS scores lead to prolonged or shortened on-scene and/or transport intervals, this would have an effect on the total pre-hospital time and thus possibly on compliance with the 45-minute pre-hospital limit. We performed Pearson's Chi-Square test to analyse whether the various RTS scores (indicating different states of maternal condition) were related to compliance with the 45-minute pre-hospital limit.
Thirdly, because we hypothesised that maternal outcomes were related to the total pre-hospital interval rather than to specific sub-intervals, we examined the association between maternal outcomes and the 45-minute pre-hospital limit. The Dutch government set the 45-minute pre-hospital limit as a standard for ambulance transfers. By relating the outcomes to this limit, the relevance or safety of the 45-minute pre-hospital limit could be assessed. To associate total blood loss as maternal outcome with the 45-minute pre-hospital limit, we applied a Mann-Whitney-U test. Depending on the number of observations, we performed the Pearson's Chi-Square test or Fisher's exact test to analyse whether the remaining maternal outcomes (admission into ICU, procedures to reduce blood loss, PRBC, and discharge day) were related to the 45-minute pre-hospital limit. To conclude our analysis of maternal outcomes, we performed Kruskall-Wallis' test to analyse the association between the maternal condition (RTS score) and maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day). We also performed a subgroup analysis where women with imminent PPH who had not suffered 1000 mL or more blood loss at onset of ambulance care were excluded. These women could have had higher RTS scores and this could influence the results positively. We performed Kruskall-Wallis' test to analyse the association between the maternal condition (RTS score) and maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day) after we excluded women suffered less than 1000 mL blood loss at onset of ambulance care.
Finally, to explore possible bias through missing data, we compared basic characteristics, blood loss at onset of ambulance care, and total blood loss of included and excluded cases using midwifery medical charts. The analysis was done using Student's T-test, Mann-Whitney-U or Pearson's Chi-Square depending on the type of variable.
All analyses were performed using IBM Statistics Data Editor (SPSS), version 21 (SPSS Inc., Chicago, IL, USA). Statistical significance was considered if $p < 0.05$.

RESULTS

All midwives (n= 584) who registered for the pre-hospital obstetric emergency course 'CAVE' were asked to participate in this study. Consent for participation was granted by 548 midwives (92%). During the study period, 98 cases of PPH in primary care were reported, 72 of these occurred at home (73.5%). Of these, eighteen cases (18/72, 25%) were excluded due to incomplete documentation.

Basic characteristics of included women are shown in Table 1. Women originated from both rural and urban areas in the Netherlands. The median age was 31 years, similar to the average age of women who gave birth in the Netherlands in 2010. The parity of women in our sample (48.4% was nullipara) was comparable to the parity of the Dutch population of women that gave birth in 2010 (48.5% nullipara).

The primary cause of PPH was uterine atony in 35/54 (64.8%) of cases, retained placenta in 15/54 (27.8%), genital tract trauma in three (5.6%), and incomplete placenta in one (1.9%). Various measures were taken by the attending midwife in order to manage PPH. All but one woman (98.1%) received uterotonics. The midwife reported "genital tract trauma" as the cause of the PPH. Bladder catheterisation was performed in more than three quarters and uterine massage in 72%. Intravenous access was established in all women; in 33.3% by the midwife prior to ambulance arrival, and in 66.7% by the ambulance paramedics. Blood loss prior to ambulance transfer, as noted by the midwife or ambulance paramedics, ranged from 400 to 2000 mL (median 1000 mL).

As can be seen in Table 2, urgency code A1 was assigned to 43 out of the 54 transfers (79.6%) and code A2 to 11/54 (20.4%). As can be expected, we found a significantly shorter response interval in A1 transfers with a median duration of 6 minutes. There were no differences in the on-scene and transport intervals between A1 and A2 codes. We found that ambulances sent with an A1-indication complied more often with the 45-minute pre-hospital limit than A2 transfers: 88% vs. 11% (OR 4, CI 1.01-16.2). Overall, the 45-minute pre-hospital limit was met in 34 cases (63%). In 20 cases (37%) this time limit was exceeded, with a maximum total pre-hospital interval of 71 minutes (median 52 minutes, range 46-71). In four cases, the midwife or ambulance personnel requested assistance from the fire department to evacuate the woman from her house, because the ambulance stretcher was too large for the staircase. In two out of these four cases, transfer was still completed within the 45-minute pre-hospital limit.

