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The impact of senior doctor assessment at triage on emergency department performance measures: Systematic review and meta-analysis of comparative studies.

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ABSTRACT

Study question To determine if placing a senior doctor at triage versus standard single nurse in a hospital emergency department (ED) improves ED performance by reviewing evidence from comparative design studies using several quality indicators.

Design Systematic review.

Data sources Cochrane Library, MEDLINE, EMBASE, CINAHL, EPOC, Web of Science, Clinical trials registry website. In addition, references from included studies and citation searches were used to identify relevant studies.

Review methods Databases were searched for comparative studies examining the role of senior doctor triage (SDT), published from 1994 to 2014. Senior doctor was defined as a qualified medical doctor who completed high specialty training in emergency medicine. Articles with a primary aim to investigate the effect of SDT on ED quality indicators such as waiting time (WT), length of stay (LOS), left without being seen (LWBS) and left without treatment complete (LWTC) were included. Articles examining the adverse events and cost associated with SDT were also included. Only studies with a control group, either in a randomized controlled trial (RCT) or in an observational study with historical controls, were included. The systematic literature search was followed by assessment of relevance and risk of bias in each individual study fulfilling the inclusion criteria using the Effective Public Health Practice Project (EPHPP) bias tool. Data extraction was based on a form designed and piloted by the authors for dichotomous and continuous data.

Data synthesis Narrative synthesis and meta-analysis of homogenous data was performed.

Results Of 4506 articles identified, 25 relevant studies were retrieved; 12 were of the weak pre-post study design, 9 were of moderate quality and 4 were of strong quality. The majority of the studies revealed improvements in ED performance measures favouring SDT. Pooled results from 2 Canadian RCTs showed a significant reduction in LOS of medium acuity patients (WMD -26.26 min 95%CI -38.50 to -14.01). Another 2 RCTs revealed a significant reduction in WT (WMD -26.17 min, 95%CI -31.68 to -20.65). LWBS was reduced in 2 Canadian RCTs (RR = 0.79, 95% CI 0.66 to 0.94). This was echoed by the majority of pre-post study designs. SDT did not change the occurrence of adverse events. No clear benefit of SDT in terms of patient satisfaction or cost effectiveness could be identified.

Conclusion This review demonstrates that SDT can be an effective measure to enhance ED performance, although cost versus benefit analysis is needed. The potential high risk of bias in the evidence identified, however, mandates more robust multi-centered studies to confirm these findings.

INTRODUCTION

Emergency department (ED) crowding occurs when demand for emergency services exceeds the capacity to provide care within a reasonable time frame (1). This problem is international in scope and affects governments, hospitals, service providers and service users (2,3,4). ED crowding is important because it is associated with long waiting times and increased length of stay of patients in the ED (2). This is often reflected in risks to patient safety and reduced patient satisfaction (3).

It is helpful to break down the causes of crowding into input, throughput and output factors (4). Trying to control input or output is largely beyond the capability of ED staff and managers. Often such action requires a multi-level approach and collaborative involvement including numerous hospital and out-of-hospital interventions (1).

On the other hand, several interventions have been implemented to improve throughput or patient flow. Nurse triage is currently the standard triage model in the majority of hospitals throughout the world (5). Nonetheless, there seems to be a rising concern among policy makers as to whether or not this older model is effective enough in the face of increased ED crowding worldwide (5). Two reviews have summarised succinctly the numerous throughput interventions aimed at improving ED flow such as nurse-requested x-ray, physician liaison triage and rapid assessment zones (6,7). Recently, the Royal College of Emergency Medicine in the UK suggested rapid senior assessment of patients within their recommendations to reduce ED crowding (1,8). In fact, there seems to be a growing interest in, and use of, senior doctor triage (SDT). SDT involves placing a senior emergency doctor in triage so that they can identify potential emergencies, initiate diagnostic workups and treatment for patients prior to being seen in the main ED. Previously, Rowe et al. reviewed evidence on doctor triage in a broad context which included junior, middle grade or senior doctors (7). In some of their included studies, the intervention was fulfilled by a doctor , a nurse practitioner, or a physician assistant (9,10). Furthermore, they depended heavily on abstract-only studies. In comparison, this current review adopts a tight focus looking specifically at the role of the 'senior' doctor in early assessment at triage.

