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Review Article

Advanced triage protocols in the emergency department: A systematic review and meta-analysis*

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Highlights: (1) Advanced Triage Protocol reduces Emergency Department overcrowding. **(2)** The Advanced Triage Protocol is a safe and effective practice in the Emergency Department. **(3)** Triage nurses are qualified to use Advanced Triage Protocol. **(4)** Increased satisfaction was identified among users submitted to the intervention. **(5)** Advanced Triage Protocol reduces patient length of stay in the Emergency Department.

Objective: to evaluate the effectiveness of using advanced triage protocols on the length of stay, safety and satisfaction of the patients and professionals in the emergency department. **Method:** a systematic review with meta-analysis of randomized clinical trials included in the Embase, BVS, PubMed, CINAHL, Cochrane Library databases and in the gray literature, using Review Manager 5.4. Studies that analyzed length of stay in their outcomes were included and the studies excluded were those that considered other triage protocols. **Results:** 26,672 peer-reviewed studies were found and ten were included in the meta-analysis. For the patients' length of stay, seven studies were included in the meta-analysis (n=8,229), showing a 36-minute reduction (-0.36[-0.55;-0.17] p=0.002), a result with low certainty of evidence, favorable to the intervention, varying between -0.53 (-0.81;- 0.25) and -0.29 (-0.50;-0.07) in the analysis of the subgroups. Regarding the exams requested, five studies were included (n=2,270), indicating that there is no significant difference between the groups (*odds ratio* 0.94 [0.64;1.38]). Four studies (n=6,094) analyzed the patients' and the professionals' satisfaction, indicating a favorable result to the intervention. **Conclusion:** the advanced triage protocol reduced length of stay in the emergency room without compromising care safety and quality, although more randomized clinical studies on the theme are needed. Registered in PROSPERO (CRD42019142640).

Descriptors: Triage; Biomedical Technology Assessment; Emergency Medical Services; Advanced Practice Nursing; Evidence-Based Nursing; Systematic Review.

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Introduction

Overcrowding of Emergency Services (ES) occupies the headlines of media vehicles daily and has shown exponential growth since the 1990s in several countries[1-2]. Since then, managers and specialists have been looking for alternatives that solve or attenuate this problem[3–6].

Overcrowding of the ES is defined as an occupancy rate greater than 90% of their capacity, absence of beds, or patients allocated to inadequate spaces[3-4]. This situation reflects negatively on the quality, safety and efficiency of this service[5]. As it is a global health problem, overcrowding has been widely discussed, and alternatives have been developed and tested according to the local profile[3,5-8]. Although frequently related to the causes of ES overcrowding, with regard to the length of stay of the patient in the emergency services, there is no consensus that defines a safe permanence time, as well as there is no clarity of the criteria that define a prolonged length of stay. The parameters vary according to the locus and to the characteristics of the patients, which implies a broad variable of this measure, between 4 and 48 hours[9].

In the search to solve overcrowding, triage with risk classification (RC), which derives from a military practice, began to be used in the ES. Despite a promising start of this strategy, in 1990 in Europe and in the mid-2000s in other countries, it did not address ES overcrowding, which is why Advanced Triage Protocols (ATPs)[1,5,10] were proposed.

The ATPs consist of standardized approaches, applicable to specific groups of patients, where the triage professional initiates diagnostic or therapeutic actions before the patients are seen by a physician. This movement allows reducing the length of stay of patients in the emergency service from the restructuring of the work process[11]. We highlight better results in the use of ATPs in emergency services that devote greater investment to the qualification and training of the triage professionals, placing this factor as a determinant of the safety and quality of this intervention[12-13].

According to a study conducted in Belgium, it is a resource that allows improving management of the patients and reducing their length of stay in the ES[1]. Some studies also suggest positive impacts on cost reduction[14] and on care quality in the ES[13]. Therefore, the objective of this study is to evaluate the effectiveness of using ATPs on the patients' length of stay, as well as on the safety and satisfaction of patients and ES professionals.

Method

Type of study

This is a systematic review (SR) of the literature with meta-analysis. It was registered in the International Prospective Register of Ongoing Systematic Reviews (PROSPERO) under number CRD42019142640 on 10/17/2019[15], and was developed rigorously in the light of the guidelines recommended by the PRISMA statement[16].

Search strategy

The development method consisted of the search for clinical randomized trials (CRTs) on the Embase, BVS, PubMed, CINAHL and Cochrane Library research platforms, in addition to the manual search in the reference lists of studies selected and in the gray literature to answer the following research question: Which is the effectiveness of using ATPs on the length of stay of patients in the ES? From the PICOS strategy (P: Patients who seek ES; I: Use of ATPs; C: Conventional triage; O: Length of stay of patients in the ES; and S: CRTs), the following search terms (MeSH) were used: *Randomized Controlled Trial*, *Triage*, *Hospital Emergency Services* and *Emergency*, as well as these free terms: *advanced triage, triage protocol* and *length of stay*, which, associated with Boolean operators (OR and AND), structured the search strategy.

Search period

The study collection period was between December 2019 and March 2020.

Selection criteria

The studies included were those of the CRT type that addressed the use of an ATP in the ES, and which measured in their outcomes the length of stay of patients in the ES. Studies relevant to the theme, found in the reference lists or gray literature, were also included. There was no language restriction in the research or regarding the publication period. Studies addressing non-face-to-face triage, ATPs initiated in the pre-hospital environment or that did not describe the patient's length of stay among their outcomes were excluded. Studies where it was not possible to access complementary data after three attempts to contact the authors were also excluded. The articles considered irrelevant to this research were excluded in different selection phases, based on the criteria described.

Study selection

The studies found were reviewed by four examiners, from the reading of titles and abstracts by peers, independently. Studies selected by only a pair of reviewers were included in the next phase. At this stage, the EndNote online reference manager was used. The lists of the studies selected in this phase were compared and agreement of the analysis was verified through the Kappa test. The agreement strength was defined as slight (from 0.00 to 0.20), fair (from 0.21 to 0.40), moderate (from 0.41 to 0.60), substantial (from 0.61 to 0.80) or almost perfect (from 0.81 to 1.00)[17].

