

## Interventions and diagnostics

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## CLINICAL EVALUATION OF THE NOVEL 'FULLSTOP' TOURNIQUET USING REAL TIME DOPPLER ULTRASOUND IN A HUMAN MODEL

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**Background** Major haemorrhage following trauma is a leading cause of preventable death. In the case of major haemorrhage from a limb, early application of a tourniquet can be life-saving. Tourniquets often need to be applied by lay persons, prior to the arrival of emergency medical services, in order to prevent exsanguination. A tourniquet needs to be completely reliable and easy to apply rapidly. We sought to evaluate the novel FullStop tourniquet (Safeguard Medical) in a human model.

**Method** A standard training session covering the FullStop method of application was provided. The FullStop tourniquet was applied to the upper arm of an adult human. Colour doppler ultrasound was used to identify the radial artery and visualise the radial pulse prior to tourniquet application and then following application. The time to full apply the FullStop was recorded. Successful application was defined as absence of any arterial pulsation on ultrasound.

**Results** 28 medical professionals participated in the study. They included doctors (n=9), nurses (n=8), medical students (n=5) and paramedics (n=6). Median time to application was 24 seconds (IQR 19–28 s). All (n=28, 100%) applications were successful in achieving complete occlusion of arterial flow in the arm.

**Conclusion** The FullStop tourniquet was rapid to apply and entirely effective in achieving complete occlusion of arterial flow in the upper limb. Further research is warranted to explore how effective the FullStop would be for lay person responders.

**Conflict of interest** None declared.

**Funding** None.

## Quality improvement and organization

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## PARAMEDICS' PERCEPTIONS OF JOB DEMANDS AND RESOURCES IN FINNISH EMERGENCY MEDICAL SERVICES: A QUALITATIVE DESCRIPTIVE STUDY

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**Background** Paramedic professionals' fatigue is rising <sup>1 2</sup>. Stress factors show increased risk for burnout and fatigue, leaving the profession, decreased performance and risk for patient safety. (1) Meanwhile, paramedics' strong community of practice, autonomy of practice and a sense of professional

respect are important factors in forming psychological resilience.<sup>3</sup> This study aimed to explore Finnish paramedics' perceptions of job demands and resources.

**Method** A cross-sectional descriptive study with qualitative design, utilizing an inductive constructivist approach. The study used reflexive thematic analysis, by Braun and Clarke, to analyse two data sets of responses from professional Finnish paramedics; open-ended questions from a web-based survey (n=174) and essays written by masters-degree students (n=34).

**Results** The results were categorized into job demands or resources, as defined in Job Demands and Resource model by Demerouti and Bakker. Themes identified as paramedics' job demands were continuous stress from mentally burdening work (high workload, environmental stress factors and bearing patients' and relatives' emotional burden), uncertainty under expectation pressures (sense of inadequacy and a pressure to perform) and organizational lack of support. Themes identified as paramedics' job resources were pressure management strategies (distancing coping mechanisms, ability to handle clinical demands and ability to affect own work) and professional self-actualization (psychologically safe work community, professional sense of pride and internal drive to professional development).

**Conclusion** Finnish paramedics exhibit both job demands and resources. Performance pressure, uncertainty and emotional burden and also environmental hazards and psychological safety in communities. This indicates a need to address not only physical aspects of the paramedic work but also early stage performance expectations and organizational cultures.

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## Pain and trauma

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## REVIEW OF PREHOSPITAL PAIN MANAGEMENT IN PEDIATRIC TRAUMA

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**Background** Adequate management of pain in children is often a neglected aspect, usually undervalued and under-treated. This study is a continuous review to see if pharmacological methods provided during the prehospital care of pediatric trauma patients is proper.

**Method** Retrospective study of clinical records of children up to 18 year of age, assisted between 2017 and 2018. Mild pathologies excluded. Epidemiological variables: age, gender,

diagnosis, pediatric trauma score(PTS), analgesia, numeric rate scale(NRS), drugs administered. Quantitative variables: central and dispersion measures. Inferential statistical analysis: relationship quantitative variables, Student's t test and categorical variables, Chi square. 95% confidence intervals,  $p < 0.05$ . SPSS 20.

**Results** Total of 725 patients. Median age was 13 years(IQR 8–15). 70.9% males (514). Critically ill patients constitute 5.8% (42). Children received analgesia: 43.6%(316); <4 years: 17.3% (14), 5 to 11: 36.7% (80) and 12 to 18: 52.1% (222). IV route: 70.8% (240), intranasal: 21.4%(74). Fentanyl was used in 73.4% (232), Paracetamol 23.1%(73), Ketorolac 22.8%(72). IV mean doses: 1.9µgr/Kg, 15.1mg/Kg, 0.34mg/Kg respectively. Analgesia with PTS <9: 76.5% and PTS  $\geq$  9: 42.8%. NRS used in 12.5%(91); median initial: 8(IQR 7–9) and after analgesia: 3(IQR 2–4).