An increasing amount of evidence assesses the benefits and risks of a senior doctor assessment at triage. The objective of this systematic review is to synthesise comparative studies available in the literature which explore the impact of SDT versus the standard single nurse triage on ED performance measures. This should allow ED clinicians to draw conclusions in respect to applying this intervention to their own practice.

METHODS

Protocol and registration

Methods of the analysis and inclusion criteria were specified in advance and documented in a protocol (11). Review registration number: CRD42014010143

Search strategy

Extensive search of the following electronic databases was undertaken to identify relevant studies MEDLINE, EMBASE, CINAHL, Cochrane Effective Practice and Organisation of Care (EPOC)
, Cochrane Library, Web of Science and Clinical.trial.gov. This was accompanied by searching citation indices, secondary references, grey literature, and hand searching through the archives of key journals. Literature for inclusion in the review was restricted to the period (1994-2014) in order to keep the information as relevant as possible. See online-only supplementary 1 for search strategy.

Eligibility criteria

Articles were included in the systematic review if they fulfilled the following eligibility criteria: 1) comparative in design (randomised and non-randomised controlled trials, before and after studies, interrupted time series and cohort studies with controls);2) published peer-reviewed studies; 3) conducted in adult or mixed age group EDs;4) evaluated senior doctor triage working either individually or within a team of other healthcare professionals; and 5) explicitly mentioned at least one of the key ED performance measures (12).

Articles were excluded if they were: 1) non comparative descriptive studies;2) abstract-only studies;3) published in a language other than English;4) investigated specific patient illnesses;5) the intervention (senior doctor) was allocated to other duties in the ED, for example seeing 'clerked' patients, administrative work or teaching and supervision;6) interventions that employed primary care physicians or general physicians in triage; 7) evaluated 'see and treat' or 'fast track' schemes.

Screening and Data Extraction

Irrelevant studies and duplicate publications were removed via screening of titles. Following this title sift, the researchers selected the studies according to the predetermined inclusion and exclusion criteria. This was achieved by reading the abstracts, or full texts if necessary. Authors were contacted to retrieve the qualification of the doctor if not clearly stated. A specifically designed and piloted form developed by the lead author was used for data extraction. Data extracted for continuous outcomes included: mean, Standard Deviation (SD) and sample size for each group. SD was sometimes calculated from confidence intervals (CI) or p value. For the purpose of the review, where only medians and Interquartile range (IQR) were reported, medians were accepted as means and SD was estimated using this formula: '*SD = IQR/1.35*' (13). This process was performed by one reviewer and verified by the other authors.

Risk of Bias

Each included study was evaluated for the risk of bias and study design using the Effective Public Health Practice Project (EPHPP) quality assessment tool (14). This tool accounts for the different study designs of the included studies.
The EPHPP tool examined each study against 6 dimensions namely: selection bias, study design, confounders, blinding, data collection methods, withdrawals and drop-outs. Finally, the quality of each article was graded as strong, moderate or weak according to the individual ratings attributed to each dimension.

Data Analysis

Narrative synthesis was completed. A table of the findings was produced to summarise the population, design and intervention of each study. Heterogeneity between studies was assessed using the I^2 statistic. Homogenous studies were statistically summarised and meta-analysed. The meta-analyses were performed by computing risk ratios (RR) and weighted means differences (WMD) with 95% CI using a random effects model, as it provides a more conservative estimate of the effect size. If meta-analysis was not feasible due to high heterogeneity ($I^2 > 90\%$), weighted means or risk ratios were calculated for all studies for a given outcome to provide a non–meta-analytic comparison for each result .This was carried out using the Review Manager programme (RevMan5.2).

