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Impact of a comprehensive prevention programme aimed at reducing incivility and verbal violence against healthcare workers in an ophthalmic emergency department: an interrupted time-series study.

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Complete List of Authors:	Touzet, Sandrine; Hospices Civils de Lyon, Pôle de Santé Publique; Université de Lyon, Laboratoire Health Services and Performance Research (HESPER) EA 7425 Ocelli, Pauline; Hospices Civils de Lyon, Pôle de Santé Publique; Université de Lyon, Laboratoire Health Services and Performance Research (HESPER) EA 7425 Denis, Angelique; Hospices Civils de Lyon, Pôle de Santé Publique Cornut, Pierre-Loïc; Hospices Civils de Lyon, Hôpital Edouard Herriot, Service d'ophtalmologie Fassier, Jean-Baptiste; Hospices Civils de Lyon, Pôle de Santé Publique; Université de Lyon, UMRESTTE Le-Pogam, Marie-Annick; University Hospital of Lausanne, Institute of Social and Preventive Medicine (IUMSP) Duclos, Antoine; Hospices Civils de Lyon, Pôle de Santé Publique; Université de Lyon, Laboratoire Health Services and Performance Research (HESPER) EA 7425 Burillon, Carole; Hospices Civils de Lyon, Hôpital Edouard Herriot, Service d'ophtalmologie; Université de Lyon
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45 **Title of the article:**
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8 Impact of a comprehensive prevention programme aimed at reducing incivility and verbal
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10 violence against healthcare workers in an ophthalmic emergency department: an interrupted time-
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12 series study.
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15 **Corresponding author**
1617 Sandrine Touzet
1819 Hospices Civils de Lyon
2021 Pôle de Santé Publique
2223 162 avenue Lacassagne
2425 69003 Lyon
2627 France
2829 sandrine.touzet@chu-lyon.fr
3031 +33 472 11 51 62
32
3334 **Authors**
35
3637 Sandrine Touzet*(1, 2), sandrine.touzet@chu-lyon.fr
3839 Pauline Occelli (1, 2), pauline.occelli@chu-lyon.fr
4041 Angelique Denis (1), angelique.denis@chu-lyon.fr
4243 Pierre-Loïc Cornut (3), dr.cornut@gmail.com
4445 Jean-Baptiste Fassier (4, 5), jean-baptiste.fassier@chu-lyon.fr
4647 Marie-Annick Le Pogam (6), marie-annick.le-pogam@chuv.ch
4849 Antoine Duclos (1, 2), antoine.duclos@chu-lyon.fr
5051 Carole Burillon (3, 7), carole.burillon@chu-lyon.fr
5253 The PREVURGO Study Group.
5455 *Corresponding author
56
57
58
59
60

The PREVURGO study group:

Nassira Amamra

Emmanuelle Aubert

Sylvain Beccat

Daniel Betito

Laetitia Bouveret

Philippe Charrier

Dominique Delaunay

Mélanie Dufourneau

André Lecoanet

Philippe Sarnin

Jéromine Sicalac

Sylvie Sullerot

Institutional addresses

1. Centre Hospitalier Universitaire de Lyon, Pôle de Santé Publique, Unité de recherche sur les services de santé, Lyon, FR.

2. Université Claude Bernard Lyon 1, Laboratoire HESPER Health Services and Performance Research EA 7425, Lyon, FR.

3. Hospices civils de Lyon, Hôpital Edouard Herriot, Service d'ophtalmologie, Lyon, FR.

4. Centre Hospitalier Universitaire de Lyon, Service de médecine et santé au travail, Lyon, FR.

5. Université Claude Bernard Lyon 1 - Domaine de Rockefeller, UMRESTTE UMR T_9405, Unité mixte de recherche Epidémiologique et de Surveillance Transport Travail Environnement, Lyon, FR.

6. Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital (CHUV), Lausanne, CH.

7. Université Claude Bernard Lyon 1, Villeurbanne, FR.

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KEY WORDS

Health services research; Time series study; Health care workers; Violence.

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ABSTRACT

Objective and setting: Primary prevention, comprising patient-oriented and environmental interventions, is considered one of the best ways to reduce violence in the emergency department.

We assessed the impact of a comprehensive prevention programme aimed at preventing incivility and verbal violence against healthcare professionals working in the ophthalmology emergency department (OED) of a university hospital.

Intervention: The programme was designed to address long waiting times and lack of information, both of which can plague patients. It combined a computerized triage algorithm linked to a waiting room patient call system, signage to assist patients navigate in the OED, educational messages broadcast in the waiting room, presence of a mediator, and a video surveillance.

Participants: All patients admitted to the OED and those accompanying them.

Design: a single-centre prospective interrupted time-series study over 18 months.

Primary outcome: Violent acts self-reported by healthcare workers committed by patients or those accompanying them against healthcare workers.

Secondary outcomes: waiting and length of stay.

Results: There were a total of 22,107 admissions, including 272 (1.4%) with at least one act of incivility and verbal violence reported by the healthcare workers. Almost all acts of violence were incivility or verbal harassment. The rate of violence significantly decreased from the pre-intervention to the intervention period (24.8; 95%CI: 20.0 to 29.5 to 9.5; 95%CI 8.0 to 10.9 acts per 1000 admissions; $p < 0.001$). An immediate 53% decrease in the violence rate (IRR=0.47, 95%CI: 0.27 to 0.82, $p = 0.0121$) was observed in the first month of the intervention period, after implementation of the triage algorithm.

Conclusion: A comprehensive prevention programme targeting patients and environment can reduce self-reported incivility and verbal violence against healthcare workers in an OED.

Trial registration: registered at clinicaltrials.gov (identifier: NCT02015884).

ARTICLE SUMMARY

Strengths and limitations of this study

- Our comprehensive primary prevention programme integrated components that were environment and patient-oriented (organisational, educational, relational, security).
- A segmented regression was conducted analysis to detect if the programme had a greater effect than an underlying secular trend.
- The primary outcome is self-reported act of violence, which is subjective.
- To limit variation in self-reporting practices, the researchers met monthly with the OED team to discuss the importance of reporting each acts of violence from least (incivility, rudeness) to most severe (assault).
- The generalization of the results is limited by the single-centre study design and by the differences between the OEDs and general emergencies.

MAIN TEXT

Introduction

According to the International Labor Office, workplace violence is a frequent phenomenon.¹ Hospital healthcare workers are particularly vulnerable by their exposure to patients who can be agitated and distressed.² Around the world, the emergency departments (ED) have been identified as an area of the healthcare sector with a high number of reported violent acts.^{3,4,5,6,7,8,9}

Four levels of aggressiveness are distinguished by order of severity by the French National Observatory of Violence in healthcare to describe violent behaviour: incivility (a lack of respect for others that manifests itself as relatively harmless acts), verbal abuse, physical threat (insults, threatening behaviour), and physically violent acts.¹⁰ This violence can have repercussions on the physical and emotional health of the victims, and thus on their well-being and the quality of their work. Healthcare workers have been shown to suffer emotional symptoms similar to post-traumatic stress disorder, job dissatisfaction, and early feelings of burnout, while hospitals have to bear the financial burden of decreased productivity.^{11,12,13,14}

In the ED, the frequency of visits observed in recent years has been accompanied by a drastic increase in the waiting times which can lead to a high level of patient dissatisfaction and of aggression towards healthcare workers. Other factors, such as anxiety, boredom, lack of information, lack of understanding of triage categories may also favour violent behaviour.^{15,16}

According to the Haddon matrix adapted by Gates *et al.*, interventions to reduce violence in the ED can be categorized according to the time of intervention: before (primary prevention), during (secondary prevention), or after (tertiary prevention) an act of violence; and according to the target of the intervention (healthcare workers, patients or accompanying visitors, and environment).^{17,18}

There are several solutions for the prevention of ED violence. Many have concerned primary prevention with interventions aiming at reducing waiting times, managing priorities (implementation of a triage algorithm to manage patients according to the seriousness of the cases), improving

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3 signage and patients' understanding of the care pathway.^{19,20} Security of premises (security guards,
4 video surveillance, warning systems, etc.) can sometimes be implemented.⁵ Mediator can also be
5 employed despite no published study evaluating their value. The few studies that have attempted to
6 evaluate the effectiveness of prevention interventions have a low level of evidence.^{18,21}
7
8 In the ophthalmology emergency department (OED) of a French university hospital, the healthcare
9 workers reported the occurrence of acts of incivility and verbal violence, with both medical and
10 nursing staff demanding that this issue be addressed.²² The solutions identified to deal with violence
11 included reducing waiting times, improving the premises (i.e. the comfort of waiting rooms,
12 confidentiality at the registration desk), changing signage, improving patient information, and
13 mediation. These components were integrated in a comprehensive primary prevention programme
14 aimed at averting violence through different components that were environment and patient-
15 oriented. The aim of this study was to evaluate the impact of this prevention programme on acts of
16 incivility and verbal violence against healthcare workers in the OED.
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36 **Methods**

37 ***Study design***

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40 The study was designed as a single-centre, prospective interrupted time series study. There were
41 three periods: a 3-month pre-interventional period (from 1 January 2014 until 30 March 2014), a 3-
42 month training period (from 31 March 2014 until 9 July 2014) and a 12-month implementation
43 period of the prevention programme (from 10 July 2014 until 30 June 2015); the protocol has been
44 previously published.²³
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52 *Deviations from the published protocol*²³: the planned study design was a "on – off" study over 24
53 months (including a 2-month pre-interventional period and a 22-month intervention period, without
54 a training period). The first 6 months of the study were not taken into account owing to strong
55 underreporting of violent acts by the healthcare worker, as ascertained during study coordination
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3 meetings. To meet the study schedule, we reduced the duration of the study to 18 months and we
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5 modified the study design. We chose to abandon the “on – off” design because of time constraints
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7 and the low acceptability of the “off” period when the intervention was to be removed.
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10 ***Patient and Public Involvement***

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13 Patients or the public were not involved in this work.
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15 ***Setting***

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18 This study took place at an adult OED of a university hospital located in an urban environment, in the
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20 Rhône-Alpes region of France. The OED is open 24 hours a day, 7 days a week, and handles all types
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22 of medical and surgical ophthalmological emergencies. In 2014, the department treated 20 309
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24 patients with 68 admissions a day on average.
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27 ***Participants***

28 ***Patients and those accompanying them***

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31 All patients (adults and children) registering at the OED from 1 January 2014 to 30 June 2015 were
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33 included. Those accompanying the patient (family, friends, etc.) were also enrolled. Patients
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35 registering during weekends and public holidays were excluded owing to the organisational
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37 characteristics of these periods (i.e. different and fewer staff as compared to weekdays), as were
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39 those registering during the 3-month training period from 31 March 2014 to 9 July 2014.
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43 ***Healthcare workers***

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46 The OED team (seven nurses, six ward aides, two orthoptic students, seven residents in
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48 ophthalmology, four senior ophthalmologists) operating on a rotating schedule to provide care 24/7
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50 were enrolled in the study. The OED team present during a week day is composed of four nurses,
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52 four ward aides, two orthoptic students, one or two residents in ophthalmology, and one on-call
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54 senior ophthalmologist; this did not change over the study period. Four admitting clerks were also
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56 enrolled.
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Prevention programme

Programme elaboration

The OED team partnered with researchers to develop the comprehensive prevention programme.

The programme had five complementary components, identified through a literature review, that were added progressively:

- An organisational component (A), beginning 30 March 2014, with the use by reception nurses of a computerized triage algorithm. This algorithm made it possible to prioritize patients as soon as they arrived in the unit and to carry out initial examinations (such as dilatation of the pupils by the orthoptist) according to the patient's reason for presentation to the OED. It was linked to a waiting room patient call system. A 3-month phase of training to use of the algorithm was conducted for reception nurses (named "training period"). This training period was not planned in the published protocol.²⁴
- An environmental component (B) and educational component (C) beginning 6 October 2014 were combined. The environmental component was signage to help patients navigate within the OED. The educational component was messages about the OED team and its activity, the care pathway, the patients' order of passage according to severity, and information on the waiting time range that were broadcast on TV in the waiting rooms to patients. As both components addressed difficulties for the patients to understand the functioning of the OED, we considered it appropriate to combine them. This is a deviation from the initial protocol.²³
- A relational component (D) beginning 5 January 2015 with the presence of a mediator in the OED, for preventive mediation actions. The mediator held a master's degree in mediation, and was recruited as part of the project. The mediator was to intervene when patients showed signs of impatience or nervousness and in case of conflict involving a patient or visitor. The mediator circulated through corridors and waiting rooms, and was available to patients and visitors.

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3 - A security component (E) beginning 6 April 2015, with the implementation of video surveillance
4 cameras throughout the OED (admissions desk, corridors) connected to the hospital security control
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7 room.
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9 *Programme implementation*

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11 The prevention programme was implemented in four steps of three months period, after a 3-month
12 training period for the computerized triage algorithm (Figure 1). The study project manager
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14 conducted monthly visits to the OED during the intervention period to ensure programme
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17 implementation.
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20 **Outcomes**

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22 *The primary outcome* was violence committed by patients or those accompanying them against
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24 healthcare workers or against other patients and those accompanying them among all admissions to
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27 the OED.
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30 Violence was reported by healthcare workers. They could report incidents directly committed against
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32 them or against patients and those accompanying them. Violence was described using a classification
33
34 that distinguishes four levels, from least (incivility) to most severe (assault), based on the French
35
36 National Observatory of Violence in healthcare (Table 1).²³ Clinical cases were used monthly to train
37
38 professionals to identify the different types of acts of violence to be reported and their level of
39
40 severity (see table 1 for examples). They were developed from situations experienced by OED
41
42 professionals. These situations were identified during interviews with OED professionals conducted
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44 by the researchers prior to the initiation of the study.²² The aim was to reduce the variability in the
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46 classification of events.
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50 The project manager also met monthly with the OED team to discuss the importance of reporting
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52 events to limit under-reporting of acts violence.
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55 *Secondary outcomes* were waiting time (defined as the interval of time between the administrative
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57 registration of the patient and the assessment by a nurse or an ophthalmologist) and length of stay
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(defined as the interval of time between registration and discharge). This information was routinely collected at the OED for all inpatients.

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Table 1. Four levels of violence, from least to most severe according to the National Observatory of Violence in Hospitals and examples of clinical cases used to train healthcare workers.

