SUPPLEMENTS. Implementing a new emergency medical triage tool in one health region in Norway: Some lessons learned

Appendices 1-6.

Appendix 1. Time for implementation of SATS-N related to time for baseline data and time for evaluation measurements per EMS end ED in the Western Health Region in Norway

Abbreviations: Q, quarter of year; EMS, Emergency medical service; ED, Emergency department; No, number

| ED/EMS No. | Implementation SATS-N | Baseline data sampled | Evaluation data sampled |
|------------|-----------------------|-----------------------|------------------------|
| ED1        | Q2 2013               | Q4 2012               | Q4 2013 and Q4 2014    |
| ED2        | Q2 2013               | Q2 2013               | Q4 2013                |
| ED3        | Q3 2013               | No baseline data      | No evaluation data     |
| ED4        | Q4 2015               | Q3 2015               | Q3 2016                |
| ED5        | Q4 2015               | Q1 2014               | Q2 2016                |
| ED6        | Q4 2015               | Q3 2015               | Q3 2016                |
| ED7        | Q1 2016               | Q3 2015               | Q4 2016                |
| EMS1       | Q2 2013               | Q4 2012               | Q4 2013                |
| EMS2       | Q3 2015               | Q3 2015               | Q4 2016                |
| EMS3       | Q4 2015               | Q1 2014               | Q2 2016                |
| EMS4       | Q1 2016               | Q3 2015               | Q3 2016                |

Appendix 2. Description of the vignettes with correct priority level (PL), number of respondents per vignette, number of respondents with correct answers per vignette, number and proportion (%) under- and over triage per vignette.

Abbreviations: V, vignettes; No, number; PL, priority level; resp, respondents

| V No. | SATS-N survey Vignettes (patient situations) | Correct PL | No. of resp. | Correct answers No. (%) | Under triage No. (%) | Over triage No. (%) |
|-------|---------------------------------------------|------------|--------------|-------------------------|---------------------|--------------------|
| 1     | 57-year-old man complaining of severe chest pain. ECG shows ST elevation. The patient is able to walk. Vital signs: RR 22/min, SpO2 97% without O2, PR 88/min, BP 150/95, temp. 37.7°C | Red        | 214          | 214 (100)              | 0 (0)               | Na                 |
| 2     | 17-year-old girl who called the EMS after eating shellfish. She is feeling nauseous, has abdominal pain, and has developed a rash all over her body. Her face is slightly swollen, and she needs assistance with walking to the ambulance. Vital signs: RR 22/min, SpO2 94% without O2, PR 124/min, BP 90/65, temp. 38.0°C | Red        | 214          | 163 (76)               | 51 (24)             | Na                 |
| 3     | 50-year old man who experienced aphasia and loss of muscle power in his right arm 1.5 hours ago whilst at work. Upon arriving in the ED, his symptoms have ceased. He can walk from the stretcher to the bed. He says he is fine now, with normal muscle strength in both arms. Vital signs: RR 18/min, SpO2 96% without O2, PR 80/min, BP 178/98, temp. 36.5°C | Red        | 212          | 197 (93)               | 15 (7)              | Na                 |
| 4     | 28-year-old woman with rapid, shallow breathing and in poor condition. She has abdominal pain, and informs the paramedics that she has been feeling tired and unwell lately. She is very thirsty. Her blood sugar level is 30 mmol/mL. She can walk with a little assistance. Vital signs: RR 38/min, SpO2 96% without O2, PR 104/min, BP 115/65, temp. 37.9°C | Orange     | 213          | 179 (84)               | 4 (2)               | 29 (14)            |
| Case | Description                                                                 | Vital Signs                                      | Acuity |
|------|------------------------------------------------------------------------------|-------------------------------------------------|--------|
| 5    | 54-year-old man who has been ill for 2 days with fever and a bad cough.     | RR 28/min, SpO2 95% without O2, PR 108/min, BP 88/54, temp. 39.8°C | Red    |
| 6    | 68-year-old woman with acute pain in the middle of her abdomen. She opens   | RR 18/min, SpO2 96% without O2, PR 112/min, BP 158/60, temp. 36.7°C | Red    |
| 7    | 58-year-old woman is admitted with TIA. She had difficulties when talking   | RR 14/min, SpO2 99% without O2, PR 74/min, BP 138/60, temp. 36.2°C | Yellow |
| 8    | A man without ID, hit by a car when crossing the road on his bicycle. Has    | RR 18/min, SpO2 96% with 2 l. O2, PR 80/min, BP 120/60, temp. 36.5°C | Red    |
| 9    | 50-year-old man with diagnosed lung cancer. Treated with chemotherapy,      | RR 18/min, SpO2 96% without O2, PR 80/min, BP 178/98, temp. 38.5°C | Red    |
| 10   | 82-year-old man who fell on his way to the bathroom this morning. He is not  | RR 22/min, SpO2 97% without O2, PR 84/min, BP 167/89, temp. 36.4°C | Yellow |
| 11   | 71-year-old man has fallen and hit the back of his head against a stone.    | RR 18/min, SpO2 97% without O2, PR 105/min irregular, BP 123/89, temp. 36.3°C | Orange |
| 12   | 82-year-old woman who lives alone, was found on the floor by her community   | RR 24/min, SpO2 94% without O2, PR 98/min irregular, BP 178/98, temp. 38.5°C | Red    |
Appendix 3. Description about selection of participants, data collection and statistical methods