Subgroup analyses, by study design, intervention type (senior-led team versus senior/nurse triage) and population type (medium acuity patients: Canadian triage and acuity scale 3 (CTAS 3) or equivalent), were conducted if feasible.
Sensitivity analysis was planned according to study design and methodological quality. Symmetry of funnel plots was used to assess for publication bias.

RESULTS

Literature search

The initial search identified 4506 abstracts, which were evaluated for relevance. 55 studies were considered potentially relevant and evaluated in full text. In addition, 2 studies were found through citation searching and secondary references. Ultimately, 25 studies were selected based on the predetermined eligibility criteria. See online-only supplementary 2, 3 for PRISMA chart and list of excluded studies respectively.

Description of the studies

All 25 included studies were comparative in design; 16 observational before and after (BA) studies (15–30), 3 cohort studies (31–33), 4 RCTs (34–37) and 2 clinical controlled trials (CCTs) (38,39).
Two studies evaluated senior doctor-only triage where the senior doctor alone was responsible for assessing patients and initiating treatment (18,30). A further group of 6 studies, including 2 Canadian RCTs, examined the presence of combined senior doctor and nurse triage (16,22,28,34,35,38). In the final group of 17 studies, the intervention was a senior doctor-led team triage where the senior doctor was accompanied by a team of other health professionals such as nurses and technicians. In 5 of these studies the team included junior doctors in addition to nurses or technicians (24,31,32,36,37). See Table 1: 'Characteristics of included studies'.

The population of the ED users appeared comparable across the included studies. Fourteen studies documented age, gender and mode of arrival to ED. In 12 of these studies, patients were middle aged with neither gender being predominant.

Quality assessment

Using the EPHPP global rating decision tool, 4 studies were assessed as being of strong quality (23,34,35,37), 9 of moderate quality (18,20,25,26,27,29,31,32,39) and 12 of weak quality. None of the studies were double blinded. Although typically patients were not aware of the introduced change in the ED, ED staff could not be blinded to the intervention. However, two strong quality RCTs from Canada and Australia stated that data analysts were blinded to the study objectives (34,37). See Table 2: 'EPHPP Quality Assessment tool rating for individual studies'.

Table 1 Characteristics of included studies

Study design group	Study & country of origin	Annual visits rate	Intervention	Study population	Study period	Study design
Before and after studies	**Choi 2006[15] Hong Kong**	~146,000	**Senior-led team triage** Triage Rapid Initial Assessment by Doctor (TRIAD) Team of senior doctor, nurse, health care assistant	2665	2 weeks	BA
	Crane 2012 [30] USA	95,000	**Single senior doctor triage** Faculty physician	NR	~ 3 months	BA
	Grant 1999 [16] Australia	NR	**Senior and nurse triage** Rapid assessment team (RAT) A senior doctor and registered nurse	9778	6 months	BA
	French 2014 [17] Jamaica	NR	**Senior and nurse triage** Team consisting of a consultant emergency medicine physician and 2 nurses	257	4 days	BA
	Han 2010[18] USA	50,000	**Single senior doctor triage** Board certified Emergency doctor	17285	~ 5 months	BA
	Imperato 2012[20] USA	36,000	**Senior-led team triage** Team of attending physician, nurse and technician.	18109	6 months	BA
	Imperato 2013[19] USA	36,000	**Senior-led team triage** Physician in Triage (PIT) Board certified emergency physician , registered nurse and technician	966	6 months	BA
	Patel 2005 USA[21]	39000	**Senior-led team triage** Team assignment system Teams of 1board certified emergency physician, 2 nurses, and usually 1 technician	78017	2 years	BA
	Richardson 2004 [22] Australia	36,000	**Senior doctor and nurse triage** Multi-disciplinary team (MDT)comprising a senior registrar/consultant and triage nurse	4148	6 months	BA
	Rogg 2013 [23] USA	90,000	**Senior-led team triage** Supplemented Triage And Rapid Treatment (START) Team of senior physicians and nurses	180870	4 years	BA
	Shetty 2012[24] Australia	56,000	**Senior-led team triage** Senior Streaming Assessment Further Evaluation after Triage (SAFE-T) zone(senior doctor, nursing and junior medical staff)	23253	77 days	BA
	Soremekun & Biddinger 2012[25] USA	90,000	**Senior-led team triage** Supplemented Triage And Rapid Treatment (START)Team of senior physicians and nurses	76858	2 years	BA