Level 1 (incivility)	<p>Insistent questions, incivility, rudeness, occupation of the corridor, spitting, making noise (telephone, etc.)</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) opens the door of the nursing office without knocking, or waiting for an answer, and calls you for some reason. - A patient (or an accompanying person) considering that everyone comes before him comes to show his dissatisfaction.
Level 2 (verbal harassment)	<p>Insult or verbal abuse without threat</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person), dissatisfied with your answer, calls you an asshole. - A patient (or an accompanying person), tired of waiting, calls you a loser or incapable.
Level 3 (threats)	<p>Verbal or physical threat.</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) raises his hand on you. - A patient (or an accompanying person) comes dangerously close to you to scream on you.
Level 4	<p>Intentional violence, assault, vandalism or damage to equipment.</p>

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3 (assaults)

Examples:

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5 - An angry patient (or an accompanying person) pushes you.

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7 - A patient (or an accompanying person) spits on you.
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Legend. Examples come from clinical cases used to train the healthcare workers to notify the level any incivility or violence they may be subject.
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Blinding

Healthcare workers and patients were not blinded to the intervention phase. However, in the absence of individual information on the study (this was not required by the Institutional Review Board), it appears unlikely that patient behaviour was influenced by the study.

Sample size

In the initial protocol the sample size was determined for an on – off design by the expected efficacy of each of the five components of the prevention programme. The statistical unit was the patient admitted to the OED. Based on the initial hypotheses, the total sample size required was 30 224 admissions with a risk alpha of 5% and the statistical power of 80%. We did not recalculate the number of subjects required; there is usually no estimation of the sample size in interrupted time-series studies.^{24,25}

Statistical methods

The analyses were conducted on data obtained during the 15-month study period (that corresponded to the pre-intervention and intervention periods and without consideration of the training period). Descriptive statistics were used to summarize and compare characteristics of patients admitted to the OED and violence outcomes during the pre-intervention and intervention periods. The proportion of admissions with violence committed by patients, or those accompanying them, was expressed as a rate per 1000 admissions. When the perpetrator was someone accompanying the patient, the violence was attributed to the patient.

For all outcomes, we conducted a pre post analysis to compare rates before and during implementation of the prevention programme using chi square tests. In addition, for the primary outcome we performed a segmented regression analysis to account for the possibility of concurrent secular trends in violence which could influence the results. We evaluated the effect of the programme on violence at both the aggregate and individual patient levels.

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3 First, a segmented Poisson regression model offset by the total number of admissions at OED per
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5 month was used to compare monthly violence rates between pre and intervention periods. The
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7 model included intercept, time trend before implementation (*time*), change in level immediately
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9 after the training period (*programme*), and change in time trend after the training period
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11 (*time_after_programme*).
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14 Further stratified analysis was conducted to investigate whether changes in violence rates varied by
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16 age group, gender, waiting time and length of stay. Results were reported as incidence rate ratio
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18 (IRR) and 95% confidence intervals (CIs).
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21 Secondly, we used piecewise logistic regression model to test for changes in monthly effects of each
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23 intervention on odds of violence occurrence within admission at OED after adjusting for individual
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25 characteristics (age, gender, waiting time >2h, admission to OED during public holidays, night
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27 admission, patients with several admissions to OED). A model with generalized equation estimation
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29 with a 1st order autoregressive correlation structure was fitted to account for the clustering of
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31 admissions to the OED within a calendar day. The full piecewise logistic regression model included
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33 both a change in level and a change in trend for each of the 4 components (A, BC, D and E). After
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35 backward stepwise selection, only parameters with $p < 0.05$ were retained in the parsimonious model.
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37 Estimates of levels and post-implementation slopes were reported as odds ratio (OR) and 95% CIs.
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39 All admissions to the OED were treated independently. All p values were 2-sided and statistical
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41 significance was defined as a p value of less than 0.05. Statistical analyses were performed with SAS
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43 version 9.4 software (SAS Institute Inc., Cary, NC, USA).
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51 **Results**

52 ***Participants***

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54 Over the 15-month study period, 22 107 admissions (corresponding to 18 826 patients) were
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56 analysed (Figure 1). Among the 18 826 patients, 12% were admitted more than once. The mean \pm
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3 standard deviation (SD) number of visits per patient was 1.2 ± 0.6 (range: 1-15), there was a mean 70
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5 ± 12 admissions per day over the 315-day study period (range: 33-105).
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8 ***Characteristics of admissions***

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11 Characteristics of admissions according to the components implemented are presented in Table 2.
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Table 2. Characteristics of admissions, waiting time and length of stay.

	Pre-intervention period N=4 118	Intervention period			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Male, n (%)	2 250 (54.6)	2 335 (53.0)	2 499 (54.5)	2 426 (54.5)	2 564 (56.4)
Age ≥ 40 years, n (%)	2 159 (52.4)	2 547 (57.8)	2 452 (53.5)	2 368 (53.2)	2 459 (54.1)
Coming during the day, n (%)	2 944 (71.5)	3 164 (71.9)	3 536 (77.1)	3 519 (79.0)	3 324 (73.1)
Waiting time > 2h ^a , n (%)	2 755 (66.9)	2 754 (62.5)	2 377 (51.8)	2 100 (47.1)	2 125 (46.8)
Length of stay > 3h, n (%)	2 045 (49.7)	2 481 (56.3)	2 002 (43.6)	1 601 (35.9)	1 595 (35.1)

Legend: Coming during the day corresponded to admission between 8 am and 7.59 pm; waiting time was defined as the duration between time of registration of patient's arrival and first time of assessment by a nurse or an ophthalmologist; Length of stay was defined as the duration between registration and discharge. Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast, D corresponded to mediator and E corresponded to video surveillance.

^a waiting time was not documented for 108 admissions.

Outcomes

A total of 376 acts of violence corresponding to 272 admissions (1.4% of 22 107 admissions) were recorded during the total study period (Table 3). Among the 272 admissions concerned, 74% (n=202) had led to one act of violence, 16% (n=45) had led to two acts, and 10% (n=25) had led to three or more acts. In the pre-intervention period, 98.6% acts of violence were incivility or verbal harassment and 1.4% were threats. In the intervention period, all acts of violence were incivility or verbal harassment.

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Table 3. Characteristics of acts of violence reported by healthcare workers.

	Pre-intervention period N=4 118	Intervention period after a 3-month training			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Rate of act of violence per 1000 admissions (95%CI)*	24.8 (20.0-29.5)	10.0 (7.1-12.9)	8.9 (6.2-11.7)	8.1 (5.5-10.7)	10.8 (7.8-13.8)
Act of violence**, n	143	54	51	56	72
Level of violence, n (%)					
Level 1 (incivility)	131 (91.6)	46 (85.2)	45 (88.2)	43 (76.8)	65 (90.3)
Level 2 (verbal harassment)	10 (7.0)	7 (13.0)	5 (9.8)	13 (23.2)	7 (9.7)
Level 3 (threats)	2 (1.4)	1 (1.9)	1 (2.0)	0 (0)	0 (0)
Level 4 (assaults)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Committed by patient, n (%)	98 (68.5)	43 (79.6)	35 (68.6)	38 (67.9)	53 (73.6)
Healthcare worker as the victim***, n (%)	140 (97.9)	51 (94.4)	48 (94.1)	54 (96.4)	72 (100)

* Rate of act of violence was defined as the percentage of admissions per period with at least one act of violence reported.

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3 ** Several acts of violence could be occurred per admission.
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5 *** 6 acts of violence were committed between patients and the victim was not documented for 5 acts of violence.
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8 Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast, D corresponded to mediator and E
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10 corresponded to video surveillance cameras.

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12 Abbreviation: CI: Confidence Interval.
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Primary outcome

The rate of violence significantly decreased from 24.8 (95%CI: 20.0 to 29.5) admissions with violence per 1000 admissions in pre-intervention period to 9.5 (95%CI: 8.0 to 10.9) acts of violence per 1000 admissions in intervention period ($p<0.001$). The effects of the components on monthly violence rates are presented in Figure 2.

Secondary outcomes

The frequency of admissions with waiting times ≥ 2 hours decreased from 67% ($n=2755$ admissions) to 52% ($n=9356$) between the pre-intervention period and the intervention period ($p<10^{-3}$). For the length of stay, frequency of admissions with a stay ≥ 3 hours decreased from 50% ($n=2045$) to 43% ($n=7679$; $p<10^{-3}$).

Segmented regression analysis

According to the Poisson regression analyses, no pre-intervention trend was seen in monthly violence rates (IRR=1.13, 95%CI: 0.87 to 1.46, $p=0.3243$). After accounting for underlying trends, an immediate 53% decrease (IRR=0.47, 95%CI: 0.27 to 0.82, $p=0.0121$) was observed in the violence rate of the first month following the training period. No monthly trend effects in overall intervention period was detected (IRR=0.97, 95%CI: 0.92 to 1.02, $p=0.1660$). Poisson regression results stratified by admission's characteristics are presented in a table 4. Following the training period, a similar immediate decrease was found for female (IRR=0.35, 95%CI: 0.15 to 0.83, $p=0.0212$), age <40 years (IRR=0.43, 95%CI: 0.19 to 0.99, $p=0.0471$), waiting time >2 hours (IRR=0.49, 95%CI: 0.26 to 0.92, $p=0.0306$), and length of stay >3 hours (IRR=0.38, 95%CI: 0.20 to 0.74, $p=0.0089$). No monthly trend effect in the intervention period was observed for all subgroups.

Table 4. Multivariate analysis* of the comprehensive prevention programme on violence rates by admissions characteristics.

Characteristics	Pre-intervention trend (per month)**		Change in level***		Change in trend (per month)****	
	IRR [95%CI]	p-value	IRR [95%CI]	p-value	IRR [95%CI]	p-value
Sex						
Male	1.05 [0.76;1.46]	0.7500	0.59 [0.28;1.20]	0.1308	0.95 [0.89;1.01]	0.0810
Female	1.27 [0.84;1.93]	0.2343	0.35 [0.15;0.83]	0.0212	1.00 [0.93;1.07]	0.9548
Age						
<40 yrs	1.11 [0.78;1.58]	0.5292	0.43 [0.19;0.99]	0.0471	0.96 [0.90;1.04]	0.2771
≥ 40 yrs	1.16 [0.79;1.69]	0.4107	0.51 [0.24;1.08]	0.0730	0.97 [0.92;1.04]	0.3601
Waiting time						
≤2h	1.11 [0.67;1.85]	0.6468	0.39 [0.13;1.18]	0.0892	0.96 [0.88;1.05]	0.3427
>2h	1.12 [0.83;1.51]	0.4233	0.49 [0.26;0.92]	0.0306	0.99 [0.94;1.04]	0.6704
Length of stay						
≤3h	1.03 [0.66;1.62]	0.8738	0.57 [0.22;1.51]	0.2329	0.96 [0.89;1.04]	0.2823
>3h	1.13 [0.82;1.55]	0.4231	0.38 [0.20;0.74]	0.0089	1.00 [0.94;1.06]	0.9764

Abbreviations: IRR: Incidence rate ratio, CI: Confidence interval.

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3 * segmented Poisson regression offset by the total number of admissions at OED per month. RR <1 represents a decline and inversely

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5 RR>1 represents an increase in monthly violence rate.

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7 ** rate of change in monthly violence rate prior the intervention (i.e. time effect).

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9 *** immediate change in the mean monthly violence rate from pre intervention to intervention period.

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11 **** change in slope per month following to the intervention period.
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Piecewise logistic regression analysis

Piecewise logistic regression analysis confirmed the absence of pre-intervention trend (see table 5).

Following the training period, three components of the programme had significant effects on the underlying trend of violence occurrence. There was a significant decline in the odds of violence occurrence over time after the implementation of component A-Algorithm (adjusted odds ratio [aOR]= 0.87, 95%CI: 0.82-0.91, $p<10^{-3}$). The trend toward decreasing occurrence of violence over time significantly reversed in the 3 months following the implementation of component D-Mediators (aOR= 1.45, 95%CI: 1.14-1.84, $p=0.002$) indicating a significant increase over time after the implementation of a mediator. The trend significantly reversed following component E- video surveillance (aOR= 0.65, 95%CI: 0.45-0.93, $p=0.019$) suggesting that the magnitude of increase in occurrence of violence decreased over time and returned at its previous level (aOR= 0.84, 95%CI: 0.66-1.07, $p=0.152$). No effect was observed for the component BC combining signage and messages broadcast on TV in the waiting rooms.

Table 5. Piecewise logistic regression analysis of the comprehensive prevention programme effects* on violence.

	Full model**		Simple model***	
	OR [95%CI]	p-value	OR [95%CI]	p-value
Trend prior to intervention (per month)	1.09 [0.81 ; 1.49]	0.5848	--	--
Immediate change in level:				
A	0.31 [0.03 ; 3.20]	0.3236	--	--
BC added to A	2.19 [0.70 ; 6.82]	0.1773	--	--
D added to ABC	1.05 [0.28 ; 3.88]	0.9406	--	--
E added to ABCD	5.73 [2.08 ; 15.77]	0.0007	--	--
Change in trend (per month):				
A	0.95 [0.55 ; 1.65]	0.8657	0.87 [0.82 ; 0.92]	<.0001
BC added at A	0.61 [0.33 ; 1.13]	0.1188	--	--
D added at ABC	1.85 [0.98 ; 3.48]	0.0572	1.45 [1.14 ; 1.84]	0.0022
E added at ABCD	0.35 [0.17 ; 0.70]	0.0031	0.65 [0.45 ; 0.93]	0.0194

Abbreviations: OR: odds ratio, CI: Confidence interval.

Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast on TV in the waiting rooms, D corresponded to mediator and E corresponded to video surveillance cameras.

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3 *logistic generalized estimating equation model adjusted for waiting time > 2h. OR <1 represent a decline and inversely OR>1 represent an increase in
4
5 monthly likelihood of violence occurrence during admission at OED per month.
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8 **full model included time effect and immediate changes after each component's implementation and changes in slopes.
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10 ***parsimonious model after backward selection.
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Discussion

The present study found a significant reduction in self-reported incivility or verbal violence by healthcare workers following the implementation of a comprehensive prevention programme. This reduction occurred after the implementation of the first component of the programme, a triage algorithm, and was maintained over time while other components were successively implemented. The violence rate during the pre-intervention period found in the present study (24.8 per 1000 admissions) was higher than that reported in a recent meta-analysis of 22 studies; the authors found a pooled incidence of 36 per 10,000 admissions (range: 1 to 172 per 10,000 admissions).²⁶ It is, however, difficult to compare the results of the present study with those reported elsewhere due to heterogeneity in the way violence is defined, collected and reported in the literature; for a majority of studies, data collection was conducted retrospectively, using security records and incident report documents that mainly report severe acts of violence.²⁶

Previous studies reported a low rate of acts of violence with a high level of severity (threats and assaults).^{27,28} In the present study, the frequency of such acts were even lower; only four acts of verbal or physical threat and no assault. This can be explained by the context of the OED which did not admit patients for drug/alcohol abuse or psychiatric disease. However, as in other studies, verbal harassment or incivility committed by patients were the most frequent form of violence experienced herein despite differences in methodology.^{28,29,30} Concomitantly, waiting times and length of stay of patients in the OED were significantly reduced. The reduction of waiting times was an expected effect of the triage algorithm, which allowed, according to the reason for consultation, for orthoptists to perform examinations such as dilating pupils without having to consult a physician. It was not related to a change in the number of professionals (which remained stable throughout the study) nor to a change in the number of admissions to OED.

