


# Emergency department crowding: An assessment of the potential impact of the *See-and-Treat* protocol for patient flow management at an Italian hospital

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## ABSTRACT

**Background:** Crowding and patient flow management are among the most relevant issues for emergency departments (EDs). This results in delayed treatment, adverse outcomes and increased costs. For these reasons, nurse-independent treatment protocols were developed aimed at managing non-emergency patients outside EDs thus improving patient flow. Our objective was to assess the potential impact of the implementation of the “*See-and-Treat*” protocol on eligible patients and related healthcare costs at an Italian ED.

**Methods:** We selected all minor access codes from 2022 at the ED of Sassuolo Hospital in Northern Italy. We only included subjects discharged to home, while we excluded those who required specialized medical care or had received “Fast-Track” treatment. We identify a list of medical conditions to identify subjects eligible for inclusion in the *See-and-Treat* protocol and calculate the related healthcare costs.

**Results:** Of 40,906 individual ED admissions, 2,607 (6.4%) qualified for *See-and-Treat* management. Limb injuries and pain were the leading conditions at presentation. Through cost analysis, we found that implementation of the *See-and-Treat* protocol may result in savings over €100,000/year at Sassuolo Hospital, and over €7 million if projected to the entire Emilia-Romagna Region.

**Conclusions:** Despite some limitations affecting protocol implementation, especially availability of highly-specialized and specifically-trained nurses, the study provided a foundation for a more comprehensive understanding of the implementation of the *See-and-Treat* protocol as a possible valid model with a view to both human and economic healthcare resources.

## 1. Introduction

Emergency Departments (EDs) are a crucial component of the hospital system, serving as a primary entry point for patients seeking medical treatment [1]. According to Affleck et al. [2], three primary indicators can measure ED performance: i) *Physician Visit Waiting Time*, which is the time between the allocation of severity codes (see Table 1)

to patients and physician assessment; ii) *Boarding Time*, which is the time between the decision to admit patients and their arrival at designated wards, dependent on bed availability; iii) *Length of Stay*, which is the time from patient admission to the ED to the closure of records (with discharge, admission or transfer). Emilia-Romagna assesses ED performance through various indicators [3]: i) *Performance indicators* that assess stays in percentage rates: those lasting less than 6 h in ED, those in

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**Table 1**  
New color code system for hospital triage implemented since October 2021 in Italy.

Color of codes	Meaning of codes	Maximum waiting time
Red	Emergency	Instant access
Orange	Urgency	15 min
Light blue	Deferrable urgency	60 min
Green	Minor urgency	120 min
White	Non urgency	240 min

Brief Intensive Observation for over 36 h, and those in Brief Intensive Observation lasting less than 6 h; ii) *Percentage of visits within triage time*, subdivided into color codes: green visits, which take less than 120 min, blue visits lasting less than 60, and orange visits taking less than 30 min. Data from Emilia-Romagna reveal that across all provinces, EDs have prolonged waiting times for initial appointments related to green and light-blue codes [4]. At the ED of Sassuolo Hospital, 71.6% of green-code visits take less than 120 min and 57.8% of light blue-code visits take less than 60 min, while the regional target is 90% for both categories [4].

Among the current issues in the healthcare system is crowding, which can compromise the correct functioning and flow of EDs [5]. This occurs when demand for ED access exceeds available logistical, instrumental and professional resources [6], with an impact on smooth operation. The conceptual model in Asplin et al. [7] identifies three critical points in ED patient flow: input, output and throughput.