The second phase of the analysis consisted of the full reading of the articles by two researchers, independently. The aforementioned inclusion and exclusion criteria were considered, as well as the ethical aspects and the presence of clinically important results and objects for this review.

Data treatment and analysis

Data extraction from the studies selected was conducted independently by two researchers. The following variables of each study were considered: first author, year of publication, place where the study was conducted, demographic data of the sample, type of intervention, type of comparison, patient's length of stay and other outcomes. The results were summarized in a Microsoft Excel® spreadsheet.

The meta-analysis was developed through the features of the Review Manager 5.4[18] software. For the "length of stay" outcome, a continuous variable with random effect and calculation of the difference of the time mean values with a 95% confidence interval were considered, where Relative Risk (RR) below 1 means a favorable outcome to the intervention. For the "number of exams requested" outcome, the data were worked on under the proportion/risk difference, considered a dichotomous variable of random effect. Relative Risk (RR) was considered a measure of effect with 95% CI, where RR below 1 means that there is no difference between the groups. Conversions were performed to obtain means of the studies that presented their data in different format[19]. The outcome was considered statistically significant when p-value<0.05. If $I^2 \leq 25$, the studies were considered homogeneous, $I^2 > 25$ and $I^2 < 75$ classified the studies as having moderate heterogeneity and $I^2 \geq 75$, as with high heterogeneity. The subgroup analysis was developed when moderate or high heterogeneity was identified[20].

Quality assessment

The analysis of the risk of bias was developed independently by two researchers based on the Cochrane Collaboration (RoB-2) tool. The following domains for internal validation were evaluated: selection bias, performance bias, detection bias; attrition bias and reporting bias, related to the following potential sources of bias: randomization, allocation concealment, blinding of participants and personnel, incomplete data of results, obfuscation of the evaluation of results and report selection of results[21].

The GRADE system was used to evaluate the quality of the evidence and the strength of the health recommendations. This system provides explicit criteria to classify the quality of the evidence (classified into one of the following four levels: high, moderate, low and very low) that include study design, risk of bias, inaccuracy, inconsistency, indirect effect and magnitude of effect[22]. Two authors performed the analysis blindly and independently, through the GRADEpro platform[23].

Results

According to what is presented in Figure 1, the literature review revealed 26,672 articles on ATPs in the emergency service (26,664 in the databases and 8 articles identified in the reference lists and in the gray literature). After the first analysis, 240 duplicate articles were excluded. Of the 26,432 related papers, 21 were listed as potentially relevant, keeping the focus on the object of this research. Of these, 11 were excluded in the second phase and 10 were selected for the qualitative analysis. The reasons for exclusion in this stage were as follows: using a different CRT design[24-29], employing remote triage resources[30], presenting insufficient data for analysis[1,31] and consisting of ATPs for specific pathologies, applied at other times of hospitalization[32]. One study was excluded in this phase due to lack of data, without answer after three attempts to contact the authors[33]. Of the studies selected, nine were included in the meta-analysis. One study[34] was excluded from the meta-analysis due to data inaccuracy, although its data were analyzed qualitatively. The articles selected for the analysis were published between 1996 and 2018. The Kappa index was K=0.73, identifying substantial agreement[34].

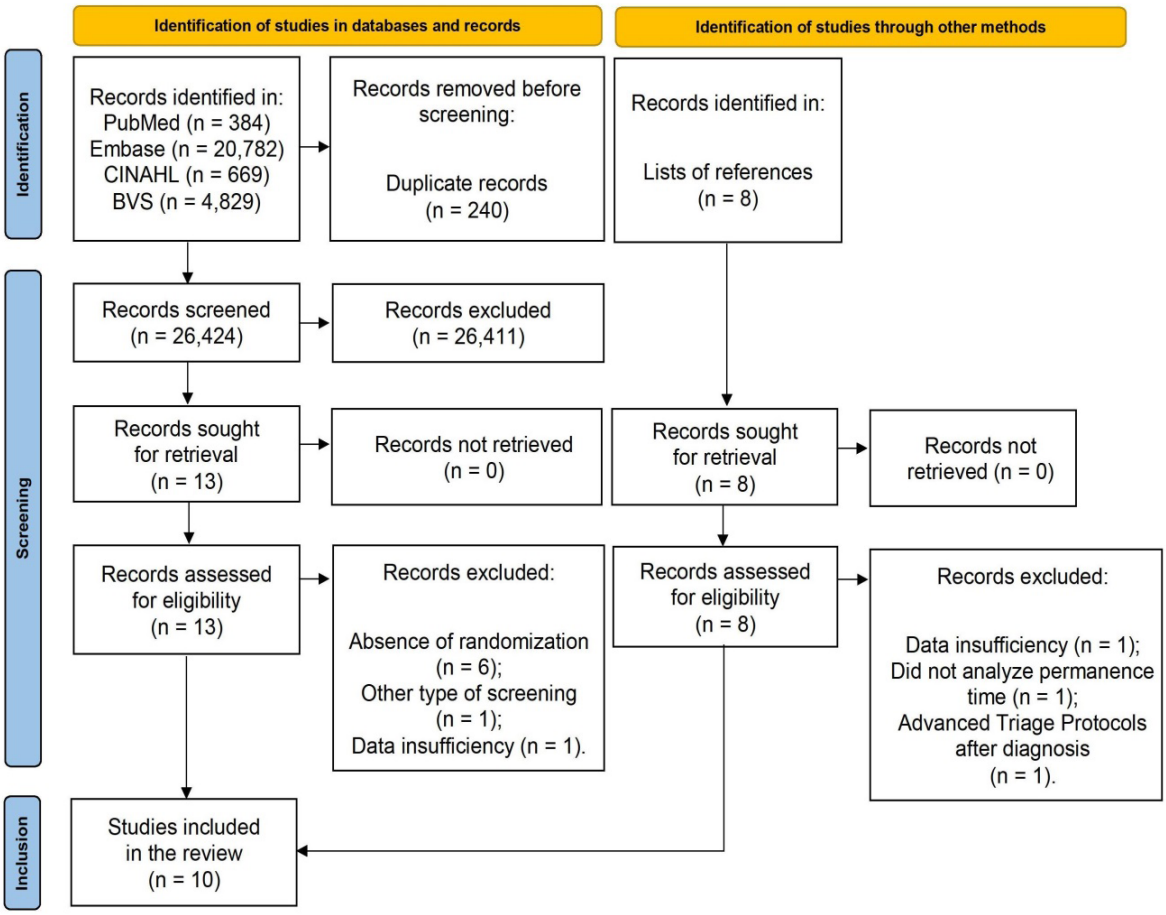


Figure 1 - Flowchart corresponding to selection of the studies in the PRISMA 2020 format, showing the stages for the selection of CRTs of this systematic review. Porto Alegre, RS, Brazil, 2020