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3 As recommended, the prevention programme combined different components, targeting regularly
4 cited causes of violence.¹⁸ The intervention targeted patients/visitors and the environment, but did
5 not target how OED professionals handle violent situations.^{31,30} Behaviour of healthcare professionals
6 such as empathic communication, early proactive interaction, and verbal and body language
7 expressing respect and confidence are associated with a reduction in incivility and verbal abuse or
8 aggressive behaviour.^{22,32}

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10 Caution should, however, be taken when interpreting the results of the present study. For instance, a
11 positive effect was observed during the implementation of the first component (triage algorithm). It
12 is not possible to conclude whether this effect was due to the algorithm or to the fact that it was
13 implemented first. Another point to consider is that violence increased despite the presence of the
14 mediator. To the best of our knowledge, there was no change in the conditions of patient reception
15 (i.e. no increase in waiting times or in admission frequency and no change in the OED team) during
16 the implementation of the mediator that could explain this unintended effect. The mediator, by
17 his/her presence, may have stimulated the declaration of violence by healthcare workers. This
18 phenomenon point out the difficulty to collect non-physical acts of violence which are underreported
19 by healthcare staff, primarily due to the fact that it is so prevalent yet rarely results in physical injury
20 and because . Most of professionals consider it as part of their jobs and these acts of violence are
21 subject to personal interpretation.^{33,34} To limit variation in reporting practices, the researchers met
22 monthly with the OED team to discuss the importance of reporting events from least (incivility) to
23 most severe (assault).

24
25 Moreover, we conducted a segmented regression analysis to detect if the programme had a greater
26 effect than an underlying secular trend.^{35,36,37,24,25} The analysis is limited by the short pre-intervention
27 phase, which does not allow a solid estimation of the trend before the programme implementation.
28 Second, the generalization of the results is limited by the single-centre study design and by the
29 differences between the OEDs and general emergencies. In particular, there are no admissions for
30 psychiatric or drug abuse and alcohol problems, which are known to be sources of violence.²⁶

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3 A qualitative approach would have allowed to better understand the mechanisms of action of the
4 programme components,³⁸ in particular the paradoxical effect of the mediator. It also would have
5 allowed us to evaluate whether the coping of the healthcare workers with the violence has
6 improved.
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12 In conclusion, a comprehensive prevention programme targeting patients, visitors and environment
13 can reduce self-reported incivility and verbal violence by healthcare workers in an OED over 12
14 months. EDs should develop comprehensive primary prevention programme that integrate various
15 environmental and patient-oriented components (organisational, educational, relational, security).
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Reporting criteria

We followed the SQUIRE criteria from the EQUATOR network to report the study.

Ethics approval

The Sud Est IV Institutional Review Board's approval was obtained in September 2011 (L11-117).

Under French law in effect at the time of the study, consent was not required for the type of study and intervention being evaluated.

Author contributions

The study was conceptualized and designed by ST, PLC, MALP, and ADu.

PLC and CB are the Co-Chief Investigators, provided leadership for the project.

ST, PLC, JBF, and ADu contributed to the development of the programme.

ST, PO, and ADe planned the statistical analysis.

ADe carried out the statistical analyses.

ST, PO, and ADe drafted the manuscript.

All authors reviewed the draft version, made suggestions, and approved the final version.

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The authors are grateful to Philip Robinson for help in manuscript preparation.

Competing Interests

None declared.

Patient consent

Not required.

Data statement

The data set is not available as ethics approval does not allow release.

Figures

Figure 1. Study flow chart of admissions at Ophthalmology Emergency Department.

Legend: Components: A: computerised triage algorithm, BC: signage and messages broadcast on TV in the waiting rooms, D: mediator, E: video surveillance.

Figure 2. Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention programme.

Abbreviation: OED: Ophthalmology Emergency Department

Legend: the grey band represents the 3-month training period. The dotted lines inside the scatter plots represents the implementation of component A (computerised triage algorithm), component BC (signage and messages broadcast on TV in the waiting rooms), component D (mediator) and component E (video surveillance).

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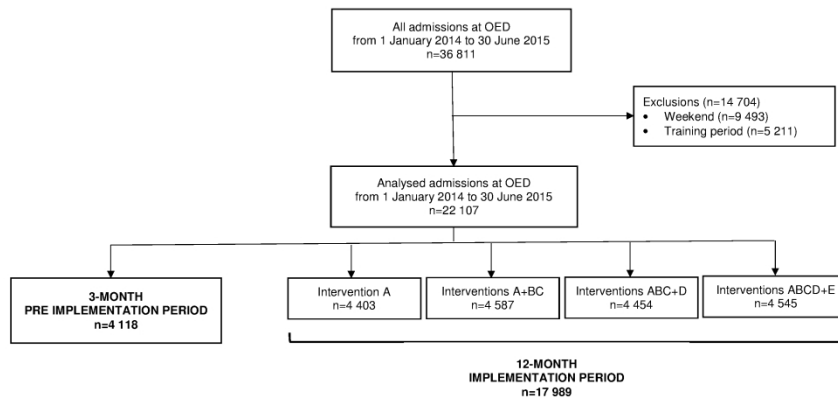
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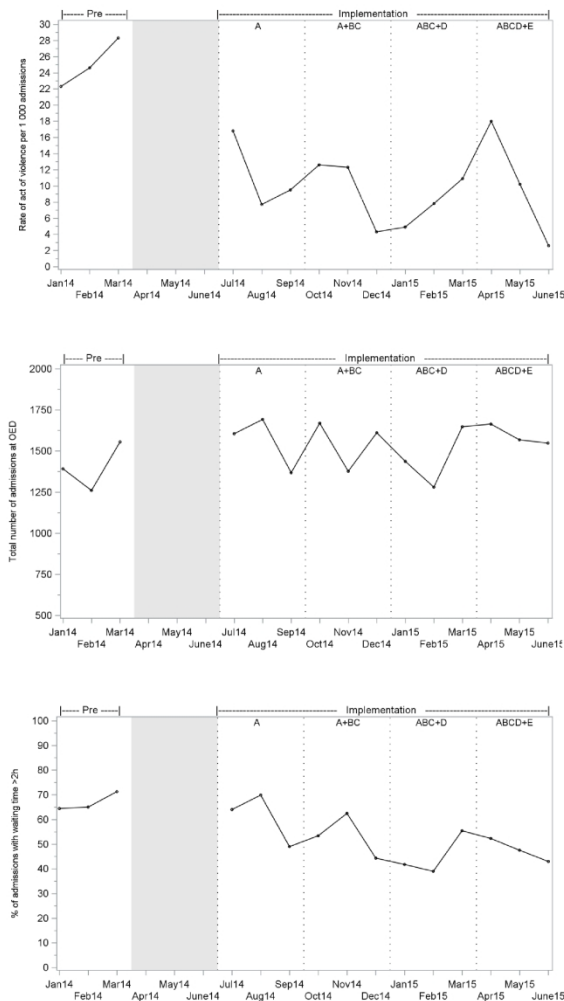
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Study flow chart of admissions at Ophthalmology Emergency Department.
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Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention program.

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	#1 Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patientcenteredness, timeliness, cost, efficiency, and equity of healthcare)	1
	#02a Provide adequate information to aid in searching and indexing	1
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Problem description	#3 Nature and significance of the local problem	6
Available knowledge	#4 Summary of what is currently known about the problem, including relevant previous studies	5
Rationale	#5 Informal or formal frameworks, models, concepts, and / or theories used to explain the problem, any reasons or	5 - 6

1			assumptions that were used to develop the intervention(s), and	
2			reasons why the intervention(s) was expected to work	
3				
4	Specific aims	#6	Purpose of the project and of this report	6
5				
6	Context	#7	Contextual elements considered important at the outset of	7
7			introducing the intervention(s)	
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10	Intervention(s)	#08a	Description of the intervention(s) in sufficient detail that others	8
11			could reproduce it	
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14		#08b	Specifics of the team involved in the work	8
15				
16	Study of the	#09a	Approach chosen for assessing the impact of the intervention(s)	6
17	Intervention(s)			
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20		#09b	Approach used to establish whether the observed outcomes	6, 12,13
21			were due to the intervention(s)	
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24	Measures	#10a	Measures chosen for studying processes and outcomes of the	9
25			intervention(s), including rationale for choosing them, their	
26			operational definitions, and their validity and reliability	
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29		#10b	Description of the approach to the ongoing assessment of	9
30			contextual elements that contributed to the success, failure,	
31			efficiency, and cost	
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34		#10c	Methods employed for assessing completeness and accuracy	9
35			of data	
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38	Analysis	#11a	Qualitative and quantitative methods used to draw inferences	12,13
39			from the data	
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42		#11b	Methods for understanding variation within the data, including	12,13
43			the effects of time as a variable	
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46	Ethical	#12	Ethical aspects of implementing and studying the intervention(s)	28,29
47	considerations		and how they were addressed, including, but not limited to,	
48			formal ethics review and potential conflict(s) of interest	
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51		#13a	Initial steps of the intervention(s) and their evolution over time	See note
52			(e.g., time-line diagram, flow chart, or table), including	1
53			modifications made to the intervention during the project	
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56		#13b	Details of the process measures and outcome	9
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1		#13c	Contextual elements that interacted with the intervention(s)	15
2				
3		#13d	Observed associations between outcomes, interventions, and	20
4			relevant contextual elements	
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7		#13e	Unintended consequences such as unexpected benefits,	See note
8			problems, failures, or costs associated with the intervention(s).	2
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11		#13f	Details about missing data	See note
12				3
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15	Summary	#14a	Key findings, including relevance to the rationale and specific	25
16			aims	
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18		#14b	Particular strengths of the project	25
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21	Interpretation	#15a	Nature of the association between the intervention(s) and the	25
22			outcomes	
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24		#15b	Comparison of results with findings from other publications	25
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26		#15c	Impact of the project on people and systems	25
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28		#15d	Reasons for any differences between observed and anticipated	20
29			outcomes, including the influence of context	
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33		#15e	Costs and strategic trade-offs, including opportunity costs	See note
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37	Limitations	#16a	Limits to the generalizability of the work	26
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39		#16b	Factors that might have limited internal validity such as	26
40			confounding, bias, or imprecision in the design, methods,	
41			measurement, or analysis	
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44		#16c	Efforts made to minimize and adjust for limitations	26
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46				
47	Conclusion	#17a	Usefulness of the work	27
48				
49		#17b	Sustainability	27
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51		#17c	Potential for spread to other contexts	26
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54		#17d	Implications for practice and for further study in the field	27
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56		#17e	Suggested next steps	27
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2 funding organization in the design, implementation,
3 interpretation, and reporting
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20 tool made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)
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Impact of a comprehensive prevention programme aimed at reducing incivility and verbal violence against healthcare workers in a French ophthalmic emergency department: an interrupted time-series study.

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3 TITLE PAGE4
5 **Title of the article:**6
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8 Impact of a comprehensive prevention programme aimed at reducing incivility and verbal violence
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1314
15 **Corresponding author**16
17 Sandrine Touzet18
19 Hospices Civils de Lyon20
21 Pôle de Santé Publique22
23 162 avenue Lacassagne24
25 69003 Lyon26
27 France28
29 sandrine.touzet@chu-lyon.fr30
31 +33 472 11 51 62
32
3334
35
36 **Authors**37
38 Sandrine Touzet*(1, 2), sandrine.touzet@chu-lyon.fr39
40 Pauline Occelli (1, 2), pauline.occelli@chu-lyon.fr41
42 Angelique Denis (1), angelique.denis@chu-lyon.fr43
44 Pierre-Loïc Cornut (3), dr.cornut@gmail.com45
46 Jean-Baptiste Fassier (4, 5), jean-baptiste.fassier@chu-lyon.fr47
48 Marie-Annick Le Pogam (6), marie-annick.le-pogam@chuv.ch49
50 Antoine Duclos (1, 2), antoine.duclos@chu-lyon.fr51
52 Carole Burillon (3, 7), carole.burillon@chu-lyon.fr53
54 The PREVURGO Study Group.55
56 *Corresponding author
57
58
59
60

1
2
3 **The PREVURGO study group:**
4

5 Nassira Amamra
6

7 Emmanuelle Aubert
8

9 Sylvain Beccat
10

11 Daniel Betito
12

13 Laetitia Bouveret
14

15 Philippe Charrier
16

17 Dominique Delaunay
18

19 Mélanie Dufourneau
20

21 André Lecoanet
22

23 Philippe Sarnin
24

25 Jéromine Sicalac
26

27 Sylvie Sullerot
28
29
30
31

32
33 **Institutional addresses**
34

35
36 1. Centre Hospitalier Universitaire de Lyon, Pôle de Santé Publique, Unité de recherche sur les
37 services de santé, Lyon, FR.
38

39
40 2. Université Claude Bernard Lyon 1, Laboratoire HESPER Health Services and Performance Research
41 EA 7425, Lyon, FR.
42

43
44 3. Hospices civils de Lyon, Hôpital Edouard Herriot, Service d'ophtalmologie, Lyon, FR.
45

46
47 4. Centre Hospitalier Universitaire de Lyon, Service de médecine et santé au travail, Lyon, FR.
48

49
50 5. Université Claude Bernard Lyon 1 - Domaine de Rockefeller, UMRESTTE UMR T_9405, Unité mixte
51 de recherche Epidémiologique et de Surveillance Transport Travail Environnement, Lyon, FR.
52

53
54 6. Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital (CHUV),
55 Lausanne, CH.
56

57
58 7. Université Claude Bernard Lyon 1, Villeurbanne, FR.
59
60

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KEY WORDS

Health services research; Time series study; Health care workers; Violence.

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ABSTRACT

Objective and setting: Primary prevention, comprising patient-oriented and environmental interventions, is considered one of the best ways to reduce violence in the emergency department.