“Input” refers to patient ED entry, regulated through the color-coded triage model since 2001 [8,9]. In October 2021, Emilia-Romagna implemented the five-color triage model outlined by international gold standards [10] (Table 1). According to this model, only patients coded as red and orange (and also light-blue using the new classification) should access EDs. Conversely, minor codes (white and green) are non-urgent and should therefore not be handled at EDs, according to the criteria established by the *Canadian Triage and Acuity Scale* and the *Hospital Urgencies Appropriateness Protocol* [11,12]. Nonetheless, red and orange codes accounted for 10% (or 34%, by including light-blue codes) of all 2022 ED visits in Emilia-Romagna. Moreover, minor codes accounted for 66% of total ED access (Fig. 1) [13]. Reasons for non-urgent ED use have been investigated in several systematic reviews [5,14,15] and included the following: (i) a rise in the old-age index, i.e., the percentage ratio of individuals over the age of 65 to those under the age of 14; (ii) a shortage of territorial services with inappropriate access by those who should rely on general practitioners (GPs), estimated to be between 10–15% [16] and 40–67% [17,18]; (iii) increased waiting times to access diagnostic services or specialist visits, with some

instances deemed to be “unacceptable” [7,12,14,15,19].

In terms of “output”, which indicates the conceptual part concerning the movements of patients from the ED to hospital wards or other places of care, the most significant issue was the difficulty of admitting or discharging frail patients, lengthening boarding time and ED stay [7,19]. Studies demonstrated that discharging inpatients “early” (i.e., before 2 pm) reduces ED boarding time [20,21].

With regard to “throughput”, it concerns the efficient movement of patients through the stages of care in the ED, from arrival to hospital discharge or admission. Numerous strategies have been explored with the aim of enhancing the throughput process. These include the use of technology, such as Clinical Decision Support Systems, Web-based dashboards and reporting applications that provide real-time information and monitor patient flow [22]. Additionally, there have been studies into the potential benefits of building and structural modifications, such as the introduction of Rapid Assessment Zones for expedited patient evaluation and treatment [22]. Conversely, the lack of nurses has been identified as a significant contributing factor to the prolonged ED processing of patients. This shortage is projected to intensify in the near future, with a considerable number of nurses set to retire within the next five years [23,24].

Possible solutions to crowding include optimizing discharge times (e.g., by discharging them in the morning shift), reinforcing primary care, especially through an increase in staff and resources (e.g., through the bed manager role or improved homecare evaluation and treatment) [25–30], and implementing organizational models for minor codes, such as multidisciplinary discharge team within ED or outpatient clinics for white codes coordinated within primary care services [31–35]. In addition, to expedite care for high acuity patients, several approaches have been proposed based on severity. These include a step-wise algorithm using the Emergency Severity Index [36] or triage protocols for direct referral to specialist consultants (*Fast Track* treatment) who evaluate and discharge patients from EDs [36]. Finally, the *Ideal Design of Emergency Access Project*, carried out in England during the early 2000s, identified a single, equal pathway for all patients as the primary cause of ED crowding. As a possible solution, the *Project* developed an organizational model known as the “*See-and-Treat*” protocol [37,38]. In this context, highly-qualified and trained nurses exclusively provide treatment for minor codes, in an attempt to increase patient throughput and decrease queuing times [39,40]. In Italy, this model was originally implemented in Tuscany in 2007, where 46 medical conditions were chosen and a specific patient selection and inclusion protocol was established for each condition. The protocol requires that nurses assigned to the *See-and-Treat* area possess a high and specialized level of

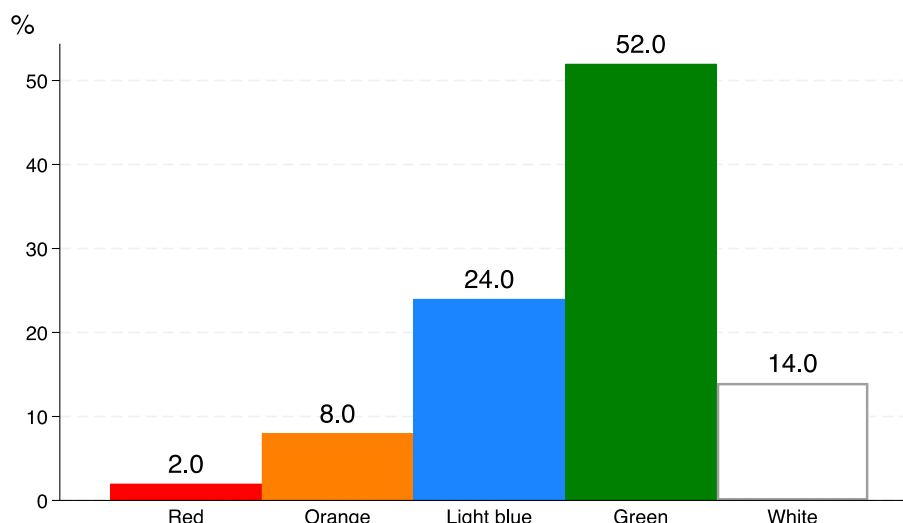


Fig. 1. Distribution of emergency room access divided by code in Emilia-Romagna (2022).