Figure 2 shows the general characteristics of the studies listed. Four studies were conducted in Canada[33,35-37]. In addition, papers carried out in England[38-39], China[40-41], Ireland[42] and Denmark[43] were also included. Six studies[33,35-37,41-42] restricted their population to adults; the others included adults and children in their samples[38-40,43]. Eight papers described their duration, which varied from eight days to one year [33,35-38,41-43]. Three studies included physicians and nurses in the triage of their interventions[35-36,42]. Four papers compared their interventions to the Canadian Triage and Acuity Scale (CTAS)[33,35-37], another two made comparison with the Manchester Triage System[38-39], and four studies did not describe the protocol used, but reported the use of some sorting order in the care provided. Six studies analyzed ATPs with imaging exams; of these, three[35,37,40] used the Ottawa Ankle Rules (OAR)[44]. Another three studies evaluated more than one ATP, and one study assessed the use of bronchodilators in the triage[41]. Five papers described training of the triage nurses[37-38,40,43].

The studies totaled 25,795 subjects, in 13 ES. One of them was carried out in the multicentric modality in four ES[39]. In addition to the length of stay of the patients in the ES, other outcomes were identified, such as: number of exams requested, number of hospitalizations, waiting time to be seen by the physician, number of patients who leave the ES without being examined, time for triage, time for medication, patients' satisfaction and ambulance diversion time. All the studies herein listed recommended the use of ATPs in their conclusions, although only one of them found statistical relevance[35].

First author (year)	Country	Age group	No. of patients	ATP*	Control	Outcome	Clinical/ Statistical relevance	Certainty of the evidence by outcome (GRADE)
Cheng (2013)	Canada	Adults	17,034	With OAR†	CTAS‡	PT§ (+) Exams requested (+)	yes/yes	⊕⊕○○ ○⊕⊕○
Fan (2006)	Canada	Adults	124	With OAR†	CTAS‡	PT§ (+) Exams requested (+) Satisfaction (=)	yes/no	⊕○○○ ○⊕⊕○ ⊕⊕○○
Ho (2012)	China	Adults	110	Without OAR†	Conventional triage	PT§ (+)	yes/no	⊕⊕○○
Ho (2018)	China	Adults and children	112	With OAR†	Conventional triage	PT§ (+) Exams requested (+)	yes/no	⊕○○○ ○⊕⊕○
Holroyd (2007)	Canada	Adults	5,718	Without OAR†	CTAS‡	PT§ (+) Satisfaction (+)	yes/no	⊕⊕○○ ⊕⊕○○
Lee (2016)	Canada	Adults	146	With OAR†	CTAS‡	PT§ (+) Satisfaction (+)	yes/no	⊕○○○ ⊕⊕○○
Lindley-Jones (2000)	England	Adults and children	612	With OAR†	MTS‖	PT§ (+) Exams requested (+)	yes/no	⊕○○○ ○⊕⊕○
Pedersen (2009)	Denmark	Adults and children	106	With OAR†	Conventional triage	PT§ (+) Exams requested(-) Satisfaction (+)	yes/no	⊕○○○ ○⊕⊕○ ⊕⊕○○
Subash (2004)	Ireland	Adults	1,028	Without OAR†	Conventional triage	PT§ (+)	yes/no	⊕⊕○○
Thurston (1996)	England	Adults and children	1,833	With OAR†	MTS‖	PT§ (+) Exams requested(+)	yes/no	⊕○○○ ⊕⊕○○

*ATP = Advanced Triage Protocol; †OAR = Ottawa Ankle Rules; ‡CTAS = Canadian Triage and Acuity Scale; §PT = Permanence Time of the patient in the emergency service; ‖MTS = Manchester Triage System; +○○○ = Very low certainty of evidence; ○○++ = Low certainty of evidence; ○++○ = Moderate certainty of evidence; (+) = Favorable outcome for the intervention; (-) = Favorable result for the control; (=) = There was no difference

Figure 2 - Characteristics of the studies included, considering study locus, participants, type of intervention, outcomes, study relevance and certainty of evidence. Porto Alegre, RS, Brazil, 2020

Figure 3 presents the summary of the risk of bias analysis according to the Cochrane System (RoB2). Methodological quality was considered good among the studies included. Most of the studies have adequate randomization and allocation concealment. There was no reduction in quality, although no blinding of the participants was observed. In some studies, it was also identified that the evaluators were not blinded[33,35-37,39-40,42-43]. Other risks of bias were reported by the authors[38] or are not clear. Due to the identification of only ten studies in this systematic review, despite the extensive search for studies, the risk of publication bias is considered, which was confirmed by the analysis of the funnel graph.