We assessed the impact of a comprehensive prevention programme aimed at preventing incivility and verbal violence against healthcare professionals working in the ophthalmology emergency department (OED) of a university hospital.

Intervention: The programme was designed to address long waiting times and lack of information, both of which can plague patients. It combined a computerized triage algorithm linked to a waiting room patient call system, signage to assist patients navigate in the OED, educational messages broadcast in the waiting room, presence of a mediator, and a video surveillance.

Participants: All patients admitted to the OED and those accompanying them.

Design: a single-centre prospective interrupted time-series study over 18 months.

Primary outcome: Violent acts self-reported by healthcare workers committed by patients or those accompanying them against healthcare workers.

Secondary outcomes: waiting and length of stay.

Results: There were a total of 22,107 admissions, including 272 (1.4%) with at least one act of incivility and verbal violence reported by the healthcare workers. Almost all acts of violence were incivility or verbal harassment. The rate of violence significantly decreased from the pre-intervention to the intervention period (24.8; 95%CI: 20.0 to 29.5 to 9.5; 95%CI 8.0 to 10.9 acts per 1000 admissions; $p < 0.001$). An immediate 53% decrease in the violence rate (IRR=0.47, 95%CI: 0.27 to 0.82, $p = 0.0121$) was observed in the first month of the intervention period, after implementation of the triage algorithm.

Conclusion: A comprehensive prevention programme targeting patients and environment can reduce self-reported incivility and verbal violence against healthcare workers in an OED.

Trial registration: registered at clinicaltrials.gov (identifier: NCT02015884).

ARTICLE SUMMARY

Strengths and limitations of this study

- Our comprehensive primary prevention programme integrated components that were environment and patient-oriented (organisational, educational, relational, security).
- A segmented regression was conducted analysis to detect if the programme had a greater effect than an underlying secular trend.
- The primary outcome is self-reported act of violence, which is subjective.
- To limit variation in self-reporting practices, the researchers met monthly with the OED team to discuss the importance of reporting each acts of violence from least (incivility, rudeness) to most severe (assault).
- The generalization of the results is limited by the single-centre study design and by the differences between the OEDs and general emergencies.

MAIN TEXT

Introduction

According to the International Labor Office, workplace violence is a frequent phenomenon.¹ Hospital healthcare workers are particularly vulnerable by their exposure to patients who can be agitated and distressed.^{2,3,4} Around the world, the emergency departments (ED) have been identified as an area of the healthcare sector with a high number of reported violent acts.^{5,6,7,8,9,10,11} However, the phenomenon is underreported, especially non-physical violence (i.e. incivility, harassment, verbal violence). Comparison of self-report and actual documentation of hospital incidents in the US showed that 88% of the events were not document.¹² Such reports are mainly informally reported to the colleagues.¹³

Four levels of aggressiveness are distinguished by order of severity by the French National Observatory of Violence in healthcare to describe violent behaviour: incivility (a lack of respect for others that manifests itself as relatively harmless acts), verbal abuse, physical threat (insults, threatening behaviour), and physically violent acts.¹⁴ This violence can have repercussions on the physical and emotional health of the victims, and thus on their well-being and the quality of their work. Healthcare workers have been shown to suffer emotional symptoms similar to post-traumatic stress disorder, job dissatisfaction, and early feelings of burnout, while hospitals have to bear the financial burden of decreased productivity.^{15,16,17,18,19}

In the ED, the frequency of visits observed in recent years has been accompanied by a drastic increase in the waiting times²⁰ which can lead to a high level of patient dissatisfaction and of aggression towards healthcare workers. Other factors, such as anxiety, boredom, lack of information, lack of understanding of triage categories, may also favour violent behaviour.^{21,22}

According to the Haddon matrix adapted by Gates *et al.*, interventions to reduce violence in the ED can be categorized according to the time of intervention: before (primary prevention), during (secondary prevention), or after (tertiary prevention) an act of violence; and according to the target

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3 of the intervention (healthcare workers, patients or accompanying visitors, and environment).^{23,24}

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5 There are several solutions for the prevention of ED violence. Many have concerned primary
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7 prevention with interventions aiming at reducing waiting times, managing priorities (implementation
8
9 of a triage algorithm to manage patients according to the seriousness of the cases), improving
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11 signage and patients' understanding of the care pathway.^{25,26} Security of premises (security guards,
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13 video surveillance, warning systems, etc.) can sometimes be implemented.⁷ The few studies that
14
15 have attempted to evaluate the effectiveness of prevention interventions have a low level of
16
17 evidence.^{24,27}

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21 In the ophthalmology emergency department (OED) of a French university hospital, the healthcare
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23 workers reported the occurrence of acts of incivility and verbal violence, with both medical and
24
25 nursing staff demanding that this issue be addressed.²⁸ The solutions identified to deal with violence
26
27 included reducing waiting times, improving the premises (i.e. the comfort of waiting rooms,
28
29 confidentiality at the registration desk), changing signage, improving patient information, and
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31 mediation. These components were integrated in a comprehensive primary prevention programme
32
33 aimed at averting violence through different components that were environment and patient-
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35 oriented. The aim of this study was to evaluate the impact of this prevention programme on acts of
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37 incivility and verbal violence against healthcare workers in the OED.
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45 **Methods**

46 ***Study design***

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49 The study was designed as a single-centre, prospective interrupted time series study. There were
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51 three periods: a 3-month pre-interventional period (from 1 January 2014 until 30 March 2014), a 3-
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53 month training period (from 31 March 2014 until 9 July 2014) and a 12-month implementation
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55 period of the prevention programme (from 10 July 2014 until 30 June 2015); the protocol has been
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57 previously published.²⁹
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3 *Deviations from the published protocol*²⁹: the planned study design was a “on – off” study over 24
4 months (including a 2-month pre-interventional period and a 22-month intervention period, without
5 a training period). The first 6 months of the study were not taken into account owing to strong
6 underreporting of violent acts by the healthcare worker, as ascertained during study coordination
7 meetings. To meet the study schedule, we reduced the duration of the study to 18 months and we
8 modified the study design. We chose to abandon the “on – off” design because of time constraints
9 and the low acceptability of the “off” period when the intervention was to be removed.
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18 ***Patient and Public Involvement***

19 Patients or the public were not involved in this work.
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22 ***Setting***

23 This study took place at an adult OED of a university hospital located in an urban environment, in the
24 Rhône-Alpes region of France. The OED is open 24 hours a day, 7 days a week, and handles all types
25 of medical and surgical ophthalmological emergencies. In 2014, the department treated 20 309
26 patients with 68 admissions a day on average.
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36 ***Participants***

37 ***Patients and those accompanying them***

38 All patients (adults and children) registering at the OED from 1 January 2014 to 30 June 2015 were
39 included. Those accompanying the patient (family, friends, etc.) were also included. Patients
40 registering during weekends and public holidays were excluded owing to the organisational
41 characteristics of these periods (i.e. different and fewer staff as compared to weekdays), as were
42 those registering during the 3-month training period from 31 March 2014 to 9 July 2014.
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52 ***Healthcare workers***

53 The OED team (seven nurses, six ward aides, two orthoptic students, seven residents in
54 ophthalmology, four senior ophthalmologists) operating on a rotating schedule to provide care 24/7
55 were included in the study. The OED team present during a week day is composed of four nurses,
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3 four ward aides, two orthoptic students, one or two residents in ophthalmology, and one on-call
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5 senior ophthalmologist; this did not change over the study period. Four admitting clerks were also
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7 included.
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10 ***Prevention programme***

11 *Programme elaboration*

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13 The OED team partnered with researchers to develop the comprehensive prevention programme.

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15 The programme had five complementary components, identified through a literature review, that
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17 were added progressively:
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21 - An organisational component (A), beginning 30 March 2014, with the use by reception nurses of a
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23 computerized triage algorithm. This algorithm made it possible to prioritize patients as soon as they
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25 arrived in the unit and to carry out initial examinations (such as dilatation of the pupils by the
26
27 orthoptist) according to the patient's reason for presentation to the OED. It was linked to a waiting
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29 room patient call system. A 3-month phase of training to use of the algorithm was conducted for
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31 reception nurses (named "training period"). This training period was not planned in the published
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33 protocol.²⁹
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37 - An environmental component (B) and educational component (C) beginning 6 October 2014 were
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39 combined. The environmental component was signage to help patients navigate within the OED. The
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41 educational component was messages about the OED team and its activity, the care pathway, the
42
43 patients' order of passage according to severity, and information on the waiting time range that were
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45 broadcast on TV in the waiting rooms to patients. As both components addressed difficulties for the
46
47 patients to understand the functioning of the OED, we considered it appropriate to combine them.
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49 This is a deviation from the initial protocol.²⁹
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53 - A relational component (D) beginning 5 January 2015 with the presence of a mediator in the OED,
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55 for preventive mediation actions. The mediator held a master's degree in mediation, and was
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57 recruited as part of the project. The mediator was to intervene when patients showed signs of
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3 impatience or nervousness and in case of conflict involving a patient or visitor. The mediator
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5 circulated through corridors and waiting rooms, and was available to patients and visitors.
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7 - A security component (E) beginning 6 April 2015, with the implementation of video surveillance
8
9 cameras throughout the OED (admissions desk, corridors) connected to the hospital security control
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11 room.
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13 *Programme implementation*

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15 The prevention programme was implemented in four steps of three months period, after a 3-month
16
17 training period for the computerized triage algorithm (Figure 1). The study project manager
18
19 conducted monthly visits to the OED during the intervention period to ensure programme
20
21 implementation.
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25 **Outcomes**

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27 *The primary outcome* was violence committed by patients or those accompanying them against
28
29 healthcare workers or against other patients and those accompanying them among all admissions to
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31 the OED.
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35 Violence was reported in medical records by healthcare workers. They could report incidents directly
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37 committed against them or against patients and those accompanying them. Violence was described
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39 using a classification that distinguishes four levels, from least (incivility) to most severe (assault),
40
41 based on the French National Observatory of Violence in healthcare (Table 1).²⁹ Clinical cases were
42
43 used monthly to train professionals to identify the different types of acts of violence to be reported
44
45 and their level of severity (see table 1 for examples). They were developed from situations
46
47 experienced by OED professionals. These situations were identified during interviews with OED
48
49 professionals conducted by the researchers prior to the initiation of the study.²⁸ The aim was to
50
51 reduce the variability in the classification of events.
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55 The project manager also met monthly with the OED team to discuss the importance of reporting
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57 events to limit under-reporting of acts violence.
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3 *Secondary outcomes* were waiting time (defined as the interval of time between the administrative
4 registration of the patient and the assessment by a nurse or an ophthalmologist) and length of stay
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6 (defined as the interval of time between registration and discharge). This information was routinely
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8 collected at the OED for all inpatients.
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Table 1. Four levels of violence, from least to most severe according to the National Observatory of Violence in Hospitals and examples of clinical cases used to train healthcare workers.

Level 1 (incivility)	<p>Insistent questions, incivility, rudeness, occupation of the corridor, spitting, making noise (telephone, etc.)</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) opens the door of the nursing office without knocking, or waiting for an answer, and calls you for some reason. - A patient (or an accompanying person) considering that everyone comes before him comes to show his dissatisfaction.
Level 2 (verbal harassment)	<p>Insult or verbal abuse without threat</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person), dissatisfied with your answer, calls you an asshole. - A patient (or an accompanying person), tired of waiting, calls you a loser or incapable.
Level 3 (threats)	<p>Verbal or physical threat.</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) raises his hand on you. - A patient (or an accompanying person) comes dangerously close to you to scream on you.
Level 4	<p>Intentional violence, assault, vandalism or damage to equipment.</p>

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3 (assaults)

Examples:

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5 - An angry patient (or an accompanying person) pushes you.

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7 - A patient (or an accompanying person) spits on you.
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Legend. Examples come from clinical cases used to train the healthcare workers to notify the level any incivility or violence they may be subject.
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Blinding

Healthcare workers and patients were not blinded to the intervention phase. However, in the absence of individual information on the study (this was not required by the Institutional Review Board), it appears unlikely that patient behaviour was influenced by the study.

Sample size

In the initial protocol the sample size was determined for an on – off design by the expected efficacy of each of the five components of the prevention programme. The statistical unit was the patient admitted to the OED. Based on the initial hypotheses, the total sample size required was 30 224 admissions with a risk alpha of 5% and the statistical power of 80%. We did not recalculate the number of subjects required; there is usually no estimation of the sample size in interrupted time-series studies.^{30,31}

Statistical methods

The analyses were conducted on data obtained during the 15-month study period (that corresponded to the pre-intervention and intervention periods and without consideration of the training period). The proportion of admissions with violence committed by patients, or those accompanying them, was expressed as a rate per 1000 admissions. When the perpetrator was someone accompanying the patient, the violence was attributed to the patient.

For all outcomes, we conducted a pre post analysis to compare rates before and during implementation of the prevention programme using chi square tests. In addition, for the primary outcome we performed a segmented regression analysis to account for the possibility of concurrent secular trends in violence which could influence the results. We evaluated the effect of the programme on violence at both the aggregate and individual patient levels.

First, a segmented Poisson regression model offset by the total number of admissions at OED per month was used to compare monthly violence rates between pre and intervention periods. The

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3 model included intercept, time trend before implementation, change in level immediately after the
4 training period, and change in time trend after the training period.

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7 Analyses were stratified to allow for differential effects by age group, gender, waiting time and
8 length of stay. Results were reported as incidence rate ratio (IRR) and 95% confidence intervals (CIs).
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11 Secondly, logistic regression was used to assess change in level and trend of odds of violence
12 occurrence within admission at OED before and after each intervention after adjusting for individual
13 characteristics (age, gender, waiting time >2h, admission to OED during public holidays, night
14 admission, patients with several admissions to OED). A model with generalized equation estimation
15 with a 1st order autoregressive correlation structure was fitted to account for the clustering of
16 admissions to the OED within a calendar day. Results were reported as odds ratio (OR) and 95% CIs.
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18 All admissions to the OED were treated independently. All p values were 2-sided and statistical
19 significance level was set at alpha=0.05. Statistical analyses were performed with SAS version 9.4
20 software (SAS Institute Inc., Cary, NC, USA).
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32 ***Ethics approval***

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35 The Sud Est IV Institutional Review Board's approval was obtained in September 2011 (L11-117).
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37 Under French law in effect at the time of the study, consent was not required for the type of study
38 and intervention being evaluated.
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42 ***Reporting criteria***

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45 We followed the SQUIRE criteria from the EQUATOR network to report the study.³²
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51 **Results**

52 ***Participants***

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55 Over the 15-month study period, 22 107 admissions (corresponding to 18 826 patients) were
56 analysed (Figure 1). Among the 18 826 patients, 12% were admitted more than once. The mean \pm
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3 standard deviation (SD) number of visits per patient was 1.2 ± 0.6 (range: 1-15), there was a mean 70
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5 ± 12 admissions per day over the 315-day study period (range: 33-105).
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8 ***Characteristics of admissions***

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10 Characteristics of admissions according to the components implemented are presented in Table 2.
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Table 2. Characteristics of admissions, waiting time and length of stay.