From each ambulance report form, the lowest RTS score was recorded and analysed. The range of the RTS scores was small and only dropped from the maximum RTS score of 12 points, to 10 points. The maximum RTS score of 12 points was assigned to 41 women (75.9%). If the RTS score was lower than the maximum of 12 points, deductions were exclusively attributable to lower systolic blood pressure. As can be seen in Table 3, we observed only one difference considering ambulance intervals between the various RTS scores: women with a RTS score of 10 had a longer transport interval of 16 minutes compared to women with a score of 11 (7.5 minutes) or 12 (10 minutes) ($p = 0.03$). Of the four women that had to be evacuated by the fire department, three received an RTS score of 12 and one scored 10 points.

In 27 cases (50%) PRBC were administered in the hospital, ranging from 1 to 8 units (median 1 unit). Total blood loss ranged from 1000 mL to 7000 mL (median 2000 mL). On two women, procedures were performed to reduce blood loss: one uterine artery embolization and one balloon tamponade. Both women had a RTS score of 12 during transfer. No statistically significant association between maternal outcomes (total blood loss, admission into ICU, procedures to reduce blood loss, PRBC, and discharge day), and compliance with the 45-minute pre-hospital limit was found (Table 5). Likewise, maternal outcomes of total blood loss, ICU admission, procedures to reduce blood loss, PRBC, and hospital stay were not statistically related to the maternal condition (RTS score, Table 4). Furthermore, after excluding women who suffered less than 1000 mL blood loss at onset of ambulance care, the association between RTS score and maternal outcomes remained non-significant.

Eighteen cases (18/72, 25%) were excluded because of incomplete documentation. In these cases, ambulance report forms could not be obtained or were incomplete (missing data on ambulance intervals, missing RTS scores). Based on those data that were available for these exclusions from midwifery medical charts and incomplete ambulance forms, there was no difference between included and excluded cases regarding basic characteristics or blood loss prior to onset of ambulance care. The total blood loss in the group of excluded cases was smaller compared to the total blood loss of the included cases (p=0.01).

DISCUSSION

Main findings

This is the first study providing insight into maternal condition during ambulance transfer and maternal pregnancy outcome in case of PPH after home birth in the Netherlands. Overall, the median total pre-hospital interval was 52 minutes (range 27-71 minutes). In 37% the 45 minute pre-hospital limit was not met, but the median excess was only seven minutes. More than three-quarters of women were in optimal condition during transfer and in case their RTS scores were compromised, their outcomes were not worse.

Women who arrived in hospital within the 45-minute pre-hospital limit and those who arrived with delay did not have significantly different maternal outcomes. Even though almost half of the women received PRBC's and two women underwent procedures to cease PPH, all women fully recovered.

Strenghts and Limitations

Strength of our study is the unique and detailed information on time intervals, maternal conditions during ambulance care and outcomes. The combination of medical files supplemented with ambulance report forms allowed for crosschecking of data, including ambulance times and RTS scores, which adds to the comprehensiveness of the measured data.

Our study also has its limitations. Midwives were requested to report all cases of PPH, however we cannot verify if all cases were actually reported to the researchers. Since anonymity was guaranteed for both care-providers and patients, we presume that failure to report occurred not more than occasionally.

Another limitation is that we did not collect information on how blood loss was measured. The most common method for this is visual estimation. It is known that estimating blood loss (in contrast to weighing) is subjective and leads to underestimation of actual blood loss. [25-27] Therefore, we applied more objective parameters such as RTS score and PRBC.

Interpretation

A contributing factor for the large proportion of women in good maternal condition during ambulance care could be the combination of the Dutch midwifery care system and the characteristics of the ambulance services in the Netherlands. In the Dutch midwifery care system, risk selection is a very important factor: only women with uncomplicated pregnancies and uncomplicated first and second stages of labour can give birth at home. However, this does not guarantee that complications will not occur. All women in our study had been identified as low-risk during their pregnancies and the first and second stage of labour progressed without complications.

Uterotonics were given in all cases but one, where the midwife chose not to administer uterotonics since she assessed that, in this woman, PPH was due to genital tract trauma. This is, in fact, in contradiction to the 'CAVE' method in which uterotonics are routinely administered. In one third of cases the midwife established IV access prior to ambulance arrival. In 80%, paramedics arrived within 15 minutes. Reasons for midwives not establishing IV access are speculative, but it is possible that the midwife prioritised other matters, such as uterine massage, bladder catheterisation and so on before ambulance arrival. An argument can be made that these interventions contributed to the high RTS scores in our study. In addition, it is assumed that pregnant women (and women directly postpartum) who are in good health may tolerate blood loss up to 1000 mL, owing to the physiological changes in pregnancy. [2;21;22] Therefore, early signs of shock as assessed through the RTS might be delayed in this low-risk population. The RTS score should therefore be interpreted with caution.