Study design group	Study & country of origin	Annual visits rate	Intervention	Study population	Study period	Study design
Before and after studies	**Soremekun& Capp2012**[26] **USA**	90,000	**Senior-led team triage** Supplemented Triage And Rapid Treatment (START); Team of senior physicians and nurses	20318	2 years	BA
	Soremekun 2014[27] **USA**	68,000	**Senior-led team triage** Attending physician and two registered nurses.	91,903	2 years	BA
	Travers 2006[28] **Singapore**	NR	**Senior doctor and nurse triage** Senior Emergency Physician and Nurse Triage (SEDNT) Team of senior physician and nurses	792	2 months	BA
	White 2012 [29] **USA**	85,000	**Senior-led team triage** Supplemented Triage And Rapid Treatment (START) Team of senior physicians and nurses	27156	6 months	BA
Clinical controlled trails	**Partovi** [39] **2001 USA**	52, 000	**Senior-led team triage** Faculty physician,2 nurses and emergency medical technician	1734	16 days	CCT
	Terris 2004 [38] **UK**	108,000	**Senior doctor and nurse triage** The IMPACT team; team composed of emergency medicine consultant and a senior ED nurse	378	3 months	CCT
Cohort studies	**Asha 2013** [31] **Australia**	65,000	**Senior-led team triage** Senior Assessment and Streaming (SAS); team of ED consultant, intern and nurse	18 962	3 months	Prospective cohort study
	Baumann 2006 [33] **USA**	52,000	**Senior-led team triage** Team Triage and Treatment (T3). Senior physician, an emergency nurse, and technician	243	1 week	Prospective cohort
	Burstrom 2012[32] **Sweden**	52,000 - 64,000	**Senior-led team triage** Consultant led team of junior doctor and nurse	91023	1 year	Retrospective cohort
Randomised controlled trials	**Cheng 2013** [34] **Canada**	45,000	**Senior doctor and nurse triage** Consultant academic emergency physician and nurse triage assessment team.	17034	~ 7 months	RCT
	Davis 2014 [37] **Australia**	70,000	**Senior led-team triage** Senior Workup Assessment and Treatment team (SWAT) Team of an emergency medicine consultant, a junior medical officer and a nurse.	1737	36 days	RCT
	Holroyd 2007 [35] **Canada**	55,000	**Senior doctor and nurse triage** Team of certified emergency physician with one year's experience and nurse	5718	6 weeks	RCT
	Subash 2004[36] **UK**	50,000	**Senior-led team triage** A team of a consultant, a middle grade, 2 senior house officers , and a nurse.	1028	8 days	RCT

BA, before and after study; CCT, clinical controlled trial; NR, Not reported; RCT, Randomised controlled trial

Table 2 EPHPP Quality Assessment tool rating for individual studies (14)