	Pre-intervention period N=4 118	Intervention period			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Male, n (%)	2 250 (54.6)	2 335 (53.0)	2 499 (54.5)	2 426 (54.5)	2 564 (56.4)
Age ≥ 40 years, n (%)	2 159 (52.4)	2 547 (57.8)	2 452 (53.5)	2 368 (53.2)	2 459 (54.1)
Coming during the day, n (%)	2 944 (71.5)	3 164 (71.9)	3 536 (77.1)	3 519 (79.0)	3 324 (73.1)
Waiting time > 2h ^a , n (%)	2 755 (66.9)	2 754 (62.5)	2 377 (51.8)	2 100 (47.1)	2 125 (46.8)
Length of stay > 3h, n (%)	2 045 (49.7)	2 481 (56.3)	2 002 (43.6)	1 601 (35.9)	1 595 (35.1)

Legend: Coming during the day corresponded to admission between 8 am and 7.59 pm; waiting time was defined as the duration between time of registration of patient's arrival and first time of assessment by a nurse or an ophthalmologist; Length of stay was defined as the duration between registration and discharge. Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast, D corresponded to mediator and E corresponded to video surveillance.

^a waiting time was not documented for 108 admissions.

Outcomes

A total of 376 acts of violence corresponding to 272 admissions (1.4% of 22 107 admissions) were recorded during the total study period (Table 3). Among the 272 admissions concerned, 74% (n=202) had led to one act of violence, 16% (n=45) had led to two acts, and 10% (n=25) had led to three or more acts. In the pre-intervention period, 98.6% acts of violence were incivility or verbal harassment and 1.4% were threats. In the intervention period, all acts of violence were incivility or verbal harassment.

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Table 3. Characteristics of acts of violence reported by healthcare workers.

	Pre-intervention period N=4 118	Intervention period after a 3-month training			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Rate of act of violence per 1000 admissions (95%CI)*	24.8 (20.0-29.5)	10.0 (7.1-12.9)	8.9 (6.2-11.7)	8.1 (5.5-10.7)	10.8 (7.8-13.8)
Act of violence**, n	143	54	51	56	72
Level of violence, n (%)					
Level 1 (incivility)	131 (91.6)	46 (85.2)	45 (88.2)	43 (76.8)	65 (90.3)
Level 2 (verbal harassment)	10 (7.0)	7 (13.0)	5 (9.8)	13 (23.2)	7 (9.7)
Level 3 (threats)	2 (1.4)	1 (1.9)	1 (2.0)	0 (0)	0 (0)
Level 4 (assaults)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Committed by patient, n (%)	98 (68.5)	43 (79.6)	35 (68.6)	38 (67.9)	53 (73.6)
Healthcare worker as the victim***, n (%)	140 (97.9)	51 (94.4)	48 (94.1)	54 (96.4)	72 (100)

* Rate of act of violence was defined as the percentage of admissions per period with at least one act of violence reported.

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3 ** Several acts of violence could be occurred per admission.
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5 *** 6 acts of violence were committed between patients and the victim was not documented for 5 acts of violence.
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8 Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast, D corresponded to mediator and E
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10 corresponded to video surveillance cameras.

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12 Abbreviation: CI: Confidence Interval.
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Primary outcome

The rate of violence significantly decreased from 24.8 (95%CI: 20.0 to 29.5) admissions with violence per 1000 admissions in pre-intervention period to 9.5 (95%CI: 8.0 to 10.9) acts of violence per 1000 admissions in intervention period ($p<0.001$). The effects of the components on monthly violence rates are presented in Figure 2.

Secondary outcomes

The frequency of admissions with waiting times ≥ 2 hours decreased from 67% (n=2755 admissions) to 52% (n=9356) between the pre-intervention period and the intervention period ($p<10^{-3}$). For the length of stay, frequency of admissions with a stay ≥ 3 hours decreased from 50% (n=2045) to 43% (n=7679; $p<10^{-3}$).

Segmented regression analysis

According to the Poisson regression analyses, no pre-intervention trend was seen in monthly violence rates (IRR=1.13, 95%CI: 0.87 to 1.46, $p=0.3243$). After accounting for underlying trends, an immediate 53% decrease (IRR=0.47, 95%CI: 0.27 to 0.82, $p=0.0121$) was observed in the violence rate of the first month following the training period. No monthly trend effects in overall intervention period was detected (IRR=0.97, 95%CI: 0.92 to 1.02, $p=0.1660$). Poisson regression results stratified by admission's characteristics are presented in a table 4. Following the training period, a similar immediate decrease was found for female (IRR=0.35, 95%CI: 0.15 to 0.83, $p=0.0212$), age <40 years (IRR=0.43, 95%CI: 0.19 to 0.99, $p=0.0471$), waiting time >2 hours (IRR=0.49, 95%CI: 0.26 to 0.92, $p=0.0306$), and length of stay >3 hours (IRR=0.38, 95%CI: 0.20 to 0.74, $p=0.0089$). No monthly trend effect in the intervention period was observed for all subgroups.

Table 4. Multivariate analysis* of the comprehensive prevention programme on violence rates by admissions characteristics.

Characteristics	Pre-intervention trend (per month)**		Change in level***		Change in trend (per month)****	
	IRR [95%CI]	p-value	IRR [95%CI]	p-value	IRR [95%CI]	p-value
Sex						
Male	1.05 [0.76;1.46]	0.7500	0.59 [0.28;1.20]	0.1308	0.95 [0.89;1.01]	0.0810
Female	1.27 [0.84;1.93]	0.2343	0.35 [0.15;0.83]	0.0212	1.00 [0.93;1.07]	0.9548
Age						
<40 yrs	1.11 [0.78;1.58]	0.5292	0.43 [0.19;0.99]	0.0471	0.96 [0.90;1.04]	0.2771
≥ 40 yrs	1.16 [0.79;1.69]	0.4107	0.51 [0.24;1.08]	0.0730	0.97 [0.92;1.04]	0.3601
Waiting time						
≤2h	1.11 [0.67;1.85]	0.6468	0.39 [0.13;1.18]	0.0892	0.96 [0.88;1.05]	0.3427
>2h	1.12 [0.83;1.51]	0.4233	0.49 [0.26;0.92]	0.0306	0.99 [0.94;1.04]	0.6704
Length of stay						
≤3h	1.03 [0.66;1.62]	0.8738	0.57 [0.22;1.51]	0.2329	0.96 [0.89;1.04]	0.2823
>3h	1.13 [0.82;1.55]	0.4231	0.38 [0.20;0.74]	0.0089	1.00 [0.94;1.06]	0.9764

Abbreviations: IRR: Incidence rate ratio, CI: Confidence interval.

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3 * segmented Poisson regression offset by the total number of admissions at OED per month. RR <1 represents a decline and inversely

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5 RR>1 represents an increase in monthly violence rate.

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7 ** rate of change in monthly violence rate prior the intervention (i.e. time effect).

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9 *** immediate change in the mean monthly violence rate from pre intervention to intervention period.

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11 **** change in slope per month following to the intervention period.
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Piecewise logistic regression analysis

Piecewise logistic regression analysis confirmed the absence of pre-intervention trend (see table 5).

Following the training period, three components of the programme had significant effects on the underlying trend of violence occurrence. There was a significant decline in the odds of violence occurrence over time after the implementation of component A-Algorithm (adjusted odds ratio [aOR]= 0.87, 95%CI: 0.82-0.91, $p<10^{-3}$). The trend toward decreasing occurrence of violence over time significantly reversed in the 3 months following the implementation of component D-Mediators (aOR= 1.45, 95%CI: 1.14-1.84, $p=0.002$) indicating a significant increase over time after the implementation of a mediator. The trend significantly reversed following component E- video surveillance (aOR= 0.65, 95%CI: 0.45-0.93, $p=0.019$) suggesting that the magnitude of increase in occurrence of violence decreased over time and returned at its previous level (aOR= 0.84, 95%CI: 0.66-1.07, $p=0.152$). No effect was observed for the component BC combining signage and messages broadcast on TV in the waiting rooms.

Table 5. Piecewise logistic regression analysis of the comprehensive prevention programme effects* on violence.

	Full model**		Simple model***	
	OR [95%CI]	p-value	OR [95%CI]	p-value
Trend prior to intervention (per month)	1.09 [0.81 ; 1.49]	0.5848	--	--
Immediate change in level:				
A	0.31 [0.03 ; 3.20]	0.3236	--	--
BC added to A	2.19 [0.70 ; 6.82]	0.1773	--	--
D added to ABC	1.05 [0.28 ; 3.88]	0.9406	--	--
E added to ABCD	5.73 [2.08 ; 15.77]	0.0007	--	--
Change in trend (per month):				
A	0.95 [0.55 ; 1.65]	0.8657	0.87 [0.82 ; 0.92]	<.0001
BC added at A	0.61 [0.33 ; 1.13]	0.1188	--	--
D added at ABC	1.85 [0.98 ; 3.48]	0.0572	1.45 [1.14 ; 1.84]	0.0022
E added at ABCD	0.35 [0.17 ; 0.70]	0.0031	0.65 [0.45 ; 0.93]	0.0194

Abbreviations: OR: odds ratio, CI: Confidence interval.

Components: A corresponded to computerized triage algorithm, BC corresponded to signage and messages broadcast on TV in the waiting rooms, D corresponded to mediator and E corresponded to video surveillance cameras.

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3 *logistic generalized estimating equation model adjusted for waiting time > 2h. OR <1 represent a decline and inversely OR>1 represent an increase in
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5 monthly likelihood of violence occurrence during admission at OED per month.
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8 **full model included time effect and immediate changes after each component's implementation and changes in slopes.
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10 ***parsimonious model after backward selection.
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Discussion

The present study found a significant reduction in self-reported incivility or verbal violence by healthcare workers following the implementation of a comprehensive prevention programme. This reduction occurred after the implementation of the first component of the programme, a triage algorithm, and was maintained over time while other components were successively implemented. The violence rate during the pre-intervention period found in the present study (24.8 per 1000 admissions) was higher than that reported. In a recent meta-analysis of 22 studies; the authors found a pooled incidence of 36 per 10,000 admissions (range: 1 to 172 per 10,000 admissions).³³ It is, however, difficult to compare the results of the present study with those reported elsewhere due to heterogeneity in the way violence is defined, collected and reported in the literature; for a majority of studies, data collection was conducted retrospectively, using security records and incident report documents that mainly report severe acts of violence.³³

Previous studies reported a low rate of acts of violence with a high level of severity (threats and assaults).^{34,33} In the present study, the frequency of such acts were even lower; only four acts of verbal or physical threat and no assault. This can be explained by the context of the OED which did not admit patients for drug/alcohol abuse or psychiatric disease which are predictor of physical violence perpetrated by patient against healthcare workers.³⁵ However, as in other studies, verbal harassment or incivility committed by patients were the most frequent form of violence experienced herein despite differences in methodology.^{36,37,38} Concomitantly, waiting times and length of stay of patients in the OED were significantly reduced. The reduction of waiting times was an expected effect of the triage algorithm, which allowed, according to the reason for consultation, for orthoptists to perform examinations such as dilating pupils without having to consult a physician. Associated with a patient call system in the waiting room, the triage algorithm was a mean streamline the order of passage and waiting time and thus reduce the stressful condition in waiting rooms.³⁵ It was not

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3 related to a change in the number of professionals (which remained stable throughout the study) nor
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5 to a change in the number of admissions to OED.
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7 As recommended, the prevention programme combined different components, targeting regularly
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9 cited causes of violence.²⁴ The intervention targeted patients/visitors and the environment, but did
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11 not target how OED professionals handle violent situations.^{38,39,40} Behaviour of healthcare
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13 professionals such as empathic communication, early proactive interaction, and verbal and body
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15 language expressing respect and confidence are associated with a reduction in incivility and verbal
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17 abuse or aggressive behaviour.^{28,35,41}
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20 Caution should, however, be taken when interpreting the results of the present study. It is not
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22 possible to distinguish the relative effect of the tested components. For instance, a positive effect
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24 was observed during the implementation of the first component (triage algorithm linked to a waiting
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26 room patient call system). It is not possible to conclude whether this effect was due to the algorithm
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28 or to the fact that it was implemented first. Another point to consider is that violence increased
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30 despite the presence of the mediator. To the best of our knowledge, there was no change in the
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32 conditions of patient reception (i.e. no increase in waiting times or in admission frequency and no
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34 change in the OED team) during the implementation of the mediator that could explain this
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36 unintended effect. The mediator, by his/her presence, may have stimulated the declaration of
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38 violence by healthcare workers. It points out the difficulty to collect non-physical acts of violence
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40 which are underreported by healthcare staff. Main reasons are: it is so prevalent yet rarely results in
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42 physical injury, most of professionals consider it as part of their jobs, these acts of violence are
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44 subject to personal interpretation, and the use of existing reporting systems is time-consuming and
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46 perceived as unnecessary because it does not lead to any action to reduce these
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48 behaviours.^{24,28,41,42,43} To limit variation in reporting practices, the researchers met monthly with the
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50 OED team to discuss the importance of reporting events from least (incivility) to most severe
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52 (assault). Moreover reporting was facilitated by its integration in the patient records.
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3 Moreover, we conducted a segmented regression analysis to detect if the programme had a greater
4 effect than an underlying secular trend.^{30,31,44,45,46} The analysis is limited by the short pre-intervention
5 phase, which does not allow a solid estimation of the trend before the programme implementation.
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10 Second, a longer post-intervention follow-up could have been useful to verify the effectiveness of the
11 program at a distance of time from its implementation.⁴⁷ A longer observation could have helped to
12 explain whether the increase in the reports after the implementation of the mediator is a real
13 phenomenon (increase of the violence) or not (greater attention to violence). A qualitative approach
14 would have also helped us to better understand the mechanisms of action of the programme
15 components,⁴⁸ in particular the paradoxical effect of the mediator. It would have allowed us to
16 evaluate whether the coping of the healthcare workers with the violence has improved. Finally, the
17 generalization of the results is limited by the single-centre study design and by the differences
18 between the OEDs and general emergencies. In particular, there are no admissions for psychiatric or
19 drug abuse and alcohol problems, which are known to be sources of violence.^{33,35}
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32 In conclusion, a comprehensive prevention programme targeting patients, visitors and environment
33 can reduce self-reported incivility and verbal violence by healthcare workers in an OED over 12
34 months. EDs should develop comprehensive primary prevention programme that integrate various
35 environmental and patient-oriented components (organisational, educational, relational, security).
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Author contributions

The study was conceptualized and designed by ST, PLC, MALP, and ADu.