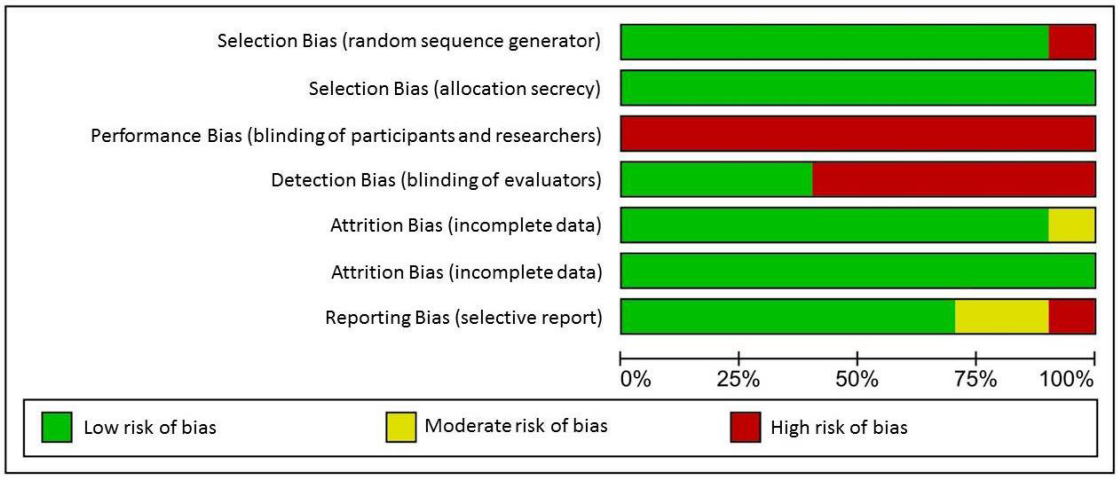
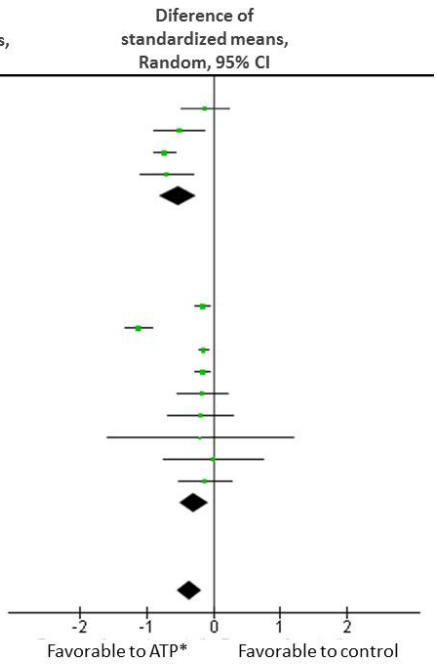


Figure 3 - Summary of the risk of bias analysis, developed with the *Review Manager* 5.4 software. Porto Alegre, RS, Brazil, 2020

Figure 4 presents the forest graph and meta-analysis of the main outcome of this systematic review, and the length of stay of the patients in the ES. A 36-minute reduction was identified (-0.36[-0.55;-0.17]), p=0.002, with the use of ATPs.

Given the high heterogeneity shown (I^2=90%), subgroup analysis was performed, considering studies or strata of studies without imaging exams (without OAR): 9 studies/study strata, n=7,293, I^2=90%; and with imaging exams (with OAR): 4 studies/study strata, n=948, I^2=70%. Thus, the ATP shows a 29-minute reduction (-0.29[-0.50;-0.07]), with high heterogeneity (I^2=90%), statistical relevance (p=0.009) and very low certainty of evidence, in the subgroup without OAR. In the subgroup with OAR, a 53-minute reduction (-0.53[-0.81;-0.25] p=0.002) is identified in the length of stay of the patients in the ES, with moderate heterogeneity (I^2=70%) and low certainty of evidence. The means and standard deviation of length of stay were calculated from the conversion of the medians[19], since most of the studies presented their data only in this format.

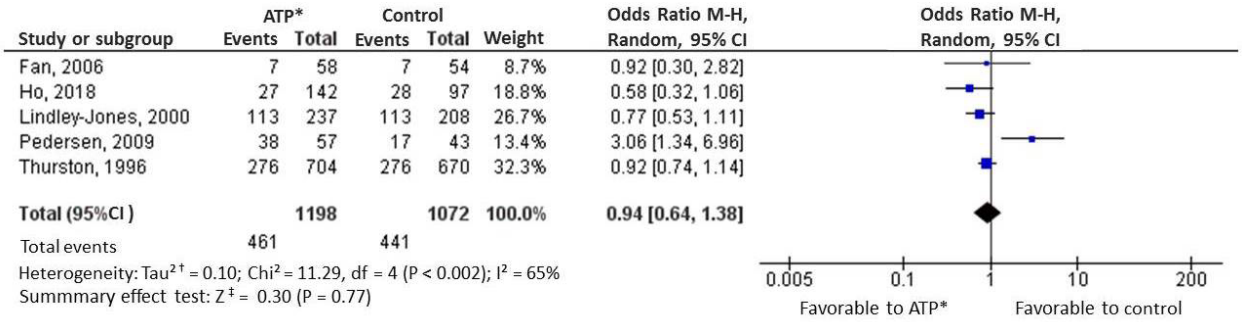
Study or subgroup	ATP* Mean	ATP* SD	ATP* Total	Control Mean	Control SD	Control Total	Weight	Diference of standardized means, Random, 95% CI
With OAR †								
Fan, 2006	65	32.5	62	70	48.1	62	7.8%	-0.12 [-0.47, 0.23]
Ho, 2018	74.3	26.7	56	87.3	24	56	7.5%	-0.51 [-0.89, -0.13]
Lindley-Jones, 2000	65.5	44.4	309	102.7	56.5	303	9.9%	-0.73 [-0.90, -0.57]
Pedersen, 2009	32	28.5	55	56	40	45	7.2%	-0.70 [-1.10, -0.29]
Subtotal (95% CI)			**482**			**466**	**32.5%**	**-0.53 [-0.81, -0.25]**
Heterogeneity: Tau²‡ = 0.06; Chi² = 9.98, df = 3 (P = 0.02); I² = 70%								
Summary effect test: Z§ = 3.67 (P = 0.0002)								
Without OAR †								
Cheng, 2013a	115	82.4344	623	126	46.7639	614	10.4%	-0.16 [-0.28, -0.05]
Cheng, 2013b	70	63.5526	126	126	46.7639	614	9.6%	-1.12 [-1.32, -0.92]
Cheng, 2013c	245	129.9002	1547	269	184.8506	1535	10.6%	-0.15 [-0.22, -0.08]
Cheng, 2013d	241	165.3327	379	269	184.8506	1535	10.4%	-0.15 [-0.27, -0.04]
Ho, 2012	139.7	44	55	146.6	39.7	55	7.6%	-0.16 [-0.54, 0.21]
Holroyd, 2007a	170	155.5556	31	203	174.0741	31	6.1%	-0.20 [-0.70, 0.30]
Holroyd, 2007b	105	90.3704	4	130	128.889	4	1.6%	-0.20 [-1.59, 1.20]
Holroyd, 2007c	483	539.2593	13	485	587.4074	14	4.0%	-0.00 [-0.76, 0.75]
Holroyd, 2007d	327	303.7037	51	366	324.4444	50	7.4%	-0.12 [-0.51, 0.27]
Subtotal (95% CI)			**2829**			**4452**	**67.5%**	**-0.29 [-0.50, -0.07]**
Heterogeneity: Tau²‡ = 0.07; Chi² = 84.14, df = 8 (P < 0.00001); I² = 90%								
Summary effect test: Z § = 2.63 (P = 0.009)								
Total (95% CI)			**3311**			**4918**	**100.0%**	**-0.36 [-0.55, -0.17]**
Heterogeneity: Tau²‡ = 0.09; Chi² = 126.15, df = 12 (P < 0.00001); I² = 90%								
Summary effect test: Z § = 3.77 (P = 0.002)								
Subgroup difference test: Chi² = 1.78, df = 1 (P = 0 0.18). I² = 43.9%								