training with considerable experience in the field. During the training phase, nurses engage in case-sharing with medical staff, after which they will assume responsibility for the entire care pathway, yet they are still limited in their ability to address low-complexity and non-critical issues. Moreover, the *See-and-Treat* area must be situated in close proximity to an area with medical personnel, who could intervene in case of need [41].

Our objective was to retrospectively assess the potential number of patients who may be eligible for the *See-and-Treat* protocol at an Italian hospital ED. The second aim was to evaluate the potential impact on healthcare costs.

## 2. Methods

Our study is designed as a retrospective observational study, involving patients admitted to the ED of Sassuolo Hospital ED in 2022.

### 2.1. Ethical considerations

The study was conducted according to the Declaration of Helsinki. Approval from the Ethics Committee was therefore waived due to the use of entirely anonymous and aggregated data from medical records [42,43]. The study protocol was reviewed and approved by the Sassuolo Hospital Management. All necessary permissions were obtained prior to the commencement of the study. The Hospital Management consented to the use of data and the publication of the study findings.

### 2.2. Study setting

Sassuolo Hospital is located in the Modena province (Emilia-Romagna, Northern Italy). It serves as a public resource acting as a referral center for the Southern area of the province. It fulfills the requirements for first level inpatient and outpatient operations. It is integrated into the provincial emergency response system, with approximately 250 beds for standard inpatient and day care needs. We focused on overall ED access for 2022 at Sassuolo Hospital using available hospital management records (using the "Aurora PS" application).

### 2.3. Study participants

Only white and green codes (minor codes) were selected for the study. We included cases resulting in "discharge to home", while other channels such as hospitalization, refusal of hospitalization, transfer to other hospitals, discharge to other outpatient facilities, abandonment before visit and abandonment before medical record closure were excluded. We excluded codes that needed implementation of work-related protocols and certificates, which are a legal obligation for medical professionals. Additionally, we excluded patients who had received *Fast Track* treatment. For the *See-and-Treat* cases, an anonymous analysis of individual dashboard strings only included Principal Condition, Principal Diagnosis, patient age and nationality. Of the 46 diagnoses identified through the *See-and-Treat* protocol in Tuscany [44] and based on the inclusion and exclusion criteria of individual protocols, we ultimately only extracted those cases that could have benefited from the organizational model under consideration.

### 2.4. Cost evaluation

For the purpose of cost evaluation, we linked the selected primary conditions to their average gross cost in ED setting as estimated by Emilia-Romagna using data of the regional program information system [45]. These costs are calculated using a methodology that includes both direct and indirect costs. The direct costs are those closely associated with the provision of healthcare services and include: medical personnel costs working in the ED as well as supplies, medical instruments and equipment used at the ED. The indirect costs are the ones necessary for

overall operation of the ED, namely facility, insurance, and management costs. The program also provided access to data linked with the same conditions treated at a regional level (Emilia-Romagna). This enables total cost evaluation for the entire region.

### 2.5. Statistical analysis

Data analysis and presentation were performed through the Stata software (StataNow v18.5 MP, Stata Corp., College Station, TX, 2023).