In the Netherlands, ambulance services have the advantage of using an excellent road network, which theoretically allows 99.7% of the patients to reach a hospital within 45 minutes (i.e. the 45-minute pre-hospital limit). [13] In our study only 63% of ambulance transfers complied with the 45-minute pre-hospital limit. The median excess duration, however, was only 7 minutes. These results are in contrast with the results of a report of the Dutch Ministry of Health, Welfare and Sport who previously reported that 82% of the obstetric emergency transfers complied with this limit. [23] There are a number of possible explanations for the differences between our findings and those of the Dutch Ministry. First, we included only postpartum transfers for PPH in our study, unlike the report of the Ministry, which included ambulance transfers in all stages of labour (e.g. birth dystocia, fetal distress). Perhaps post-partum complications and transfers are more time-consuming than transfers during labour, but without further research that remains a hypothesis. Another explanation could be that more ambulances were sent with A1 urgency in the report of the Ministry, ensuring a shorter response interval. We found that ambulances with an A1 urgency code complied with the 45-minute pre-hospital limit in 88% of cases. Similar to our results, a study performed in a large city in the Netherlands, also reported shorter total pre-hospital intervals with A1 urgency ambulance transfers. [24] When analysing ambulance intervals separately for the various RTS scores, we found a longer transport interval (median 6 minutes) for women with an RTS score of 10 points (Table 3). A possible explanation for this is that the ambulance could not drive as fast when transferring a patient with a suboptimal condition, but this is speculative.

Even though 37% of transfers did not arrive at the hospital within 45 minutes of dispatcher call, we found no differences in maternal outcomes (PRBC, procedures to reduce blood loss, ICU admission). We analysed whether cases in which women suffered less than 1000 mL blood loss at onset of ambulance care, had less favourable maternal outcomes. This was not the case. In fact, the results of this subgroup analysis were comparable to the outcomes of the whole group. It is plausible however, that transfer to hospital, which obviously causes delay, influences maternal condition and outcomes. Comparing outcomes of low-risk hospital births complicated with PPH after home birth is an interesting subject for further research.

We excluded 18 cases (25%) due to incomplete documentation. We performed an analysis to assess bias through excluded cases. We used available data from midwifery medical charts and found no change of results when analysing the influence of the excluded cases.

Until now, limited information was available on ambulance transfers after home birth. [24;28;29] This is the first study analysing ambulance transfer in case of PPH. This study is not aiming to assess the practice of home birth, but it makes a valuable contribution to the ongoing home birth debate in the Netherlands. [28;30-34] Evidently, if a birth proceeds without complications, no interventions other than guidance and support are required. But, in case of an emergency, transfer to hospital is time-consuming, especially compared to being in a hospital setting already. Although our study is based on a limited number of cases, our findings show that 80% of women were in good maternal condition at time of transfer and it can be assumed that referral was initiated timely.

Conclusion

We found no relation between the duration of ambulance transfer and maternal conditions and outcomes. All women who sustained PPH following home birth fully recovered. The low-risk profile of women in primary care, the well-organised midwifery and ambulance care and excellent road network in the Netherlands are likely to contribute to these findings. Further research must be performed to assess if home birth has an effect on the outcomes of PPH.

Acknowledgements

The authors would to thank the midwives for reporting cases of PPH and ambulance services throughout the country for assisting in data retrieval. We also thank Yvonne Beuger, for data management of all cases during the study period and Barbara Havenith and Jacobien van der Ploeg, obstetricians and directors of the postgraduate training programme for their work on motivating midwives to participate in this study.

Table 1. Patient characteristics, maternal condition and maternal outcomes (n=54).

Characteristics			
Age in years	(median, range)	31	(23-41)
Gestational age in weeks + days	(median, range)	40+0	(37+0 - 41+6)
Parity	(frequency, proportion)		
0		27	(50%)
1		18	(33.3%)
2		8	(14.8%)
3		1	(1.9%)
Maternal outcomes			
Total blood loss in mL	(median, range)	2000	(1000-7000 mL)
ICU admission	(frequency, proportion)	2	(3.7%)
Procedures to reduce blood loss	(frequency, proportion)		
Balloon tamponade		1	(1.9%)
Uterine artery embolization		1	(1.9%)
Units of PRBC	(frequency, proportion)		
0		27	(50%)
1 or 2		13	(24.1%)
3 or 4		12	(22.3%)
8		2	(3.7%)
Duration of hospital stay in days	(frequency, proportion)		
1		19	(35.2%)
2 or 3		25	(46.3%)
4 or more		8	(14.9%)