*ATP = Advanced Triage Protocol; †OAR = Ottawa Ankle Rules; ‡Tau² = Tau correlation coefficient; §Z = Z effect test

Figure 4 - Forest graph showing the length of stay of the patients in the emergency service (in minutes). Porto Alegre, RS, Brazil, 2020

Among the studies analyzed, five[35,38-39,41,43] analyzed in their outcomes the number of exam requests with and without the use of ATPs. It was decided to include these data in the meta-analysis, presented in Figure 5. In a sample that comprised 2,270 requested exams, no difference between the groups is identified, obtaining a result of 0.94 OR (0.64; 1.38), p=0.7, with moderate heterogeneity (I^2=65%) and moderate certainty of evidence.



*ATP = Advanced Triage Protocol; †Tau² = Tau correlation coefficient; ‡Z = Z effect test

Figure 5 - Forest graph showing the number of exams requested and fractures identified, comparing exams requested in the triage (ATP) and in the medical consultation (control). Porto Alegre, RS, Brazil, 2020

Another outcome found in the analysis of the studies was the satisfaction of professionals and of patients subjected to the ATP in the ES, which was included in this study due to its relevance. As it was presented by the authors in different ways, it was decided to qualitatively analyze this outcome, based on the data presented in Figure 2.

A study included in this analysis[37] evaluated the professionals' satisfaction with the use of the ATP through focus groups held after the intervention and reported that 80% of the physicians and 90% of the nurses assessed the ATP as beneficial for the patients and that more than 70% of the professionals stated that the intervention promoted agility in the care provided.

Other studies[33,43] identified increased satisfaction. One of the studies[43] performed this analysis separately based on questionnaires applied to the patients after the service, about their satisfaction and their desire to have access to the ATP in a new visit to the ES. The authors report that 89.2% of the patients who did not have access to the ATP by the ES would like to have been subjected to interventions initiated in the triage and 97.6% of the intervention group expressed the same desire. Another study[33] evaluated this outcome through objective questionnaires, with answers on a numerical scale, applied by telephone to patients and professionals. With regard to the patients, satisfaction with the length of the appointment was better assessed in the group subjected to the ATP, with no difference between the groups in other aspects. Regarding the nurses' satisfaction, the authors report that they feel comfortable using the ATP, believing that this intervention reduces the patients' length of stay, although they expressed concern about the increase in workload in the triage.

Only one study[35] found no difference between the groups in the patients' satisfaction after the care provided. This outcome was analyzed using the Sun satisfaction scale, comprised of five levels, which analyzed users' satisfaction based on their desire to return to the service and found no difference in the patients' satisfaction after the appointment with ATP.

Discussion

From the meta-analysis, this study found a 36-minute reduction (-0.36[-0.55;-0.07] p=0.002) in the length of stay of patients in the ES using the ATP. It was evidenced that there was no difference in the number of tests requested and in the patients' and professionals' satisfaction rates.

Length of Stay

As for the patients' length of stay, this study identified, with low certainty of evidence with high heterogeneity, findings that are similar to those found in other meta-analyses[12,45]. Heterogeneity is justified by two main factors: the difference between the types of ATP analyzed in each study and the difference between the samples. It was reduced by means of the analysis of the subgroups, categorized according to the type of ATP, in: with OAR (I^2=70%) and without OAR (I^2=90%). The possibility that substantial heterogeneity overestimates the study result is minimized by the fact that, it was in the more homogeneous subgroup (with OAR) that the highest reduction in length of stay was identified.

In the subgroup without OAR, three studies were included[36-37,41], two of them subdivided into three strata, according to risk classification at the time of triage. Two studies[36-37] analyzed an ATP that associated a physician's face-to-face or telephone consultation to decide on the triage orders. One study[41] analyzed an ATP consisting of initiation of the therapy with bronchodilators in the triage for patients with decompensated asthma. In this latter, the main finding reported was a clinical improvement in the patient when seen by the physician. When evaluating only ATPs that include therapeutic interventions, greater relevance is observed in care quality than in length of stay[12].

In the subgroup with OAR, a 53-minute reduction in the length of stay of patients in the ES was identified (-0.53[-0.81;-0.25] p=0.0002). This intervention, as well as others, which also use diagnostic tests in the ATP, present greater potential to influence length of stay. According to some authors' findings, these protocols use an existing time (period in which the patient waits to be seen by the physician) for an additional purpose[38]. Thus, at the time of the first medical appointment, the patient already has the test results, necessary for the diagnostic decision, reducing the period of time in which the patient remains in the ES. Since high permanence time is one of the factors that influence overcrowding, the potential of the ATP in reducing overcrowding in the ES stands out[45]. A relationship between long length of stay and increased patient mortality was also identified[9,46].

Some studies also report that greater time reductions can be obtained when the mean length of stay of patients in the ES is high[40,47]. It was not possible to verify this data in this study because the mean ES time was only described in one study[36].

Only two studies found statistical relevance in this outcome[36,38]. However, all the studies considered the time reductions found as clinically relevant, described as between 6.7 minutes[35] and 56 minutes[36].