## 3. Results

As summarized in Fig. 2, of the total figure for ED accesses at Sassuolo Hospital for 2022 (40,906), only minor codes (white and green) were selected for a total 24,971 cases (2,180 white codes and 22,791 green codes). We then excluded all cases that were not discharged to home, in order to avoid potentially critical cases that require further diagnostic investigation and as such cannot be managed by the nursing staff alone. Of the 13,823 cases eligible for the *See-and-Treat* protocol after initial selection (see to Fig. 2 for details), the *Principal Condition of Access to the Emergency Room* and the *Principal Diagnosis of Access* were contextually analyzed on a case-by-case basis. This analysis took into account the 46 principal conditions identified by the "Tuscany Protocol" for access to the *See-and-Treat* protocol, along with individual inclusion and exclusion criteria. As a result, 2,607 cases were identified as potentially qualifying for access to the *See-and-Treat* protocol, comprising 377 cases with white codes (17.3% of the total number of white codes) and 2,230 cases with green codes (9.8%). These cases represent 6.4% of all ED admissions and 10.4% of minor codes.

Table 2 displays the most common principal condition within the selected sample. It is worth noting that the number and names of these conditions do not precisely match those in *See-and-Treat* protocol implemented in Tuscany. This is due to variation in the system for associating conditions and diagnoses in Emilia-Romagna compared to Tuscany. Limb injuries and pain, both upper and lower, are the most common presenting condition that can be managed by nursing staff alone. These represent the reason behind nearly half as many of ED presentations (46.3%), followed by minor lacerations (8.5%) and recurring acute low back pain (6.4%). Issues regarding injuries to the upper and lower extremities include mild contusions that account for 16.5% of presentations, superficial wounds accounting for approximately 8%, and finger or toe fractures accounting for 4%.

In Fig. 3, age distribution shows that the largest group lies in the 40–59 range, accounting for 32.2% of the selected patients. The 20–39 and 60–79 age ranges follow closely at 25% each. In terms of nationality, 83.2% of the selected patients were Italian, while 6.2% were Moroccan and 2% of Albanian descent. Tunisians and Romanians each amounted to 1%.

The cost analysis revealed that potential savings related to cases eligible for the *See-and-Treat* protocol and territorial settings are over € 111,000 per year at Sassuolo Hospital (Supplementary Table S1). When generalized to the entire region, such amount would exceed € 7 million (Supplementary Table S2). It is important to note that the *See-and-Treat* protocol included finger and toe fractures in these access numbers. In such cases, radio-diagnostic assessment is necessary for an accurate diagnosis of fractures. Accordingly, these cannot be evaluated by specialized nurses without such imaging procedures. However, it is worth noting that fractures only accounted for 4% of all painful injuries or symptoms in the upper and lower extremities. Despite this, fractures amounted to 46% of the total selected cases, resulting in a total cost of € 61,733. Therefore, removing this workload from preventable costs would still result in a potential cost saving of over € 100,000 for Sassuolo Hospital.