PLC and CB are the Co-Chief Investigators, provided leadership for the project.

ST, PLC, JBF, and ADu contributed to the development of the programme.

ST, PO, and ADe planned the statistical analysis.

ADe carried out the statistical analyses.

ST, PO, and ADe drafted the manuscript.

All authors reviewed the draft version, made suggestions, and approved the final version.

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Competing Interests

None declared.

Patient consent

Not required.

Data statement

The data set is not available as ethics approval does not allow release.

Figures

Figure 1. Study flow chart of admissions at Ophthalmology Emergency Department.

Legend: Components: A: computerized triage algorithm, BC: signage and messages broadcast on TV in the waiting rooms, D: mediator, E: video surveillance.

Figure 2. Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention programme.

Abbreviation: OED: Ophthalmology Emergency Department

Legend: the grey band represents the 3-month training period. The dotted lines inside the scatter plots represents the implementation of component A (computerized triage algorithm), component BC (signage and messages broadcast on TV in the waiting rooms), component D (mediator) and component E (video surveillance).

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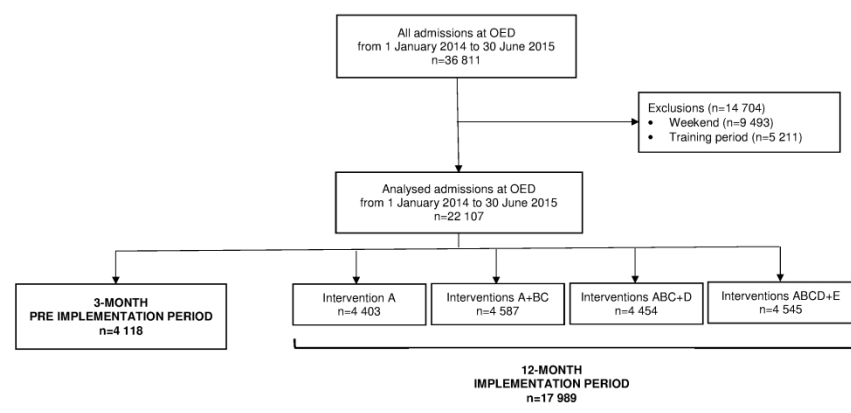
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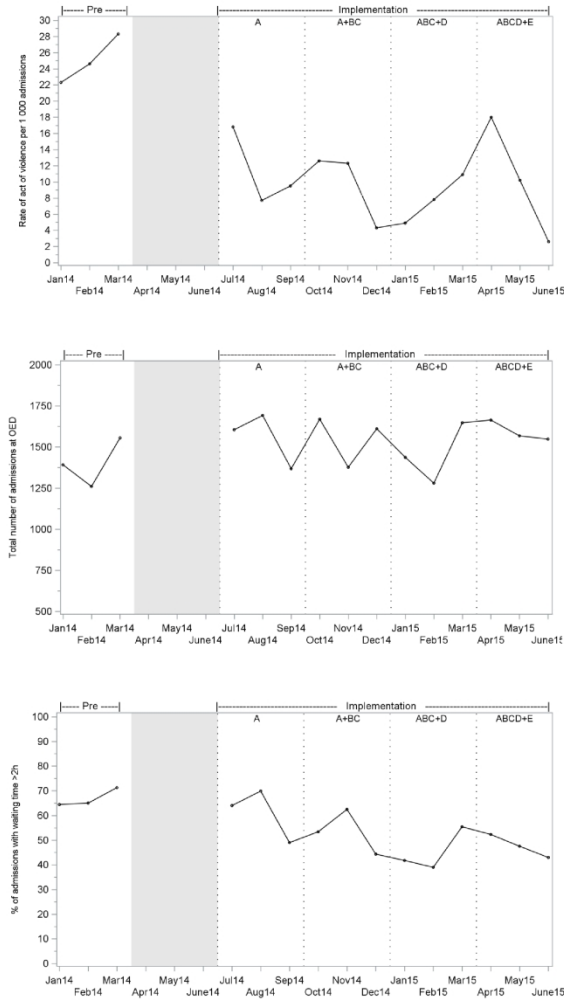
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Study flow chart of admissions at Ophthalmology Emergency Department.
 Legend: Components: A: computerised triage algorithm, BC: signage and messages broadcast on TV in the waiting rooms, D: mediator, E: video surveillance.



Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention program.

Abbreviation: OED: Ophthalmology Emergency Department

Legend: the grey band represents the 3-month training period. The dotted lines inside the scatter plots represents the implementation of component A (computerised triage algorithm), component BC (signage and messages broadcast on TV in the waiting rooms), component D (mediator) and component E (video surveillance).

209x297mm (300 x 300 DPI)

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	Reporting Item	Page Number
	#1 Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patientcenteredness, timeliness, cost, efficiency, and equity of healthcare)	1
	#02a Provide adequate information to aid in searching and indexing	1
	#02b Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	1
Problem description	#3 Nature and significance of the local problem	6
Available knowledge	#4 Summary of what is currently known about the problem, including relevant previous studies	5
Rationale	#5 Informal or formal frameworks, models, concepts, and / or theories used to explain the problem, any reasons or	5 - 6

1		assumptions that were used to develop the intervention(s), and	
2		reasons why the intervention(s) was expected to work	
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4	Specific aims	#6 Purpose of the project and of this report	6
5			
6	Context	#7 Contextual elements considered important at the outset of	7
7		introducing the intervention(s)	
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10	Intervention(s)	#08a Description of the intervention(s) in sufficient detail that others	8
11		could reproduce it	
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14		#08b Specifics of the team involved in the work	8
15			
16	Study of the	#09a Approach chosen for assessing the impact of the intervention(s)	6
17	Intervention(s)		
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20		#09b Approach used to establish whether the observed outcomes	6, 12,13
21		were due to the intervention(s)	
22			
23			
24	Measures	#10a Measures chosen for studying processes and outcomes of the	9
25		intervention(s), including rationale for choosing them, their	
26		operational definitions, and their validity and reliability	
27			
28			
29		#10b Description of the approach to the ongoing assessment of	9
30		contextual elements that contributed to the success, failure,	
31		efficiency, and cost	
32			
33			
34		#10c Methods employed for assessing completeness and accuracy	9
35		of data	
36			
37			
38	Analysis	#11a Qualitative and quantitative methods used to draw inferences	12,13
39		from the data	
40			
41			
42		#11b Methods for understanding variation within the data, including	12,13
43		the effects of time as a variable	
44			
45			
46	Ethical	#12 Ethical aspects of implementing and studying the intervention(s)	15,30
47	considerations	and how they were addressed, including, but not limited to,	
48		formal ethics review and potential conflict(s) of interest	
49			
50			
51		#13a Initial steps of the intervention(s) and their evolution over time	See note
52		(e.g., time-line diagram, flow chart, or table), including	1
53		modifications made to the intervention during the project	
54			
55			
56		#13b Details of the process measures and outcome	9
57			
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1		#13c	Contextual elements that interacted with the intervention(s)	15
2				
3		#13d	Observed associations between outcomes, interventions, and	20
4			relevant contextual elements	
5				
6				
7		#13e	Unintended consequences such as unexpected benefits,	See note
8			problems, failures, or costs associated with the intervention(s).	2
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11		#13f	Details about missing data	See note
12				3
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15	Summary	#14a	Key findings, including relevance to the rationale and specific	27
16			aims	
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18		#14b	Particular strengths of the project	27
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21	Interpretation	#15a	Nature of the association between the intervention(s) and the	27
22			outcomes	
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24		#15b	Comparison of results with findings from other publications	27
25				
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27		#15c	Impact of the project on people and systems	27
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29		#15d	Reasons for any differences between observed and anticipated	22
30			outcomes, including the influence of context	
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33		#15e	Costs and strategic trade-offs, including opportunity costs	See note
34				4
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37	Limitations	#16a	Limits to the generalizability of the work	28
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39		#16b	Factors that might have limited internal validity such as	28
40			confounding, bias, or imprecision in the design, methods,	
41			measurement, or analysis	
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44		#16c	Efforts made to minimize and adjust for limitations	28
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47	Conclusion	#17a	Usefulness of the work	29
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52		#17c	Potential for spread to other contexts	28
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54		#17d	Implications for practice and for further study in the field	29
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56		#17e	Suggested next steps	29
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1	Funding	#18	Sources of funding that supported this work. Role, if any, of the	30
2			funding organization in the design, implementation,	
3			interpretation, and reporting	
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Author notes

1. 8, figure 1
2. n/a (not measured)
3. n/a (self-reported)
4. n/a (not measured)

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BMJ Open

Impact of a comprehensive prevention programme aimed at reducing incivility and verbal violence against healthcare workers in a French ophthalmic emergency department: an interrupted time-series study.

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3 TITLE PAGE4
5 **Title of the article:**6
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8 Impact of a comprehensive prevention programme aimed at reducing incivility and verbal violence
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12 series study.
1314
15 **Corresponding author**16
17 Sandrine Touzet18
19 Hospices Civils de Lyon20
21 Pôle de Santé Publique22
23 162 avenue Lacassagne24
25 69003 Lyon26
27 France28
29 sandrine.touzet@chu-lyon.fr30
31 +33 472 11 51 62
32
3334
35
36 **Authors**37
38 Sandrine Touzet*(1, 2), sandrine.touzet@chu-lyon.fr39
40 Pauline Occelli (1, 2), pauline.occelli@chu-lyon.fr41
42 Angelique Denis (1), angelique.denis@chu-lyon.fr43
44 Pierre-Loïc Cornut (3), dr.cornut@gmail.com45
46 Jean-Baptiste Fassier (4, 5), jean-baptiste.fassier@chu-lyon.fr47
48 Marie-Annick Le Pogam (6), marie-annick.le-pogam@chuv.ch49
50 Antoine Duclos (1, 2), antoine.duclos@chu-lyon.fr51
52 Carole Burillon (3, 7), carole.burillon@chu-lyon.fr53
54 The PREVURGO Study Group.55
56 *Corresponding author
57
58
59
60

1
2
3 **The PREVURGO study group:**
4

5 Nassira Amamra

6 Emmanuelle Aubert

7
8
9
10 Sylvain Beccat

11 Daniel Betito

12 Laetitia Bouveret

13 Philippe Charrier

14 Dominique Delaunay

15 Mélanie Dufourneau

16 André Lecoanet

17 Philippe Sarnin

18 Jéromine Sicalac

19 Sylvie Sullerot

20
21
22
23
24
25
26
27
28
29
30
31
32
33 **Institutional addresses**
34

35
36 1. Centre Hospitalier Universitaire de Lyon, Pôle de Santé Publique, Unité de recherche sur les
37 services de santé, Lyon, FR.

38
39
40 2. Université Claude Bernard Lyon 1, Laboratoire HESPER Health Services and Performance Research
41 EA 7425, Lyon, FR.

42
43
44 3. Hospices civils de Lyon, Hôpital Edouard Herriot, Service d'ophtalmologie, Lyon, FR.

45
46
47 4. Centre Hospitalier Universitaire de Lyon, Service de médecine et santé au travail, Lyon, FR.

48
49
50 5. Université Claude Bernard Lyon 1 - Domaine de Rockefeller, UMRESTTE UMR T_9405, Unité mixte
51 de recherche Epidémiologique et de Surveillance Transport Travail Environnement, Lyon, FR.

52
53
54 6. Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital (CHUV),
55 Lausanne, CH.

56
57
58 7. Université Claude Bernard Lyon 1, Villeurbanne, FR.
59
60

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KEY WORDS

Health services research; Time series study; Healthcare workers; Violence.

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ABSTRACT

Objective and setting: Primary prevention, comprising patient-oriented and environmental interventions, is considered to be one of the best ways to reduce violence in the emergency department. We assessed the impact of a comprehensive prevention programme aimed at preventing incivility and verbal violence against healthcare professionals working in the ophthalmology emergency department (OED) of a university hospital.

Intervention: The programme was designed to address long waiting times and lack of information. It combined a computerised triage algorithm linked to a waiting room patient call system, signage to assist patients navigate in the OED, educational messages broadcast in the waiting room, presence of a mediator, and video surveillance.

Participants: All patients admitted to the OED and those accompanying them.

Design: Single-centre prospective interrupted time-series study conducted over 18 months.

Primary outcome: Violent acts self-reported by healthcare workers committed by patients or those accompanying them against healthcare workers.

Secondary outcomes: Waiting time and length of stay.

Results: There were a total of 22,107 admissions, including 272 (1.4%) with at least one act of violence reported by the healthcare workers. Almost all acts of violence were incivility or verbal harassment. The rate of violence significantly decreased from the pre-intervention to the intervention period (24.8; 95%CI: 20.0 to 29.5, to 9.5; 95%CI 8.0 to 10.9 acts per 1000 admissions; $p < 0.001$). An immediate 53% decrease in the violence rate (Incidence rate ratio=0.47; 95%CI: 0.27 to 0.82; $p = 0.0121$) was observed in the first month of the intervention period, after implementation of the triage algorithm.

Conclusion: A comprehensive prevention programme targeting patients and environment can reduce self-reported incivility and verbal violence against healthcare workers in an OED.

Trial registration: Registered at clinicaltrials.gov (identifier: NCT02015884).

ARTICLE SUMMARY

Strengths and limitations of this study

- The comprehensive primary prevention programme integrated components that were environment and patient-oriented (organisational, educational, relational, security).
- A segmented regression analysis was conducted to detect whether the programme had a greater effect than an underlying secular trend.
- The primary outcome is self-reported acts of violence, which is subjective.
- To limit variation in self-reporting practices, the researchers met monthly with the OED team to discuss the importance of reporting each act of violence from the least (incivility, rudeness) to most severe (assault).
- The generalisation of the results is limited by the single-centre study design and by the differences between the OEDs and general emergency departments.