Study design	*1st Author*	*Study title*	*Selection Bias*	*Study Design*	*Confounders*	*Blinding*	*Data collection methods*	*Withdrawals and dropouts*	*Global rating*
Before and after studies	Choi 2006 (15)	Triage rapid initial assessment by doctor (TRIAD) improves waiting time and processing time of the emergency department	M	M	W	M	M	W	***W***
	Crane 2012(30)	A lack of effect on patient satisfaction scores in one large urban emergency department	W	M	W	M	S	W	***W***
	French 2014(16)	Doctor at triage – Effect on waiting time and patient satisfaction in a Jamaican hospital	W	W	M	M	S	M	***W***
	Grant 1999(17)	Rapid assessment team reduces waiting time	W	M	W	W	M	M	***W***
	Han 2010(18)	The effect of physician triage on emergency department length of stay	M	M	S	M	S	W	***M***
	Imperato 2012(20)	Physician in triage improves emergency department patient throughput	M	M	W	M	M	S	***M***
	Imperato 2013(19)	Improving patient satisfaction by adding a physician in triage	W	M	W	M	S	W	***W***
	Patel 2005(21)	Team assignment system: expediting emergency department care	M	M	W	W	W	W	***W***
	Richardson 2004(22)	Multidisciplinary assessment at triage: A new way forward	W	M	W	M	S	W	***W***
	Rogg 2013(23)	A Long-term analysis of physician triage screening in the emergency department	M	M	S	M	M	M	***S***
	Shetty 2012(24)	Senior streaming assessment further evaluation after triage zone: A novel model of care encompassing various emergency department throughput measures	M	M	M	W	S	W	***W***
	Soremekun a 2012(25)	Operational and financial impact of physician screening in the ED	M	M	S	W	M	M	***M***
	Soremekun b 2012(26)	Impact of physician screening in the ED on patient flow	M	M	M	W	S	M	***M***
	Soremekun 2014 (27)	The effect of an emergency department dedicated midtrack area on patient flow	M	M	S	W	S	M	***M***
	Travers 2006 (28)	Avoiding prolonged waiting time during busy periods in the emergency department: is there a role for the senior emergency physician in triage?	M	M	W	W	W	W	***W***
	White 2012 (29)	Supplemented triage and rapid treatment (START) improves performance measures in the emergency department	M	M	M	W	S	M	***M***
Cl in ic -	Partovi 2001 (39)	Faculty triage shortens emergency department length of stay	M	S	W	M	S	M	***M***

	Terris 2004 (38)	Making an IMPACT on emergency department flow: improving patient processing assisted by consultant at triage	M	S	W	W	W	S	***W***
Cohort studies	Asha 2013 (31)	Improvement in emergency department length of stay using an early senior medical assessment and streaming model of care: A cohort study	M	M	S	M	S	S	***M***
	Baumann 2006 (33)	Team triage: addressing challenges to emergency department flow	W	M	S	W	M	S	***W***
	Burstrom 2012 (32)	Physician-led team triage based on lean principles may be superior for efficiency and quality? A comparison of three emergency departments with different triage models	M	W	S	M	S	S	***M***
Randomised controlled trials	Cheng 2013 (34)	Implementing wait-time reductions under Ontario government benchmarks (Pay-for-Results): a cluster randomized trial of the effect of a Physician-Nurse supplementary triage assistance team (MDRNSTAT) on emergency department patient wait times	M	S	S	M	S	S	***S***
	Davis 2014 (37)	Senior work-up assessment and treatment team in an emergency department: A randomised control trial	M	S	S	M	S	S	***S***
	Holroyd 2007 (35)	Impact of a triage liaison physician on emergency department overcrowding and throughput: A randomized controlled trial	S	S	S	M	S	M	***S***
	Subash 2004 (36)	Team triage improves emergency department efficiency	M	S	W	W	S	W	***W***

W' weak; M, medium; S, strong

Outcomes

See Table 3: 'Summary of reported outcomes of included studies'.

1. Length of stay

Nineteen studies reported on length of stay (LOS) including 4 RCTs. Two Canadian RCTs by Cheng et al. and Holroyd et al. revealed a significant reduction in LOS with combined senior doctor and nurse triage (34,35). This was not the case in the remaining 2 RCTs (36,37) including an Australian study by Davis et al. where a Senior Work-up Assessment and Treatment (SWAT) model was associated with a 6 min increase in LOS (37). High heterogeneity did not allow pooled estimates to be provided. All non-RCTs except 3 (16,17,31) were associated with a significant reduction in LOS with a median decrease of 26 min (IQR -6 to -56). See Figure 1: 'Impact of senior doctor triage on length of stay (min)'