Table 2. Duration of ambulance intervals in minutes by urgency coding, median, range (n=54)

	A1 (n=43)	**A2 (n=11)**	***p*-value**
Response interval	9 (5-23)	15 (6-29)	$p < 0.05$
On scene interval	17 (7-44)	19 (7-33)	*p* 0.75
Transport interval	10 (4-27)	12 (6-21)	*p* 0.33
Total pre-hospital interval	40 (27-61)	46 (32-71)	*p* 0.06

Table 3. Duration of ambulance intervals in minutes by maternal condition, median, range (n=54)

	RTS 12 (n=41)	**RTS 11 (n=8)**	**RTS 10 (n=5)**	***p*-value**
Response interval	10 (5-29)	13 (5-23)	12 (7-23)	*p* 0.55
On scene interval	17 (7-38)	18 (9-44)	22 (17-25)	*p* 0.51
Transport interval	10 (4-27)	7.5 (4-20)	16 (15-21)	$p < 0.05$
Total pre-hospital interval	40 (27-71)	43.5 (30-60)	50 (45-60)	*p* 0.06

Table 4. RTS scores and maternal outcomes (n=54)

Maternal outcome	RTS 12 (n=41)	RTS 11 (n=8)	RTS 10 (n=5)	p-value
Total blood loss (median, range)	2000 (1000-7000)	2050 (1200-3000)	2200 (1500-2700)	*p* 0.73
ICU admission (frequency)	2	0	0	*p* 0.72
Procedures to reduce blood loss* (frequency)	2	0	0	*p* 0.72
Units of PRBC (median, range)	0 (0-8)	1.5 (0-4)	2 (0-3)	*p* 0.67
Discharge day (median, range)	2 (1-6)	2 (1-3)	2 (1-4)	*p* 0.64

**balloon tamponade and embolisation*

Table 5. RTS scores and maternal outcomes by 45-minute pre-hospital limit (n=54)

	< 45 minutes	> 45 minutes	*p-value*
All cases	34	20	
RTS scores			
12 and 11	*33*	*16*	
10	*1*	*4*	*p* 0.06
Maternal outcomes			
Total blood loss	2000 (1100-7000)	2050 (1000-6000)	*p* 0.91
Blood loss at onset of ambulance care	1000 (400-2000)	1000 (900-2000)	*p* 0.80
ICU admission	1	1	*p* 0.61
Procedures to reduce blood loss	1	1	*p* 0.61
Units of PRBC	0 (0-8)	2 (0-8)	*p* 0.85
Discharge day	2 (1-6)	2 (1-4)	*p* 0.74

Figure 1: Modified interval model

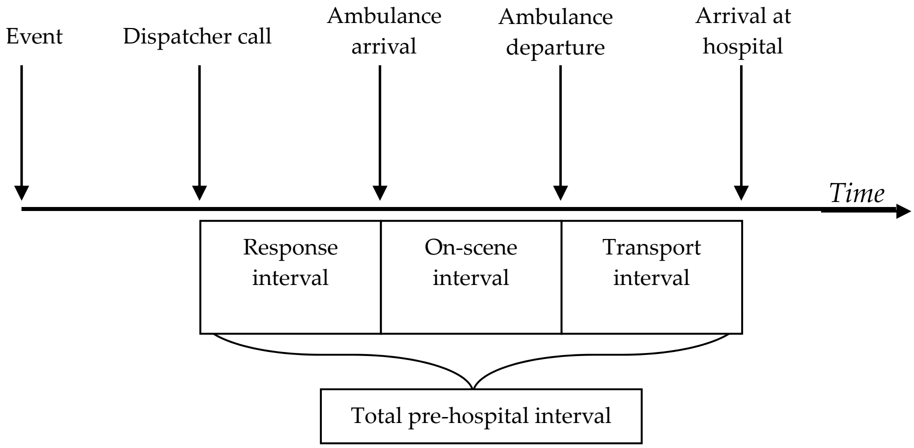
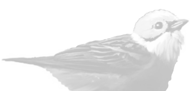


Figure 2. Revised Trauma Score

Points	Glasgow Coma Scale	Systolic blood pressure	Respiratory frequency
4	13-15	>90 mmHg	10-29/min
3	9-12	76-89 mmHg	>30/min
2	6-8	50-75 mmHg	6-9/min
1	4-5	1-49 mmHg	1-5/min
0	3	0 mmHg	0/min



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