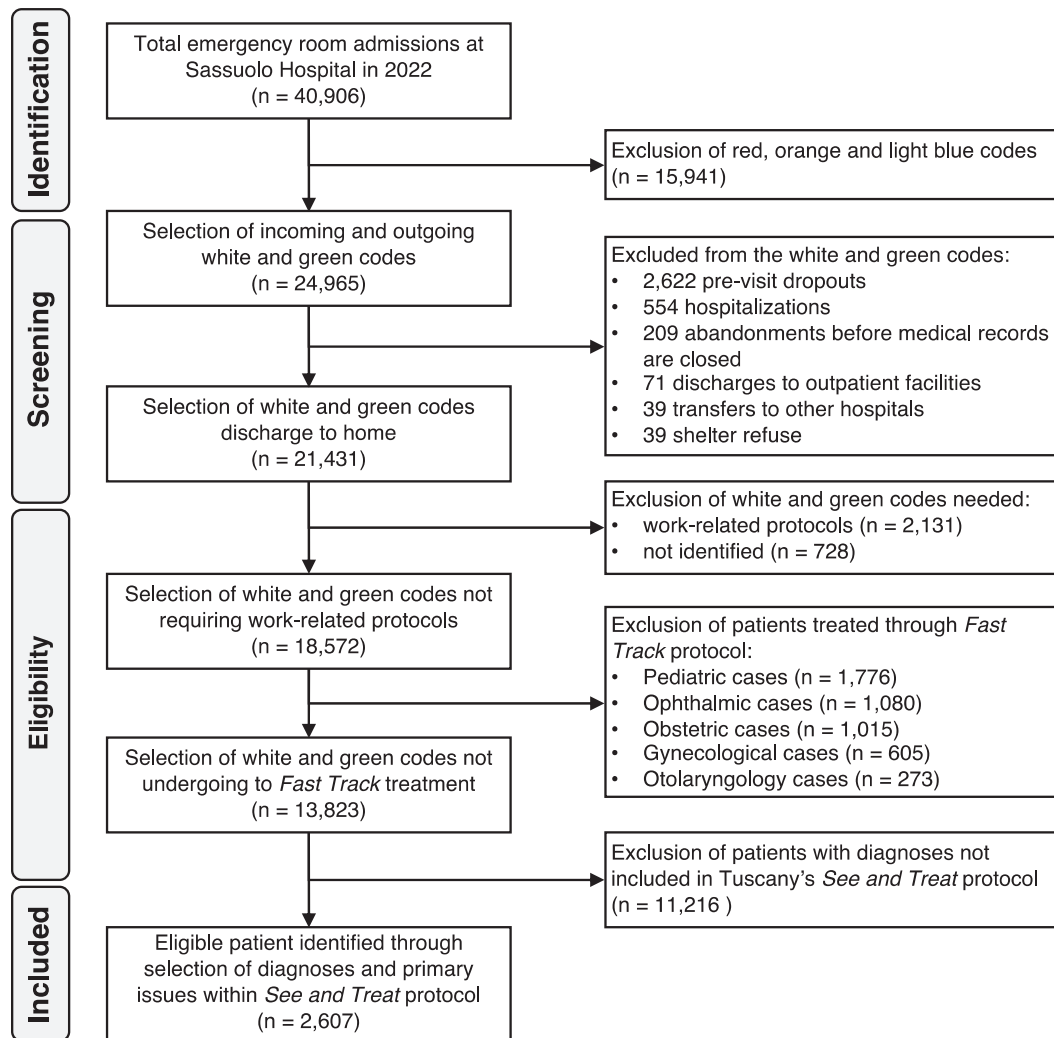


Fig. 2. Summary outline for selection and analysis of cases eligible for management using *See-and-Treat*.

**Table 2**  
Distribution of main conditions of selected subjects for the *See-and-Treat* protocol.

Main conditions	N	%
Upper limb injury	451	17.30
Lower limb injury	300	11.51
Upper limb pain	239	9.17
Laceration / Puncture	221	8.48
Lower limb pain	216	8.29
Low back pain	167	6.41
Minor nonspecific disorders	110	4.22
Polytrauma – Contusion	65	2.49
Flushed swelling	61	2.34
Other skin problems	60	2.30
Urinary tract infection symptoms	59	2.26
Bite injury	52	1.99
Erythema	50	1.92
Puncture wound	38	1.46
Diagnostic imaging/ Biochemical examinations (performing nasopharyngeal swab)	37	1.42
Ocular foreign body	28	1.07
Epistaxis	28	1.07
Otalgia	28	1.07
Diarrhea	27	1.04
Toothache/ Gum disease	27	1.04
Burn	27	1.04
Others	316	12.11

#### 4. Discussion

The study found that in 2022 6.3% of total non-specific ED admissions and 10.4% of minor codes were eligible for the *See-and-Treat* protocol. The implementation of such protocol may have cost savings of approximately € 110,000 per year at Sassuolo Hospital, and over € 7 million for Emilia-Romagna as a whole.