Subgroup analysis according to patient acuity was conducted. A pooled result from 2 homogeneous Canadian RCTs (34,35) reported significant reduction in LOS for medium acuity patients (CTAS 3) with combined senior doctor and nurse triage (WMD -26.26 95% CI -38.50 to -14.01).
The remaining RCTs by Subash et al. and Davis et al. did not present LOS according to patients' acuity and were not included in the analysis.
The effect of senior doctor triage on medium acuity patients in non-RCT studies was similar with median decrease of 29 min (IQR -6 to -56).
A subgroup analysis in accordance with the intervention type (single senior doctor, senior doctor and nurse, senior-led team) did not explain the high heterogeneity (I^2=99) among the included studies. Median decrease in LOS for senior doctor-led team triage was also 29 min (IQR -6 to -56).

Sensitivity analysis was not possible owing to the high heterogeneity of the studies. Visual inspection of the funnel plots suggests the possibility of publication bias. See Figure 2: 'Funnel plots for publication bias'.

2. Waiting time

Thirteen studies reported outcome data on waiting time (WT) to see a doctor. Two RCTs by Cheng et al. and Subash et al. revealed a significant reduction in WT in association with SDT (WMD -26.17 min, 95%CI -31.68,-20.65)(34,36). The RCTs by Holroyd and Davis did not report WT. All non-RCTs except 2 (31,33) showed a significant reduction in this indicator with median reduction of -15 min [IQR – 7.5 to -18]. See Figure 3: 'Impact of senior doctor triage on waiting time (min)'.

3. Left without being seen

Fourteen studies reported on patients who left the ED before being seen by a doctor (LWBS). Pooled results from 2 Canadian RCTs by Cheng et al. and Holroyd et al. reported an improvement in LWBS [RR = 0.79, 95% CI 0.66 to 0.94] (34,35). The RCTs by Davis et al. and Subash et al. did not report this outcome. See Figure 4: 'Impact of senior doctor triage on the number of patients who left without being seen'.

All the remaining 12 non-RCTs showed a reduction in LWBS rates. However, in 4 studies, this reduction was not statistically significant (20,31,33,39). Pooled results from 2 homogenous American non-RCTs (I^2=0) evaluating senior-led team triage on medium acuity patients showed a significant reduction in LWBS rates [RR=0.56, 95% CI 0.51, 0.61](25,26). Missing data did not allow the calculation of weighted risk ratios for 3 studies (22,27,33).

4. Left without treatment complete

Four studies reported on patients leaving without completing their treatment (LWTC) (23,29,32,35) including one RCT by Holroyd et al. Holroyd et al. demonstrated that the number of LWTC patients did not decrease significantly (RR of 0.65 [95% CI 0.25, 1.67])(35).On the other hand, 3 non-RCTs showed a significant reduction in LWTC rates (23,29,32).

5. Adverse events (mortality and re-attendances)

Two studies reported on the impact of SDT on mortality rate of patients visiting the ED (32,34). One RCT by Cheng et al. showed that senior doctor and nurse triage was associated with a non-significant reduction in mortality rate [0.16 to 0.06%, p=0.45](34). An observational study by Burstorm et al. showed that there was a statistically significant reduction in mortality (p<0.001)(32).

Patient re-attendance was measured in 3 non-RCTs (15,32,38). Burstorm et al. showed a significant improvement in unplanned re-attendance associated with senior-led team triage (P<0.001) (32).The other 2 studies followed up a sample of the patients presented in the intervention period only. First, Terris et al. documented no adverse events while Choi et al. reported one case with a minor complication (15,38).

6. Patient satisfaction

Patient satisfaction was reported in 6 studies (17,19,21,28,30,38) using different survey tools.
Three non-RCTs compared patient satisfaction in intervention and control periods (17,19,30). Two of these studies revealed no change in patient satisfaction (17,30). In contrast, a study by Imperato et al. showed a significant improvement in patient satisfaction with SDT (RR =0.16, 95% CI 0.04, 0.28)(19). Three studies evaluated patient satisfaction on intervention days only (21,28,38) and found it to be high.