Selection of participants and data collection

After institutional approval (No. 2017/10514), the local ED and EMS managers provided employee lists among the 1100 users. In units with less than 40 employees, all were invited to participate, while in the larger units a random sample of 40 employees from each unit were sampled and invited to participate. Of 384 employees initially selected to receive the questionnaire, 16 were excluded due to change of job or were on leave. The study was paper-based, and 368 uniquely numbered but otherwise anonymous envelopes, were distributed; 222 (60%) to the EDs and 146 (40%) to the EMS. The local managers personally handed out the envelopes, and were responsible for collecting the responses and returning them to the research team.

Statistical methods

The data were recorded and analysed by IBM SPSS version 24.0 and the statistical software suite R version 4.0.0 (1). The mixed-effects models were fitted using the lme4 R package version 1.1-23 (2). Descriptive data are reported as counts and proportions. To investigate which background factors were associated with assignment of a correct PL, we fitted univariate and multivariate mixed-effects logistic regression models, with correctness (yes/no) for each vignette as the response variable, and random effects (intercepts) for participant, place of work (11 units), and vignette number. For the regression analyses, we used data for all participants for whom background information was available, including participants who did not score every vignette. A p-value ≤ 0.05 was defined as statistically significant.

The ‘participant’ random effect measures the participants’ skill levels, while place of work is included to take into account any unit differences not captured by the background factors. The ‘vignette’ random effect measures the ‘difficulty’ of each vignette. It could also have been included as a fixed effect. However, one vignette was correctly assessed by every participant, giving a theoretical odds ratio of infinity (‘complete separation’) when comparing the vignette to other vignettes, and this leads to convergence problems for the logistic model. Since the vignettes were designed to reflect the variety of difficulty in correct assessment of PL in real-life situations, including them as a random effect is reasonable. Doing so effectively applies a tiny bit of penalization and shrinkage to the odds ratios for the vignette difficulties, eliminating any convergence problems and giving more realistic estimates. (For example, the predicted probability of correctly assessing the easiest item, for a random participant, in a model with no predictor variables, is shrunk from 100% to 99.5%).

For the regression analyses, we used data for all participants who had entered information on the background factors, including participants who did not score every vignette. For the other analyses, we used complete-case analysis and report the number of participants each analysis is based on (whenever there are missing data). (3)

The data were recorded electronically using IBM SPSS version 24.0. They were checked and obvious errors corrected. The statistical software suite R version 4.0.0 (1) was used for all analyses, and the mixed-effects models were fitted using the lme4 R package version 1.1-23. (2) A p-value ≤ 0.05 were defined as statistically significant.
### Appendix 4. Background factors for respondents (n = 214). * Respondents may have participated in several learning activities. Abbreviations: ED, emergency department; EMS, ambulance service; No., number of respondents; Prop., proportion of respondents,

| Professional background | ED | EMS | Total |
|-------------------------|----|-----|-------|
|                         | No. | Prop. | No. | Prop. | No. | Prop. |
| Paramedic/EMT           | 0   | 0%    | 84  | 84%   | 84  | 39%   |
| Registered nurse        | 114 | 100%  | 16  | 16%   | 130 | 61%   |

| Sex                     | ED | EMS | Total |
|-------------------------|----|-----|-------|
|                         | No. | Prop. | No. | Prop. | No. | Prop. |
| Male                    | 16  | 14%   | 63  | 63%   | 79  | 37%   |
| Female                  | 98  | 86%   | 37  | 37%   | 135 | 63%   |