**Conclusion** IV opioids are the most widely used. Doses administered by weight are correct. The use of analgesia predominates in critically ill patients although not as high as indicated in international guidelines. We observed undertreatment in the groups of younger children, possibly due to a higher incidence of TBI. Alternative routes to IV administration could increase the use. Although pain scales were seldom used, the results show notable reduction of pain.

**Conflict of interest** None.

**Funding** None.

## Cardiac arrest

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### MATHEMATICALLY OPTIMISED PUBLIC ACCESS DEFIBRILLATOR PLACEMENT – FAIRNESS OR ACCESSIBILITY?

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**Background** Mathematical optimisation can be used to maximise public access defibrillator (PAD) accessibility for out-of-hospital cardiac arrests (OHCA). It is unclear whether enforcing 'fairness' (defined as parity of PAD accessibility) across city wards would impact resulting PAD accessibility compared to an unconstrained approach.

**Method** We included all suspected OHCA responses to by the Scottish Ambulance Service (SAS) in the cities of Glasgow, Edinburgh, Aberdeen, and Dundee between Jan. 2011 – Sept. 2017, and PADs registered with SAS as of Feb. 2020. We computed the accessibility (defined as within 100 m of OHCA) for existing PADs and developed a mathematical model to select locations for additional PADs under two scenarios: (1) select optimal locations across whole cities, and (2) select optimal locations distributed equally between city wards. Up to 20 additional PAD locations per ward were considered. For both scenarios, we compared PAD accessibility on out-of-sample OHCA using McNemar's test and fairness across wards using the Nash social welfare function.

**Results** We identified 14,674 OHCA responses and 424 existing PADs. Existing PADs were within range of 1.1% of OHCA (0.4–2.0% per city). Optimising new PAD locations per city, regardless of wards, increased PAD accessibility to 15.4% of OHCA (14.9–17.9% per city). Constraining an

equal number of PADs in each ward resulted in accessibility loss of 0.2–1.4 percentage points depending on the quantity of PADs placed ( $P < 0.05$  for 18 of 20 cases) but improved fairness values by up to 89% for smaller quantities of PADs.

**Conclusion** Enforcing ward-level parity when selecting optimal new PAD locations results in fairer but less accessible PADs for OHCA.

**Conflict of interest** None.

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## Cardiac arrest

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### OPTIMIZING RESIDENTIAL AUTOMATED EXTERNAL DEFIBRILLATOR COVERAGE BY TARGETING SOCIAL HOUSING AREAS

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**Background** Strategies for deployment of automated external defibrillators (AEDs) in residential areas are warranted. Social housing is widespread in Europe, has a high frequency of socio-economic predictors for out-of-hospital cardiac arrest, and consists of well-defined units with local leadership<sup>1,2</sup>. We aimed to optimize AED placement by targeting social housing in Vienna and Copenhagen.

**Method** Population density was obtained from Urban Atlas<sup>3</sup>; AED and social housing data from Vienna through City of Vienna, and from Copenhagen through the Danish AED Network and the National Building Foundation, respectively. From April 2020, all 24-hour accessible AEDs in residential areas were included. AED coverage was defined as number of inhabitants within 100 meters of an AED. AEDs were randomly distributed in social housing accounting for current AEDs and a density of 0.5 AED/hectare. Current vs. optimized AED coverage were compared in Vienna and Copenhagen.

**Results** In Vienna vs. Copenhagen, respectively, 25% (n=492,752) vs. 31% (n=304,966) of the population live in social housing areas, characterized by a high average population density: 361 inhabitants/hectare (all residential areas 173) vs. 142 inhabitants/hectare (all residential areas 71). AED density was 0.02 AED/hectare (271 AEDs) vs. 0.12 AED/hectare (1,641 AEDs) for Vienna vs. Copenhagen, and AED coverage was 358 (95%CI:309;414) inhabitants/AED vs. 119 (95%CI:114;128) inhabitants/AED, respectively. Application of the AED optimization model in social housing increased population coverage by nearly 2-fold: Vienna to 661 (95%CI:628;695, p-value<0.0001) inhabitants/AED; Copenhagen to 243 (95%CI:231;255, p-value<0.0001) inhabitants/AED.

**Conclusion** AED deployment targeting social housing may be a feasible strategy for optimizing coverage of residential out-of-hospital cardiac arrest.