7. Costs associated with senior doctor triage

Costs associated with SDT were not commonly reported. This outcome was examined in one American study over a one-year period (25). The study found an overall positive financial impact of having a START (Supplemented Triage And Rapid Treatment) team led by a senior doctor with nett present value of £ 16.6 million and 13 months period to break even from initial investment (25).

Table 3 **Summary of reported outcomes of included studies.**

Study design		BA																CCT		Cohort			RCT			
Primary and secondary outcome measures	Total	Choi 2006 (15)	Crane 2012 (30)	Grant 1999 (16)	French 2014 (17)	Han 2010 (18)	Imperato 2012 (20)	Imperato 2013 (19)	Patel 2005 (21)	Richardson 2004 (22)	Rogg 2013 (23)	Shetty 2012 (24)	Soremekun a 2012 (25)	Soremekun b 2012 (26)	Soremekun 2014 (27)	Travers 2006 (28)	White 2012 (29)	Partovi 2001 (39)	Terris 2004 (38)	Asha 2013 (31)	Baumann 2006 (33)	Burstrom 2012 (32)	Cheng 2013 (34)	Davis 2014 (37)	Holroyd 2007 (35)	Subash 2004 (36)
LOS, min	19	X		X	X	X	X				X	X	X	X	X		X	X		X	X	X	X	X	X	X
Waiting time, min	13	X	X	X		X	X		X					X		X				X	X	X	X			X
LWBS,%[1]	14			X		X	X		X	X		X	X	X	X			X		X	X		X		X	
LWTC,%	4										X						X					X			X	
Patient satisfaction	6		X		X			X	X							X			X							
Mortality,%	2																					X	X			
Re-attendance,%	3	X																	X			X				

BA, Before and after study; CCT, Clinical controlled trail; LOS, Length of stay; LWBS, Left without being seen; LWTC, Left without treatment complete; RCT, Randomised controlled trial

[1] In three American studies , LWBS is defined as proportion of patients who left without being seen as well as those who left without their treatment complete (18,20,33).

DISCUSSION

The majority of studies concluded that dedicating a senior doctor in triage reduced the WT for patients to see a doctor, decreased the LOS, and lowered the proportion of LWBS patients as well as the proportion of LWTC patients. Nevertheless, the impact of this model on patient satisfaction was not consistent across the studies. The cost-effectiveness of this triage model could not be established from the available evidence.

The review findings confirm those presented by Rowe et al. (7). However, Rowe evaluated physician liaison triage i.e. the physician -of any grade- assisted in triage and was not necessarily always present to perform early assessment in triage (9,10). In addition, they drew nearly half of their included evidence from abstract-only studies (7).

It is important to differentiate SDT from fast track or "see and treat" models. Fast tracking often targets patients with a specific illness such as chest pain for rapid life-saving intervention. Several studies included in the review have a separate fast track unit running in their ED.

This review demonstrates that SDT positively impacted the total LOS across the majority of the studies reporting this outcome. After performing subgroup analysis, a pooled result from two strong quality Canadian RCTs (34,35) revealed around half an hour reduction in LOS associated with senior doctor and nurse triage of medium acuity patients. A good quality BA study, that considered seasonal variation and a potential Hawthorne effect, showed a sustainable reduction in LOS over a three year-period after the introduction of a senior doctor-led team triage (23). Although a well-conducted RCT by Davis et al stated no significant difference in LOS with senior doctor triage, a subgroup of discharged patients revealed a significant reduction in LOS associated with Senior Work-up Assessment and Treatment (SWAT) model (37).This reduction in LOS may be explained by shorter WT as the senior doctor is involved early in the patient journey. Previous studies have shown that different factors can be responsible for variation in LOS including daily admissions, discharges and timing of presentations (40). The asymmetric funnel plot, however, suggests the possibility of publication bias. This is a cautionary finding to be considered in the interpretation of the results of this review.