ED access rates are similar to results reported for Tuscany after the implementation of such protocol, where 6.37% of all admissions and 11% of minor codes (white, green and light-blue) underwent *See-and-Treat* [46]. Conversely, a more recent study carried out between 1 January 2019 and 12 March 2019 at Grosseto Hospital (Tuscany) reported that the *See-and-Treat* protocol was implemented for 14,506 (23.5%) subjects with minor codes (green and white) [47]. At a tertiary care hospital in Abu Dhabi, similarly, 11,329 (26.3%) subjects were treated with the *See-and-Treat* protocol from 1 June 2016 to 30 June 2017 [48], resulting in a positive impact on ED crowding. Compared with more recent reports, our assessment seems to underestimate the true potential behind the implementation of the *See-and-Treat* protocol. In our study, we selected only minor (white and green) codes, although it cannot be excluded that this approach might be extended to light-blue codes as well. Indeed, light-blue code is assigned to patients with the same clinical characteristics as those categorized as green codes yet with higher levels of pain or frailty primarily related to older age. The purpose of the protocol is to prevent protracted waiting times and limit the

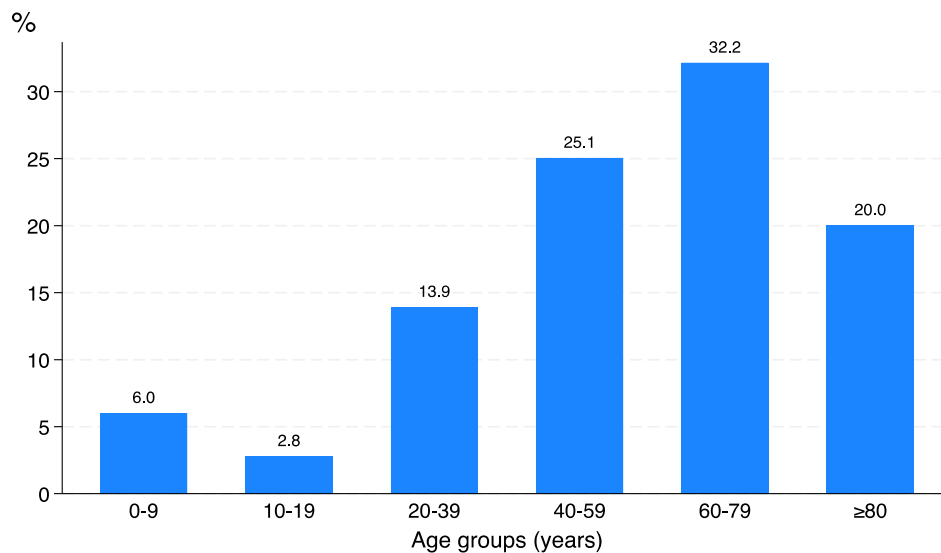


Fig. 3. Distribution of selected codes by age group.

deterioration of clinical conditions for such patients [40], although the frailty of possible eligible patients may actually hamper their selection for *See-and-Treat* protocol.

The economic impact associated with *See-and-Treat* should not be overlooked. Moving away from EDs towards other territorial settings, e. g., community homes or primary care services with GPs [49], would reduce costs related to unnecessary diagnostic and laboratory procedures, and improve accessibility. This shift would also allow for a reallocation of resources that are already available but not adequately used within the territory [49]. Overall, our analysis shows significant cost savings in the event of the *See-and-Treat* protocol being implemented at both Sassuolo Hospital and over Emilia-Romagna. In particular, demographic data and access rates divided by color code have been shown to overlap between Sassuolo Hospital and the Region, enhancing the reliability of our estimation. In addition, we estimated costs related to cases suitable for *See-and-Treat*, only. However, the numbers for inappropriate access may be much higher, ranging between 20% and 40% based on the *Canadian Triage and Acuity Scale* and the *Hospital Urgencies Appropriateness Protocol* [11,12]. As a matter of fact, these tools also take into account the number of hours that patients can wait without risking death, the need for diagnostic tests and immediate treatment, hospitalization, prolonged intensive observation, and the possibility of treatment with other dedicated healthcare services.

## 5. Study limitations and implications

Despite the positive impact of the implementation of *See-and-Treat*, some limitations should be acknowledged. The main issue is the lack of trained and qualified nurses for triage and application of this new protocol [24]. As a result, the protocol has only been implemented during limited time frames, specifically at noon and midweek [46,50]. This lack of dedicated staff has inevitably resulted in the underutilization of *See-and-Treat*. Additionally, the number of medical conditions selected by the Tuscany protocol ( $n = 46$ ) are far fewer compared to those initially considered in the UK [40], thus leading to a probable underestimation of its impact on the territory. Finally, previous studies suggest that deviations from the protocol may put patients at risk [51], thus adequate training and correct adherence should be guarantee and monitored.