Agreement between the diagnostic interventions initiated in the triage was reported in five studies, whether requested by nurses or by physicians. The relevance of this outcome was described in some studies, where the authors state that nurses are qualified to initiate diagnostic or therapeutic approaches in the triage[1,48-49].

Even though they were not included in the search strategy of this SR, the outcomes related to the number of exams requested and the professionals' and users' satisfaction were analyzed, considering their representativeness and relevance for using advanced triage protocols in the ES.

Exam Requests

In this outcome, the comparative data between the number of exams requested and their positive findings were considered. This was the main result described by one of the authors, who stated that the triage orders do not compromise care safety in the ES[23]. This meta-analysis found no relevant difference in the number of tests requested between the intervention and control groups (OR 0.94[0.64.1.38]), described with moderate certainty of evidence, as it supports the hypothesis that triage professionals are competent to initiate diagnostic processes[12].

Some service administrators fear the economic impact that this intervention may cause, as there can be an increase in the number of exams requested[32]. Such assertion was contradicted by subsequent studies, which stated that the reduction in the length of stay of the patients in the ES and, consequently, in the costs of this length of stay with medications and care, would offset a possible increase in the exams requested[1,12,50-51], a situation that, as described, was not verified in this study.

From a multicentric study, it was concluded that a longer training period of the ES triage professionals in using the ATP was associated with a lower number of exams requested[39]. Other studies described similar findings, associating better performance and safety of the triage professionals with better training programs[12,48,50]. Advanced practice Nursing stands out, where nurses who work in ES triage have technical competence and autonomy for decision-making[52].

Patients' and professionals' satisfaction

Analyzing the patients' and the professionals' satisfaction is a quality indicator for a health service[9,52]. Positive results related to this topic using the ATP were identified in a Canadian study by describing 94% satisfaction among the patients with the use of the ATP[52] and in an SR conducted in 2017[12]. Of the four CRTs that presented such outcome in this systematic review, three pointed to increased satisfaction using the ATP, and one of them identified no difference between the groups.

The satisfaction of the patients and professionals who seek the ES characterizes an important quality indicator, which is significantly impaired when the ES is overcrowded or has long permanence times[9], in addition to the association of this data with a worse prognosis[46]. Thus, although brief, the reduced time periods contributed to the satisfaction of patients and professionals of the ES, findings that supported the clinical relevance of the result[35-36,39].

Quality of the studies

From the risk of bias analysis, the quality of the studies was generally considered as satisfactory in the studies included. The main risk of bias identified was related to masking. None of the studies included in this review masked the participants. This is due to the type of intervention, which makes blinding both of patients and of triage professionals unfeasible. This risk of bias has already been reported in other studies[12]; however, as they are protocols, this does not harm the study result. Also within the scope of the masking bias, some studies did not perform masking of the evaluators. This masking would improve the quality of the studies[21]. In addition to that, the way in which one of the studies presented the data led the authors to consider an attrition bias[33]. Two studies[37,42] do not describe the concern with other possible biases and one study[39] refers to certain bias in the training of the triage professionals that influenced the results found, considered a high risk for other biases. In one of the studies[42], randomization was performed inappropriately, throughout the days of the week, a factor that justifies its exclusion; the other studies used computerized algorithms for randomization.

As for the certainty of the evidence, the outcome of the length of stay of the patients in the ES presented very low certainty of evidence. The authors believe that this is due to the low number of CRTs included, to the use of different ATPs in each study, and to the lack of standardization in data presentation, requiring their conversion. This difficulty was reported in other SRs[12,45]. Due to greater clarity in data presentation, even if extracted from the same studies, moderate certainty of the evidence stands out for the outcome of exams requested.

Since only 10 CRTs were selected, the existence of some publication bias was considered, evidenced by the analysis of the funnel graph. The lack of standardization in the format of the data presented was also a limitation of this study, requiring conversion of medians to means in some studies, as well as the definition of confidence intervals, implying possible result bias.

Conclusion

Using the advanced triage protocol in emergency services made it possible to attain a 36-minute mean reduction in the length of stay of patients in this locus, with greater repercussion in services with prolonged permanence times. The triage professionals are competent to initiate diagnostic procedures in triage in a safe manner, as long as they are trained to do so, and these measures reflect an increase in the patients' satisfaction.

This study evidenced a guiding element for a change in behavior that contributes, through the optimization of care processes, to a cost-effective and safe reduction in the patients' length of stay and overcrowding in the ES.

However, the need to conduct good quality CRTs on the theme is highlighted, especially in ES with high permanence times, in order to obtain papers that are more methodologically adequate, as well as the need to develop more cost-effectiveness studies to determine the economic impact of using the advanced triage protocol.

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References

1. Jobé J, Ghuysen A, D'Orio V. Advanced nurse triage for emergency department. Rev Med Liege [Internet]. 2018 [cited 2021 Jan 28];73(5-6):229-36. Available from: http://hdl.handle.net/2268/242969

2. Ministério da Saúde (BR), Grupo Hospitalar Conceição. Inovação Tecnológica no Enfrentamento da Superlotação Hospitalar: a experiência do Hospital Nossa Senhora da Conceição - Porto Alegre/RS. Porto Alegre: Hospital Nossa Senhora da Conceição; 2018.

3. Hoot NR, Aronsky D. Systematic Review of Emergency Department Crowding: Causes, Effects, and Solutions. Ann Emerg Med. 2008;52(2). doi: http://doi.org/10.1016/j.annemergmed.2008.03.01

4. O'Dwyer GO, Oliveira SP, Seta MH. Evaluation of emergency services of the hospitals from the QualiSUS program. Ciênc Saude Coletiva. 2009;14(5):1881-90. doi: http://doi.org/10.1590/S1413-81232009000500030

5. Bittencourt RJ, Hortale VA. Interventions to solve overcrowding in hospital emergency services: a systematic review. Cad Saude Publica. 2009;25(7):143954. doi: http://doi. org/10.1590/S0102-311X2009000700002

6. Silva BMRV. Lean healthcare no serviço de urgência geral do Hospital Pêro da Covilhã [dissertation] [Internet]. Portugal: Universidade da Beira Interior; 2012 [cited 2021 Jan 28]. Available from: http://search.ebscohost.com/login.aspx?direct=true&site=eds-live&db=edsrca&AN=rcaap.portugal.10400.6.1183