MAIN TEXT

Introduction

According to the International Labor Office, workplace violence is a frequent phenomenon.¹ Hospital healthcare workers are particularly vulnerable by their exposure to patients who can be agitated and distressed.^{2,3,4} Around the world, emergency departments (ED) have been identified as an area of the healthcare sector with a high number of reported violent acts.^{5,6,7,8,9,10,11} However, the phenomenon is underreported, especially non-physical violence (i.e. incivility, harassment, verbal violence).

Comparison of self-reported and actual documentation of hospital incidents in the US showed that 88% of the events were not documented.¹² Such reports are mainly informally reported to their colleagues.¹³

Four levels of aggressiveness, in order of severity, are distinguished by the French National Observatory of Violence in healthcare to describe violent behaviour: incivility (a lack of respect for others that manifests itself as relatively harmless acts), verbal abuse, physical threat (insults, threatening behaviour), and physically violent acts.¹⁴ This violence can have repercussions on the physical and emotional health of the victims, and thus on their well-being and the quality of their work. Healthcare workers have been shown to suffer emotional symptoms similar to post-traumatic stress disorder, job dissatisfaction and early feelings of burnout, while hospitals have to bear the financial burden of decreased productivity.^{15,16,17,18,19}

In the ED the frequency of visits observed in recent years has been accompanied by a drastic increase in waiting times,²⁰ that can lead to a high level of patient dissatisfaction and of aggression towards healthcare workers. Other factors, such as anxiety, boredom, lack of information, and lack of understanding of triage categories may also favour violent behaviour.^{21,22}

According to the Haddon matrix adapted by Gates *et al.*, interventions to reduce violence in the ED can be categorized according to the time of intervention: before (primary prevention), during (secondary prevention), or after (tertiary prevention) an act of violence; and according to the target

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2
3 of the intervention (healthcare workers, patients or accompanying visitors, and environment).^{23,24}

4
5 There are several solutions for the prevention of ED violence. Many interventions have concerned
6
7 primary prevention with interventions aiming at reducing waiting times, managing priorities
8
9 (implementation of a triage algorithm to manage patients according to the seriousness of the cases),
10
11 improving signage and patients' understanding of the care pathway.^{25,26} Security of premises
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13 (security guards, video surveillance, warning systems, *etc.*) can sometimes be implemented.⁷ The few
14
15 studies that have attempted to evaluate the effectiveness of prevention interventions provide a low
16
17 level of evidence.^{24,27}

18
19 In the ophthalmology emergency department (OED) of a French university hospital the healthcare
20
21 workers reported the occurrence of acts of incivility and verbal violence, with both medical and
22
23 nursing staff demanding that this issue be addressed.²⁸ The solutions identified to deal with violence
24
25 included reducing waiting times, improving the premises (*i.e.* the comfort of waiting rooms,
26
27 confidentiality at the registration desk), changing signage, improving patient information, and
28
29 mediation. These components were integrated in a comprehensive primary prevention programme
30
31 aimed at averting violence through different components that were environment and patient-
32
33 oriented. The aim of this study was to evaluate the impact of this prevention programme on acts of
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35 incivility and verbal violence against healthcare workers in the OED.
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45 **Methods**

46 ***Study design***

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48 The study was designed as a single-centre, prospective interrupted time series study. There were
49
50 three periods: a 3-month pre-interventional period (from 1 January 2014 until 30 March 2014), a 3-
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52 month training period (from 31 March 2014 until 9 July 2014), and a 12-month implementation
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54 period of the prevention programme (from 10 July 2014 until 30 June 2015); the protocol has been
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56 previously published.²⁹
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3 *Deviations from the published protocol:*²⁹ the planned study design was a “on – off” study over 24
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5 months (including a 2-month pre-interventional period and a 22-month intervention period, without
6
7 a training period). The first 6 months of the study were not taken into account owing to strong
8
9 underreporting of violent acts by the healthcare workers, as ascertained during study coordination
10
11 meetings. To meet the study schedule, we reduced the duration of the study to 18 months and we
12
13 modified the study design. We chose to abandon the “on – off” design because of time constraints
14
15 and the low acceptability of the “off” period when the intervention was to be removed.
16
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18 19 ***Patient and Public Involvement***

20
21 Patients or the public were not involved in this work.
22
23

24 25 ***Setting***

26
27 This study took place at an adult OED of a university hospital located in an urban environment, in the
28
29 Rhône-Alpes region of France. The OED is open 24 hours a day, 7 days a week, and handles all types
30
31 of medical and surgical ophthalmological emergencies. In 2014, the department treated 20 309
32
33 patients with an average of 68 admissions per day.
34
35

36 37 ***Participants***

38 39 *Patients and those accompanying them*

40
41 All patients (adults and children) registering at the OED from 1 January 2014 to 30 June 2015 were
42
43 included. Those accompanying the patient (family, friends, etc.) were also included. Patients
44
45 registering during weekends and public holidays were excluded owing to the organisational
46
47 characteristics of these periods (*i.e.* different and fewer staff as compared to weekdays), as were
48
49 those registering during the 3-month training period from 31 March 2014 to 9 July 2014.
50
51

52 53 *Healthcare workers*

54
55 The OED team (seven nurses, six ward aides, two orthoptic students, seven residents in
56
57 ophthalmology, four senior ophthalmologists) operating on a rotating schedule to provide care 24/7
58
59 were included in the study. The OED team present during a week day is composed of four nurses,
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3 four ward aides, two orthoptic students, one or two residents in ophthalmology, and one on-call
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5 senior ophthalmologist; this did not change over the study period. Four admitting clerks were also
6
7 included.
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10 ***Prevention programme***

11 *Programme elaboration*

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13 The OED team partnered with researchers to develop the comprehensive prevention programme.

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15 The programme had five complementary components, identified through a literature review, that
16
17 were added progressively:
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21 - An organisational component (A), beginning 30 March 2014, with the use by reception nurses of a
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23 computerised triage algorithm. This algorithm made it possible to prioritise patients as soon as they
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25 arrived in the unit and to carry out initial examinations (such as dilatation of the pupils by the
26
27 orthoptist) according to the patient's reason for presentation to the OED. It was linked to a waiting
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29 room patient call system. A 3-month phase of training to use of the algorithm was conducted for
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31 reception nurses (named "training period"). This training period was not planned in the published
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33 protocol.²⁹
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37 - An environmental component (B) and educational component (C), beginning 6 October 2014, were
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39 combined. The environmental component was signage to help patients navigate within the OED. The
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41 educational component was messages about the OED team and its activity, the care pathway, the
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43 patients' order of passage according to severity, and information on the waiting time that were
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45 broadcast on a TV in the waiting rooms to patients. As both components addressed difficulties for
46
47 the patients to understand the functioning of the OED, we considered it appropriate to combine
48
49 them. This is a deviation from the initial protocol.²⁹
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53 - A relational component (D), beginning 5 January 2015, with the presence of a mediator in the OED,
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55 for preventive mediation actions. The mediator held a Master's degree in mediation, and was
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57 recruited as part of the project. The mediator was to intervene when patients showed signs of
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3 impatience or nervousness and in case of conflict involving a patient or visitor. The mediator
4 circulated through corridors and waiting rooms, and was available to patients and visitors.
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6
7 - A security component (E), beginning 6 April 2015, with the implementation of video surveillance
8 cameras throughout the OED (admissions desk, corridors) connected to the hospital security control
9 room.
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11

12 *Programme implementation*

13
14 The prevention programme was implemented in four steps, each corresponding to a period of three
15 months, after a 3-month training period for the computerized triage algorithm (Figure 1). The study
16 project manager conducted monthly visits to the OED during the intervention period to ensure
17 programme implementation.
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26 **Outcomes**

27
28 *The primary outcome* was violence committed by patients or those accompanying them against
29 healthcare workers or against other patients and those accompanying them among all admissions to
30 the OED.
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34
35 Violence was reported in medical records by healthcare workers. They could report incidents directly
36 committed against them or against patients and those accompanying them. Violence was described
37 using a classification that distinguishes four levels, from least (incivility) to most severe (assault),
38 based on the French National Observatory of Violence in healthcare (Table 1).²⁹ Clinical cases were
39 used monthly to train professionals to identify the different types of acts of violence to be reported
40 and their level of severity (see Table 1 for examples). They were developed from situations
41 experienced by OED professionals. These situations were identified during interviews with OED
42 professionals conducted by the researchers prior to the initiation of the study.²⁸ The aim was to
43 reduce the variability in the classification of events.
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55 The project manager also met monthly with the OED team to discuss the importance of reporting
56 events to limit under-reporting of acts of violence.
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3 *Secondary outcomes* were waiting time (defined as the interval of time between the administrative
4 registration of the patient and the assessment by a nurse or an ophthalmologist) and length of stay
5
6 (defined as the interval of time between registration and discharge). This information was routinely
7
8 collected at the OED for all inpatients.
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Table 1. Four levels of violence, from least to most severe according to the National Observatory of Violence in Hospitals and examples of clinical cases used to train healthcare workers.

Level 1 (incivility)	<p>Insistent questions, incivility, rudeness, occupation of the corridor, spitting, making noise (telephone, etc.)</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) opens the door of the nursing office without knocking, or waiting for an answer, and calls you for some reason. - A patient (or an accompanying person) considering that everyone comes before him comes to show his/her dissatisfaction.
Level 2 (verbal harassment)	<p>Insult or verbal abuse without threat</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person), dissatisfied with your answer, calls you an arsehole. - A patient (or an accompanying person), tired of waiting, calls you a loser or incapable.
Level 3 (threats)	<p>Verbal or physical threat.</p> <p>Examples:</p> <ul style="list-style-type: none"> - A patient (or an accompanying person) raises his/her hand on you. - A patient (or an accompanying person) comes dangerously close to you to scream on you.
Level 4	<p>Intentional violence, assault, vandalism or damage to equipment.</p>

1
2
3 (assaults)

Examples:

4
5 - An angry patient (or an accompanying person) pushes you.

6
7 - A patient (or an accompanying person) spits on you.
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Legend. Examples come from clinical cases used to train the healthcare workers to notify the level any incivility or violence they may be subject.
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Blinding

Healthcare workers and patients were not blinded to the intervention phase. However, in the absence of individual information on the study (this was not required by the Institutional Review Board), it appears unlikely that patient behaviour was influenced by the study.

Sample size

In the initial protocol, the sample size was determined for an on – off design by the expected efficacy of each of the five components of the prevention programme. The statistical unit was the patient admitted to the OED. Based on the initial hypotheses, the total sample size required was 30 224 admissions with a risk alpha of 5% and the statistical power of 80%. We did not recalculate the number of subjects required; there is usually no estimation of the sample size in interrupted time-series studies.^{30,31}

Statistical methods

The analyses were conducted on data obtained during the 15-month study period (that corresponded to the pre-intervention and intervention periods, and without consideration of the training period). The proportion of admissions with violence committed by patients, or those accompanying them, was expressed as a rate per 1000 admissions. When the perpetrator was someone accompanying the patient, the violence was attributed to the patient.

For all outcomes, we conducted a pre -post analysis to compare rates before and during implementation of the prevention programme using the Chi square test. In addition, for the primary outcome we performed a segmented regression analysis to account for the possibility of concurrent secular trends in violence that could influence the results. We evaluated the effect of the programme on violence at both the aggregate and individual patient levels.

First, a segmented Poisson regression model offset by the total number of admissions at OED per month was used to compare monthly violence rates between pre and intervention periods. The

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3 model included intercept, time trend before implementation, change in level immediately after the
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5 training period, and change in time trend after the training period.
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7 Analyses were stratified to allow for differential effects by age group, gender, waiting time, and
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9 length of stay. Results were reported as incidence rate ratio (IRR) and 95% confidence intervals (CIs).
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11 Secondly, logistic regression was used to assess change in level and trend of odds of violence
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13 occurrence within admission at OED before and after each intervention after adjusting for individual
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15 characteristics (age, gender, waiting time >2h, admission to OED during public holidays, night
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17 admission, patients with several admissions to OED). A model with generalised equation estimation
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19 with a 1st order autoregressive correlation structure was fitted to account for the clustering of
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21 admissions to the OED within a calendar day. Results were reported as odds ratio (OR) and 95% CIs.
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23 All admissions to the OED were treated independently. All p values were 2-sided and statistical
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25 significance level was set at alpha=0.05. Statistical analyses were performed with SAS version 9.4
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27 software (SAS Institute Inc., Cary, NC, USA).
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32 ***Ethics approval***

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34 Approval from the Sud Est IV Institutional Review Board was obtained in September 2011 (L11-117).
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36 Under French law in effect at the time of the study, consent was not required for the type of study
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38 and intervention being evaluated.
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42 ***Reporting criteria***

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44 We followed the SQUIRE criteria from the EQUATOR network to report the study.³²
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51 **Results**

52 ***Participants***

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54 Over the 15-month study period, 22 107 admissions (corresponding to 18 826 patients) were
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56 analysed (Figure 1). Among the 18 826 patients, 12% were admitted more than once. The mean \pm
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3 standard deviation (SD) number of visits per patient was 1.2 ± 0.6 (range: 1-15), there was a mean 70
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5 ± 12 admissions per day over the 315-day study period (range: 33-105).
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8 ***Characteristics of admissions***

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11 Characteristics of admissions according to the components implemented are presented in Table 2.
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Table 2. Characteristics of admissions, waiting time and length of stay.

	Pre-intervention period N=4 118	Intervention period			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Male, n (%)	2 250 (54.6)	2 335 (53.0)	2 499 (54.5)	2 426 (54.5)	2 564 (56.4)
Age ≥ 40 years, n (%)	2 159 (52.4)	2 547 (57.8)	2 452 (53.5)	2 368 (53.2)	2 459 (54.1)
Coming during the day, n (%)	2 944 (71.5)	3 164 (71.9)	3 536 (77.1)	3 519 (79.0)	3 324 (73.1)
Waiting time > 2h ^a , n (%)	2 755 (66.9)	2 754 (62.5)	2 377 (51.8)	2 100 (47.1)	2 125 (46.8)
Length of stay > 3h, n (%)	2 045 (49.7)	2 481 (56.3)	2 002 (43.6)	1 601 (35.9)	1 595 (35.1)

Legend: Coming during the day corresponded to admission between 8 am and 7.59 pm; waiting time was defined as the interval between time of registration of patient's arrival and first time of assessment by a nurse or an ophthalmologist; Length of stay was defined as the interval between registration and discharge. Components: A corresponds to computerised triage algorithm, BC corresponds to signage and message broadcast, D corresponds to mediator, and E corresponds to video surveillance.

^a waiting time was not documented for 108 admissions.