In addition to previous definitions of appropriateness [11,12], Emilia-Romagna further included “Access at Risk of Inappropriateness” for those cases with white code and discharged to home or premature abandonment (prior to visit or referral), and green-code cases that not involving GPs, pediatricians, specialists, primary medical care service

physicians, or ED operators [52]. This may result in inappropriate access of approximately 24%. Several studies have evaluated costs associated with inappropriate use of emergency-urgent systems and particularly EDs, indicating that these costs account for a significant share of healthcare expenses. These studies found that managing non-emergency patients in community and home care could result in a substantial cost reduction – e.g., over US \$ 4 trillion in a country such as the United States [53,54]. Such savings could be applicable to Italy, as the costs for accessing medical care with color codes were even higher than the estimates we considered [55].

Additional study limitations are linked to the retrospective analysis and radically different sub-diagnoses, potentially resulting in over- or under-selection of certain cases. Furthermore, although triage remains the purview of nurses, the retrospective nature of the study precludes the accurate estimation of the number of cases that, while exhibiting low criticality and complexity, could be redirected to the ED. For greater precision, all ED admissions eligible for *See-and-Treat* should undergo evaluation through ED report analysis and association of individual cases with laboratory-instrumental tests. This would enable more accurate and reliable cost analysis, compared to the estimates used in this study. Finally, the estimated cost savings may be underestimated due to the limited clinical conditions considered. However, it does not take into account the costs, both direct and indirect, which would remain borne by the hospital until the transition to more suitable territorial contexts. In particular, the direct cost of the recruitment of nurse personnel dedicated to the *See-and-Treat* protocol should be considered, as well as some indirect costs related to the implementation of such healthcare service in the same building of the EDs, thus partially lowering the overall cost saving.

In spite of such limits, the study allowed us to examine essential elements for the improvement of patient flows at ED. These factors do not solely rely on organizational aspects inherent in ED but also, if not primarily, on community and hospital-based healthcare factors. Recognizing that the causes of ED crowding are part of the wider saturation process of healthcare systems is vital to identifying potential solutions. The case-study evaluation revealed the importance of enhancing the organizational efficiency of hospitals to manage patient traffic and prevent crowding [50,56]. In addition, the study highlights how nurses can represent a relevant professional for the innovation for the management of patient flow and crowding [57].

One key study finding is the scale of the advantages gained by diverting inappropriate access to emergency-urgent systems to territorial health systems, whether in terms of resource efficiency, time

optimization or cost savings. In addition, the study provides evidence indicating how advisable it is to encourage to increase information literacy, high-specialized training with de-escalation of care, avoiding inappropriate prescriptions and services that inevitably prolong delivery times at the expense of cases in genuine need [58,59]. This is a priority in the context of a health system that is ailing and requires restructuring, in order to sustain its adequate standards as an affordable public service.

## 6. Conclusions

This study serves as a foundation for a more comprehensive understanding and effective implementation of the *See-and-Treat* protocol and related approaches in order to enhance patient outcomes, decrease crowding and improve the use of both human and economic health resources. Further research with diverse applications and broader intervention scopes is necessary to ascertain the true effectiveness and legal framework of the protocol in emergency departments.

## CRedit authorship contribution statement

**Pietro Verzelloni:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Giorgia Adani:** Writing – review & editing, Validation, Methodology, Data curation, Conceptualization. **Alessandro Longo:** Writing – review & editing, Resources, Methodology. **Silvio Di Tella:** Writing – review & editing, Methodology, Formal analysis. **Anna Laura Santunione:** Writing – review & editing, Supervision, Methodology. **Marco Vinceti:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Tommaso Filippini:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ienj.2024.101569>.

## Data availability statement.

All data generated or analysed during this study are included in this published article and its [supplementary information files](#).

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