| Years in current position | ED | EMS | Total |
|---------------------------|----|-----|-------|
| < 1 year                  | 15 | 13% | 12  | 12% | 27  | 13% |
| 1–3 years                 | 27 | 24% | 14  | 14% | 41  | 19% |
| 4–9 years                 | 38 | 33% | 13  | 13% | 51  | 24% |
| 10+ years                 | 34 | 30% | 61  | 61% | 95  | 44% |

| Completed SATS-N training in SATS-N (n = 212)* | ED | EMS | Total |
|------------------------------------------------|----|-----|-------|
| Read user manual                               | 62 | 54% | 65  | 66% | 127 | 60% |
| Attended theory presentation                   | 51 | 45% | 27  | 28% | 78  | 37% |
| Practical training                             | 78 | 68% | 48  | 49% | 126 | 59% |
| Completed e-learning course                    | 69 | 61% | 37  | 38% | 106 | 50% |
| No training                                    | 1  | 1%  | 6   | 6%  | 7   | 3%  |

| Numbers of ED admissions yearly               | ED | EMS | Total |
|------------------------------------------------|----|-----|-------|
| 0–20,000                                      | 91 | 80% | –    | –    | –    | –    |
| 30,000–40,000                                 | 23 | 20% | –    | –    | –    | –    |

| Numbers of ambulance missions yearly          | ED | EMS | Total |
|------------------------------------------------|----|-----|-------|
| 15,000–25,000                                 | –  | –   | 51   | 51%  | –    | –    |
| 35,000–60,000                                 | –  | –   | 49   | 49%  | –    | –    |
Appendix 5. Odds ratios for correct assignment of priority level (n = 214 respondents, 2,525 responses).
Based on mixed effects logistic models with random effects for participant, unit and vignette number. The number of responses varied by vignette number, from 209 to 214. Abbreviations: OR: odds ratio; CI: confidence interval; EMT: emergency medical technician; ED: emergency department.

|                  | Univariate |       |       | Multivariate |       |       |
|------------------|------------|-------|-------|--------------|-------|-------|
|                  | OR 95% CI  | P-value | OR 95% CI | P-value |
| **Sex**          |            |        |        |              |        |        |
| Male             | 1.0        | –      | –      | 1.0          | –      | –      |
| Female           | 1.01       | 0.72 to 1.41 | 0.97 | 1.05 | 0.74 to 1.49 | 0.79 |
| **Years in current position** |            |        |        |              |        |        |
| < 1 year (ref.)  | 1.0        | –      | –      | 1.0          | –      | –      |
| 1–3 years        | 1.37       | 0.82 to 2.27 | 0.23 | 1.36 | 0.82 to 2.25 | 0.24 |
| 4–9 years        | 2.19       | 1.32 to 3.64 | 0.003 | 2.15 | 1.29 to 3.58 | 0.003 |
| 10+ years        | 1.49       | 0.95 to 2.33 | 0.08 | 1.64 | 1.04 to 2.58 | 0.03 |
| **Read user manual** |            |        |        |              |        |        |
| Attended theory presentation | 1.10 | 0.82 to 1.49 | 0.53 | 1.04 | 0.77 to 1.40 | 0.82 |
| Practical training | 1.11 | 0.81 to 1.52 | 0.51 | 0.97 | 0.71 to 1.33 | 0.85 |
| Completed e-learning course | 1.49 | 1.09 to 2.04 | 0.01 | 1.45 | 1.04 to 2.02 | 0.03 |
| **Occupation**   |            |        |        |              |        |        |
| Paramedic/EMT (ref.) | 1.0  | –      | –      | 1.0          | –      | –      |
| Registered nurse | 1.50       | 1.01 to 2.23 | 0.05 | 1.42 | 0.81 to 2.49 | 0.22 |
| **Place of work** |            |        |        |              |        |        |
| ED (ref.)        | 1.0        | –      | –      | 1.0          | –      | –      |
| Ambulance        | 0.72       | 0.45 to 1.15 | 0.17 | 1.10 | 0.56 to 2.18 | 0.78 |

Appendix 6. Results of the survey

Among the 214 EMSs and ED nurses responding to the survey, 82% correctly assigned priority levels (PL) to the vignettes.
Number of years in current position, and completing the SATS-N e-learning course were the only statistically significant background variables for setting correct priority levels to the vignettes.
The survey uncovered some areas for improvements in the structure of the discriminator list, contents of the discriminators, and footnotes. The survey led to a regional improvement of the content of the discriminators and structuring of the discriminator list according to the ABCDE principles and a new version of the triage tool, SATS-N 4.0.

Literature

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