7. Vose C, Reichard C, Pool S, Snyder M, Burmeister D. Using LEAN to improve a segment of emergency department flow. J Nurs Adm. 2014;44(11):558-63. doi: http://doi.org/10.1097/NNA.0000000000000098

8. Tsai MT, Yen YL, Su CM, Hung CW, Kung CT, Wu KH, et al. The influence of emergency department crowding on the efficiency of care for acute stroke patients. Int J Qual Health Care. 2016;28(6):774-8. doi: http://doi.org/10.1093/intqhc/mzw109

9. Andersson J, Nordgren L, Cheng I, Nilsson U, Kurland L. Long emergency department length of stay: A concept analysis. Int Emerg Nurs. 2020;53(2020):100930. doi: https://doi.org/10.1016/j.ienj.2020.100930

10. Mackway-Jones K, Marsden J, Windle J. Sistema Manchester de Classificação de Risco. 2nd ed. Belo Horizonte: Folium; 2017.

11. Douma MJ, Drake CA, O'Dochartaigh D, Smith KE. A Pragmatic Randomized Evaluation of a Nurse-Initiated Protocol to Improve Timeliness of Care in an Urban Emergency Department. Ann Emerg Med. 2016;68(5):1-7. doi: http://dx.doi.org/10.1016/j.annemergmed.2016.06.019

12. Cabilan CJ, Boyde M. A systematic review of the impact of nurse-initiated medications in the emergency department. Australas Emerg Nurs J. 2017;20(2):53-62. doi: http://dx.doi.org/10.1016/j.aenj.2017.04.001

13. Delnavaz S, Hassankhani H, Roshangar F, Dadashzadeh A. Comparison of scenario based triage education by lecture and role playing on knowledge and practice of nursing students. Nurse Educ Today. 2018;70(1):54-9. doi: http://dx.doi.org/10.1016/j.nedt.2018.08.006

14. Cheng I, Castren M, Kiss A, Zwarenstein M, Brommels M, Mittmann N. Cost- effectiveness of a physician-nurse supplementary triage assessment team at an academic tertiary care emergency department. Can J Emerg Med. 2016;18(3):191-204. doi: https://doi.org/10.1017/cem.2015.88

15. Soster CB, Anschau F, Rodrigues NH, Silva LGA, Klafke A. The assistance impact of the advanced triage protocol in the emergency department: systematic review and meta-analysis [Internet]. 2019 [cited 2021 Apr 12]. Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42019142640

16. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi: https://doi.org/10.1136/bmj.n71

17. McHugh ML. Lessons in biostatistics interrater reliability: the kappa statistic. Biochem Medica [Internet]. 2012 [cited 2021 Apr 12];22(3):276-82. Available from: https://hrcak.srce.hr/89395

18. Cochrane Training. Cochrane RevMan [Homepage]. London: The Cochrane Collaboration; 2020 [cited 2021 Apr 12]. Available from: https://training.cochrane.org/online-learning/core-software-cochrane-reviews/revman

19. McGill R, Tukey JW, Larsen WA. Variations of box plots. Am Stat. 1978;32(1):12-6. doi: http://dx.doi.org/10.1080/00031305.1978.10479236

20. Pereira MG, Galvão TF. Heterogeneity and publication bias in systematic reviews. Epidemiol Serv Saúde. 2014;23(4):775-8. doi: http://doi.org/10.5123/S1679-4974201400040002

21. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Emberson JR, et al. RoB 2: A revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:1-8. doi: https://doi.org/10.1136/bmj.l4898

22. Guyatt G, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, et al. GRADE guidelines: 1. Introduction - GRADE evidence profiles and summary of findings tables. J Clin Epidemiol. 2011;64:383-94. doi: http://doi.org/10.1016/j.jclinepi.2010.04.026

23. Evidence Prime, Inc. GRADEpro GTD [Homepage]. Hamilton: Evidence Prime; 2020 [cited 2021 Apr 12]. Available from: https://gradepro.org/

24. Parris W, McCarthy S, Kelly A, Richardson S. Do triage nurse-initiated X-rays for limb injuries reduce patient transit time? Accid Emerg Nurs. 1997 Jan;5(1):14-5. doi: http://doi.org/10.1016/s0965-2302(97)90056-4

25. Jesionowski M, Riordan J, Quatrara B. Does a Provider in Triage and Rapid Medical Evaluation Help With Left Without Being Seen Rates and ED Crowding? 2019 Jan;45(1):38-45. doi: http://doi.org/10.1016/j.jen.2018.09.001

26. Seguin D. A nurse-initiated pain management advanced triage protocol for ED patients with an extremity injury at a level I trauma center. J Emerg Nurs. 2004 Aug;30(4):330-5. doi: http://doi.org/10.1016/j.jen.2004.06.010

27. Singer AJ, Taylor M, LeBlanc D, Meyers K, Perez K, Thode HC Jr, et al. Early Point-of-Care Testing at Triage Reduces Care Time in Stable Adult Emergency Department Patients. J Emerg Med. 2018 Aug;55(2):172-8. doi: https://doi.org/10.1016/j.jemermed.2018.04.061

28. Simon LV, Matteucci MJ, Tanen DA, Roos JA, Riffenburgh RH. The Pittsburgh Decision Rule: Triage nurse versus physician utilization in the emergency department. J Emerg Med. 2006 Oct;31(3):247-50. doi: https://doi.org/10.1016/j.jemermed.2005.12.020

29. Tsai KC, Lin RF, Lee C, Li AH. An alternative tool for triaging patients with possible acute coronary symptoms before admission to a chest pain unit. Am J Emerg Med. 2018 Jul;36(7):1222-30. doi: https://doi.org/10.1016/j.ajem.2017.12.026

30. Marconi GP, Chang T, Pham PK, Grajower DN, Nager AL. Traditional nurse triage vs physician telepresence in a pediatric ED. Am J Emerg Med. 2014 Apr;32(4):325-9. doi: http://dx.doi.org/10.1016/j.ajem.2013.12.032