A key finding of the review is that the use of SDT can result in shorter waiting times. Pooled results from two RCTs by Cheng et al. and Subash et al. showed that WT was reduced by around half an hour (34,36). Interestingly, WT was reduced by around 15 minutes across the majority of the non-RCTs reporting this outcome. Although the majority of the studies reporting this outcome examined potential sources of bias, the fact that most of these studies were retrospective, single centre studies should not be overlooked. Subgroup analysis was conducted in an attempt to group homogeneous studies together. However, this was only occasionally successful. Advantages related to significant time savings early in the ED process may translate into enhanced patient flow and reduction of the proportion of LWBS patients (41).

Another key observation is that the majority of the studies reported that fewer patients left the ED without being seen by a physician. Such an effect can be related to the presence of a senior doctor in triage. Reduced numbers of departures unseen by a doctor from the ED may represent a direct effect of immediate assessment and handling of patients more rapidly. To put this finding into perspective, one previous study showed a reduction in the proportion of patients who LWBS is an important factor of quality for both doctors and patients, resulting in better patient satisfaction and better adherence to treatment in the ED (42). However, these results must always be interpreted with caution because these small changes in LWBS rates can be a natural phenomenon in a BA study i.e. the risk of regression to the mean bias must be taken into account (43).

In terms of patient satisfaction, an important outcome measure in contemporary health care (44), only a few studies reported on this outcome. Reports on patient satisfaction following introduction of SDT showed contradictory findings across studies. While two recently published studies showed no change in patient satisfaction (17,30), recent evidence of weak quality suggests improved patient satisfaction under the SDT model (19).

Lastly, the majority of studies did not include a resource and cost analysis, or address the safety profile of SDT in terms of mortality or unplanned re-attendances. Studies often neglected to report these essential outcomes.

Strengths and limitations

This review has certain strong points. It employed a comprehensive approach to assess risk of bias in the included studies. This allowed the reviewer to detect any internal or external validity threats in individual studies. Furthermore, since few systematic reviews focus on innovations in ED operations (7,45), this review is of potential value to ED clinicians as well as policy makers as an up-to-date summary of the literature on SDT.

Limitations of this review must also be acknowledged. The main limitation is that the patient population and outcome definitions are not standardised across the studies. One could argue that an overall consistent effect across a majority of the studies, notwithstanding the heterogeneous nature of those studies, should allow more global conclusions to be drawn (46). Moreover, subgroup analysis was performed in an attempt to facilitate more meaningful comparisons.

Secondly, the majority of studies employed a retrospective, single-centre design with a lack of randomisation. Only four randomised trials could be found .This has implications for the internal validity and the applicability of any conclusions made. Finally, publication and language bias might account for some of the observed effect.

Implications for research

The logical next step for future research would be to confirm the review findings with more robust multi-centric studies to determine if SDT provides safe, sustainable and cost effective gains. Work is also required to develop an international ED outcome measurement tool and to use this tool as a basis for collaborative research and comparative evaluation. Lastly, qualitative research is needed to gain a better understanding of senior doctor views in regard to undertaking a possibly stressful and highly pressurised role of early initial assessment at triage.

CONCLUSION

In this review, SDT was associated with improvements in numerous ED metrics in most included studies (e.g. Cheng et al., Imperato et al. 2013 and Shetty et al). SDT may represent a valuable solution for ED managers and administrators in the battle of ED overcrowding. Unfortunately, the evidence is not sufficiently robust to support this transition. Future research should investigate and evaluate the benefits, costs and sustainability of senior initial assessment at triage through multi-centric cluster RCTs and qualitative research.

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Competing Interests None

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Figure legends

Figure 1 Impact of senior doctor triage on length of stay (min)

Figure 2 Funnel plots of mean effects of senior doctor triage on length of stay and waiting time to detect signs of publication bias. Each dot represents a study. The Y-axis represents the size of each study while the X-axis represents the result of each study. MD, Mean difference; SE, Standard error

Figure 3 Impact of senior doctor triage on waiting time (min)

Figure 4 Impact of senior doctor triage on the number of patients who left without being seen