31. Klassen TP, Ropp LJ, Sutcliffe T, Blouin R, Dulberg C, Raman S, et al. A randomized, controlled trial of radiograph ordering for extremity trauma in a pediatric emergency

department. Ann Emerg Med. 1993 Oct;22(10):1524-9. doi: http://doi.org/10.1016/s0196-0644(05)81252-1
32. Roberts RR, Zalenski RJ, Mensah EK, Rydman RJ, Ciavarella G, Gussow L, et al. Costs of an emergency department - Based accelerated diagnostic protocol vs hospitalization in patients with chest pain: A randomized controlled trial. JAMA. 1997 Nov;278(20):1670-6. doi: http://doi.org/10.1001/jama.1997.03550200046030
33. Lee KM, Wong TW, Chan R, Lau CC, Fu YK, Fung KH. Accuracy and efficiency of X-ray requests initiated by triage nurses in an Accident and Emergency department. Accid Emerg Nurs. 2016 Oct;4(4):179-81. doi: http://doi.org/10.1016/s0965-2302(96)90076-4
34. Kraemer HC, Periyakoil VS, Noda A. Kappa coefficients in medical research. Stat Med. 2002 Jul:2109-29. doi: http://doi.org/10.1002/sim.1180
35. Fan J, Woolfrey K. The Effect of Triage-applied Ottawa Ankle Rules on the Length of Stay in a Canadian Urgent Care Department: A randomized controlled trial. Acad Emerg Med. 2006 Feb;13(2):1537. doi: http://doi.org/10.1197/j.aem.2005.07.041
36. Cheng I, Lee J, Mittmann N, Tyberg J, Ramagnano S, Kiss A, et al. 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. BMC Emerg Med. 2013 Nov;13(1):17. doi: https://doi.org/10.1186/1471-227X-13-17
37. Holroyd BR, Bullard MJ, Latoszek K, Gordon D, Allen S, Tam S, et al. Impact of a Triage Liaison Physician on Emergency Department Overcrowding and Throughput: A Randomized Controlled Trial. Acad Emerg Med. 2007 Aug;14(8):702-8. doi: http://doi.org/10.1197/j.aem.2007.04.018
38. Lindley-Jones M, Finlayson BJ. Triage nurse requested x rays - are they worthwhile? J Accid Emerg Med. 2000 Mar;17(2):103-7. doi: http://doi.org/10.1136/emj.17.2.103
39. Thurston J, Field S. Should accident and emergency nurses request radiographs? Results of a multicentre evaluation. J Accid Emerg Med. 1996 Mar;13:86-9. doi: http://doi.org/10.1136/emj.13.2.86
40. Ho JKM, Chau JPC, Chan JTS, Yau CHY. Nurse-initiated radiographic-test protocol for ankle injuries: A randomized controlled trial. Int Emerg Nurs. 2018 Nov 41:1-6. doi: 10.1016/j.ienj.2018.04.001.
41. Ho JK, Yau WH. Nurse-initiated albuterol metered-dose inhaler for acute exacerbations of chronic obstructive pulmonary disease in an emergency department: a randomised controlled trial. Hong Kong J Emerg Med. 2012;19(3):162-70. doi: http://doi.org/10.1177/102490791201900302
42. Subash F, Dunn F, McNicholl B, Marlow J. Team triage improves emergency department efficiency. Emerg Med J. 2004 Sep;21(5):542-4. doi: https://doi.org/10.1136/emj.2002.003665
43. Pedersen GB, Storm JO. Emergency department X-rays requested by physicians or nurses. Ugeskrift for Laeger [Internet]. 2009 Jun [cited 2021 Mar 15];171(33):1747-51. Available from: https://www.researchgate.net/publication/24438918
44. Morais B, Branquinho A, Barreira M, Corrreia J, Marino M, Marques N. Validation of the Ottawa ankle rules: Strategies for increasing specificity. Injury. 2021 Jan;52(4):1017-22. doi: http://doi.org/10.1016/j.injury.2021.01.006
45. Lindner G, Woiktok BK. Emergency department overcrowding: Analysis and strategies to manage an international phenomenon. Wien Klin Wochenschr. 2021 Mar;133(5-6):229-33. doi: https://doi.org/10.1007/s00508-019-01596-7
46. Rocha HMN, Farre AGMC, Santana VJ Filho. Adverse Events in Emergency Department Boarding: A systematic review. J Nurs Scolarsh. 2021;53(4):458-67. doi: http://doi.org/10.1111/jnu.12653
47. Rowe BH, Villa-Roel C, Guo X, Bullard MJ, Ospina M, Vandermeer B, et al. The role of triage nurse ordering on mitigating overcrowding in emergency departments: a systematic review. Acad Emerg Med. 2011 Dec;18(12):1349-57. doi: https://doi.org/10.1111/j.1553-2712.2011.01081.x
48. Ghanes K, Jouini O, Wargon M, Jemai Z. Modeling and analysis of triage nurse ordering in emergency departments. In: Conference on Industrial Engineering and Systems Management (IESM 2015) [Internet]; 2015 Oct 21-23; Seville, Spain. Red Hook, NY: Curran Associates: 2016 [cited 2021 Mar 15]. Available from: https://hal.archives-ouvertes.fr/hal-01265284/document
49. Fry M. Triage nurses order x-rays for patients with isolated distal limb injuries: A 12-month ED study. J Emerg Nurs. 2001 Feb;27(1):17-22. doi: http://doi.org/10.1067/men.2001.112979
50. Stang AS, Crotts J, Johnson DW, Hartling L, Guttmann A. Crowding measures associated with the quality of emergency department care: a systematic review. Acad Emerg Med. 2015 May;22(6):643-56. doi: https://doi.org/10.1111/acem.12682
51. Miranda MV Neto, Rewa T, Leonello VM, Oliveira MAC. Advanced practice nursing: a possibility for primary health care? Rev Bras Enferm. 2018;71(1):716-21. doi: https://doi.org/10.1590/0034-7167-2017-0672
52. James MR, Pyrgos N. Nurse practitioners in accident and emergency departments. Arch Emerg Med. 1989;6(4):241-6. doi: http://doi.org/10.1136/emj.6.4.241

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