Outcomes

A total of 376 acts of violence, corresponding to 272 admissions (1.4% of 22 107 admissions), were recorded during the total study period (Table 3). Among the 272 admissions concerned, 74% (n=202) had led to one act of violence, 16% (n=45) had led to two acts, and 10% (n=25) had led to three or more acts. In the pre-intervention period, 98.6% acts of violence were incivility or verbal harassment and 1.4% were threats. In the intervention period, all acts of violence were incivility or verbal harassment.

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Table 3. Characteristics of acts of violence reported by healthcare workers.

	Pre-intervention period N=4 118	Intervention period after a 3-month training			
		A N=4 403	A+BC N=4 587	ABC+D N=4 454	ABCD+E N=4 545
Rate of act of violence per 1000 admissions (95%CI)*	24.8 (20.0-29.5)	10.0 (7.1-12.9)	8.9 (6.2-11.7)	8.1 (5.5-10.7)	10.8 (7.8-13.8)
Act of violence**, n	143	54	51	56	72
Level of violence, n (%)					
Level 1 (incivility)	131 (91.6)	46 (85.2)	45 (88.2)	43 (76.8)	65 (90.3)
Level 2 (verbal harassment)	10 (7.0)	7 (13.0)	5 (9.8)	13 (23.2)	7 (9.7)
Level 3 (threats)	2 (1.4)	1 (1.9)	1 (2.0)	0 (0)	0 (0)
Level 4 (assaults)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Committed by patient, n (%)	98 (68.5)	43 (79.6)	35 (68.6)	38 (67.9)	53 (73.6)
Healthcare worker as the victim***, n (%)	140 (97.9)	51 (94.4)	48 (94.1)	54 (96.4)	72 (100)

* Rate of acts of violence was defined as the percentage of admissions per period with at least one act of violence reported.

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3 ** Several acts of violence could occur per admission.
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5 *** 6 acts of violence were committed between patients, and the victim was not documented for 5 acts of violence.
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8 Components: A corresponds to computerised triage algorithm, BC corresponds to signage and message broadcast, D corresponded to mediator, and E
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10 corresponds to video surveillance.

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12 Abbreviation: CI: Confidence Interval.
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Primary outcome

The rate of violence significantly decreased from 24.8 (95%CI: 20.0 to 29.5) admissions with violence per 1000 admissions in the pre-intervention period to 9.5 (95%CI: 8.0 to 10.9) acts of violence per 1000 admissions in the intervention period ($p<0.001$). The effects of the components on monthly violence rates are presented in Figure 2.

Secondary outcomes

The frequency of admissions with waiting times ≥ 2 hours decreased from 67% ($n=2755$ admissions) to 52% ($n=9356$) between the pre-intervention period and the intervention period ($p<10^{-3}$). For the length of stay, frequency of admissions with a stay ≥ 3 hours decreased from 50% ($n=2045$) to 43% ($n=7679$; $p<10^{-3}$).

Segmented regression analysis

According to the Poisson regression analyses, no pre-intervention trend was found in monthly violence rates (IRR=1.13, 95%CI: 0.87 to 1.46, $p=0.3243$). After accounting for underlying trends, an immediate 53% decrease (IRR=0.47, 95%CI: 0.27 to 0.82, $p=0.0121$) was observed in the violence rate of the first month following the training period. No monthly trend effects in overall intervention period was detected (IRR=0.97, 95%CI: 0.92 to 1.02, $p=0.1660$). Poisson regression results stratified by admission's characteristics are presented in Table 4. Following the training period, a similar immediate decrease was found for female (IRR=0.35, 95%CI: 0.15 to 0.83, $p=0.0212$), age <40 years (IRR=0.43, 95%CI: 0.19 to 0.99, $p=0.0471$), waiting time >2 hours (IRR=0.49, 95%CI: 0.26 to 0.92, $p=0.0306$), and length of stay >3 hours (IRR=0.38, 95%CI: 0.20 to 0.74, $p=0.0089$). No monthly trend effect in the intervention period was observed for all subgroups.

Table 4. Multivariate analysis* of the comprehensive prevention programme on violence rates by admissions characteristics.

Characteristics	Pre-intervention trend (per month)**		Change in level***		Change in trend (per month)****	
	IRR [95%CI]	p-value	IRR [95%CI]	p-value	IRR [95%CI]	p-value
Sex						
Male	1.05 [0.76;1.46]	0.7500	0.59 [0.28;1.20]	0.1308	0.95 [0.89;1.01]	0.0810
Female	1.27 [0.84;1.93]	0.2343	0.35 [0.15;0.83]	0.0212	1.00 [0.93;1.07]	0.9548
Age						
<40 yrs	1.11 [0.78;1.58]	0.5292	0.43 [0.19;0.99]	0.0471	0.96 [0.90;1.04]	0.2771
≥ 40 yrs	1.16 [0.79;1.69]	0.4107	0.51 [0.24;1.08]	0.0730	0.97 [0.92;1.04]	0.3601
Waiting time						
≤2h	1.11 [0.67;1.85]	0.6468	0.39 [0.13;1.18]	0.0892	0.96 [0.88;1.05]	0.3427
>2h	1.12 [0.83;1.51]	0.4233	0.49 [0.26;0.92]	0.0306	0.99 [0.94;1.04]	0.6704
Length of stay						
≤3h	1.03 [0.66;1.62]	0.8738	0.57 [0.22;1.51]	0.2329	0.96 [0.89;1.04]	0.2823
>3h	1.13 [0.82;1.55]	0.4231	0.38 [0.20;0.74]	0.0089	1.00 [0.94;1.06]	0.9764

Abbreviations: IRR: Incidence rate ratio, CI: Confidence interval.

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3 * segmented Poisson regression offset by the total number of admissions at OED per month. RR <1 represents a decline and conversely

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5 RR >1 represents an increase in monthly violence rate.

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7 ** rate of change in monthly violence rate prior to the intervention (*i.e.* time effect).

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9 *** immediate change in the mean monthly violence rate from pre-intervention to intervention period.

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11 **** change in slope per month following to the intervention period.
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Piecewise logistic regression analysis

Piecewise logistic regression analysis confirmed the absence of pre-intervention trend (see Table 5).

Following the training period, three components of the programme had significant effects on the underlying trend of violence occurrence. There was a significant decline in the odds of violence occurrence over time after the implementation of component A-Algorithm (adjusted odds ratio [aOR]= 0.87, 95%CI: 0.82-0.91, $p<10^{-3}$). The trend toward decreasing occurrence of violence over time significantly reversed in the 3 months following the implementation of component D-Mediators (aOR= 1.45, 95%CI: 1.14-1.84, $p=0.002$) indicating a significant increase over time after the implementation of a mediator. The trend significantly reversed following component E- video surveillance (aOR= 0.65, 95%CI: 0.45-0.93, $p=0.019$) suggesting that the magnitude of increase in occurrence of violence decreased over time and returned at its previous level (aOR= 0.84, 95%CI: 0.66-1.07, $p=0.152$). No effect was observed for the component BC combining signage and messages broadcast on TV in the waiting rooms.

Table 5. Piecewise logistic regression analysis of the comprehensive prevention programme effects* on violence.

	Full model**		Simple model***	
	OR [95%CI]	p-value	OR [95%CI]	p-value
Trend prior to intervention (per month)	1.09 [0.81 ; 1.49]	0.5848	--	--
Immediate change in level:				
A	0.31 [0.03 ; 3.20]	0.3236	--	--
BC added to A	2.19 [0.70 ; 6.82]	0.1773	--	--
D added to ABC	1.05 [0.28 ; 3.88]	0.9406	--	--
E added to ABCD	5.73 [2.08 ; 15.77]	0.0007	--	--
Change in trend (per month):				
A	0.95 [0.55 ; 1.65]	0.8657	0.87 [0.82 ; 0.92]	<.0001
BC added to A	0.61 [0.33 ; 1.13]	0.1188	--	--
D added to ABC	1.85 [0.98 ; 3.48]	0.0572	1.45 [1.14 ; 1.84]	0.0022
E added to ABCD	0.35 [0.17 ; 0.70]	0.0031	0.65 [0.45 ; 0.93]	0.0194

Abbreviations: OR: odds ratio, CI: Confidence interval.

Components: A corresponds to computerised triage algorithm, BC corresponds to signage and messages broadcast on TV in the waiting rooms, D corresponds to mediator, and E corresponds to video surveillance.

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3 *logistic generalised estimating equation model adjusted for waiting time > 2h. OR <1 represent a decline and inversely OR>1 represent an increase in
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5 monthly likelihood of violence occurrence during admission at OED per month.
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8 **full model included time effect and immediate changes after each component's implementation and changes in slopes.
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10 ***parsimonious model after backward selection.
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Discussion

The present study found a significant reduction in self-reported incivility or verbal violence by healthcare workers following the implementation of a comprehensive prevention programme. This reduction occurred after the implementation of the first component of the programme, a triage algorithm, and was maintained over time while other components were successively implemented. The violence rate during the pre-intervention period found in the present study (24.8 per 1000 admissions) was higher than that previously reported. In a recent meta-analysis of 22 studies the authors found a pooled incidence of 36 per 10,000 admissions (range: 1 to 172 per 10,000 admissions).³³ It is, however, difficult to compare the results of the present study with those reported elsewhere due to heterogeneity in the way violence is defined, collected, and reported in the literature; for a majority of studies, data collection was conducted retrospectively, using security records and incident report documents that mainly report severe acts of violence.³³ Previous studies reported a low rate of acts of violence with a high level of severity (threats and assaults).^{34,35} In the present study, the frequency of such acts were even lower; only four acts of verbal or physical threat and no assault. This can be explained by the context of the OED that did not admit patients for drug/alcohol abuse or psychiatric disease which are predictors of physical violence perpetrated by patients against healthcare workers.³⁵ However, as in other studies, verbal harassment or incivility committed by patients were the most frequent form of violence experienced herein despite differences in methodology.^{36,37,38} Concomitantly, waiting times and length of stay of patients in the OED were significantly reduced. The reduction of waiting times was an expected effect of the triage algorithm, which allowed, according to the reason for consultation, for orthoptists to perform examinations such as dilating pupils without having to consult a physician. Associated with a patient call system in the waiting room, the triage algorithm was a mean streamline the order of passage and waiting time and thus reduce the stressful condition in waiting rooms.³⁵ It was not

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3 related to a change in the number of professionals (which remained stable throughout the study) nor
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5 to a change in the number of admissions to OED.
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7 As recommended, the prevention programme combined different components, targeting regularly
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9 cited causes of violence.²⁴ The intervention targeted patients/visitors and the environment, but did
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11 not target how OED professionals handle violent situations.^{38,39,40} Behaviour of healthcare
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13 professionals such as empathic communication, early proactive interaction, and verbal and body
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15 language expressing respect and confidence are associated with a reduction in incivility and verbal
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17 abuse or aggressive behaviour.^{28,35,41}
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20 Caution should, however, be taken when interpreting the results of the present study. It is not
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22 possible to distinguish the relative effect of the tested components. For instance, a positive effect
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24 was observed during the implementation of the first component (triage algorithm linked to a waiting
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26 room patient call system). It is not possible to conclude whether this effect was due to the algorithm
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28 or to the fact that it was implemented first. Another point to consider is that violence increased
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30 despite the presence of the mediator. To the best of our knowledge, there was no change in the
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32 conditions of patient reception (*i.e.* no increase in waiting times or in admission frequency and no
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34 change in the OED team) during the implementation of the mediator that could explain this
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36 unintended effect. The mediator, by his/her presence, may have stimulated the declaration of
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38 violence by healthcare workers. It highlights the difficulty to collect non-physical acts of violence that
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40 are underreported by healthcare staff. The main reasons of this are that it is prevalent yet rarely
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42 results in physical injury, most of professionals consider it as part of their jobs, these acts of violence
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44 are subject to personal interpretation, and the use of existing reporting systems is time-consuming
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46 and perceived as unnecessary because it does not lead to any action to reduce such
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48 behaviour.^{24,28,41,42,43} To limit variation in reporting practices, the researchers met monthly with the
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50 OED team to discuss the importance of reporting events from least (incivility) to most severe
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52 (assault). Moreover reporting was facilitated by its integration in the patient records.
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3 Moreover, we conducted a segmented regression analysis to detect if the programme had a greater
4 effect than an underlying secular trend.^{30,31,44,45,46} The analysis is limited by the short pre-intervention
5 phase, which does not allow a solid estimation of the trend before the programme implementation.
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10 Second, a longer post-intervention follow-up could have been useful to verify the effectiveness of the
11 program at a distance of time from its implementation.⁴⁷ A longer observation period could have
12 helped to explain whether the increase in the reports after the implementation of the mediator was
13 a real phenomenon (increase of the violence) or not (greater attention to violence). A qualitative
14 approach would have also helped us to better understand the mechanisms of action of the
15 programme components,⁴⁸ in particular the paradoxical effect of the mediator. It would have allowed
16 us to evaluate whether the coping of the healthcare workers with the violence has improved. Finally,
17 the generalisation of the results is limited by the single-centre study design and by the differences
18 between the OEDs and general emergencies. In particular, there are no admissions for psychiatric or
19 drug abuse and alcohol problems, which are known to be sources of violence.^{33,35}
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32 In conclusion, a comprehensive prevention programme targeting patients, visitors and environment
33 can reduce self-reported incivility and verbal violence by healthcare workers in an OED over 12
34 months. EDs should develop comprehensive primary prevention programme that integrate various
35 environmental and patient-oriented components (organisational, educational, relational, security).
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Author contributions

The study was conceptualized and designed by ST, PLC, MALP, and ADu.

PLC and CB are the Co-Chief Investigators, provided leadership for the project.

ST, PLC, JBF, and ADu contributed to the development of the programme.

ST, PO, and ADe planned the statistical analysis.

ADe carried out the statistical analyses.

ST, PO, and ADe drafted the manuscript.

All authors reviewed the draft version, made suggestions, and approved the final version.

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Competing Interests

None declared.

Patient consent

Not required.

Data statement

The data set is not available as ethics approval does not allow release.

Figures

Figure 1. Study flow chart of admissions at Ophthalmology Emergency Department.

Legend: Components: A: computerised triage algorithm, BC: signage and messages broadcast on TV in the waiting rooms, D: mediator, E: video surveillance.

Figure 2. Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention programme.

Abbreviation: OED: Ophthalmology Emergency Department

Legend: The grey band represents the 3-month training period. The dotted lines inside the scatter plots represents the implementation of component A (computerised triage algorithm), component BC (signage and messages broadcast on TV in the waiting rooms), component D (mediator) and component E (video surveillance).

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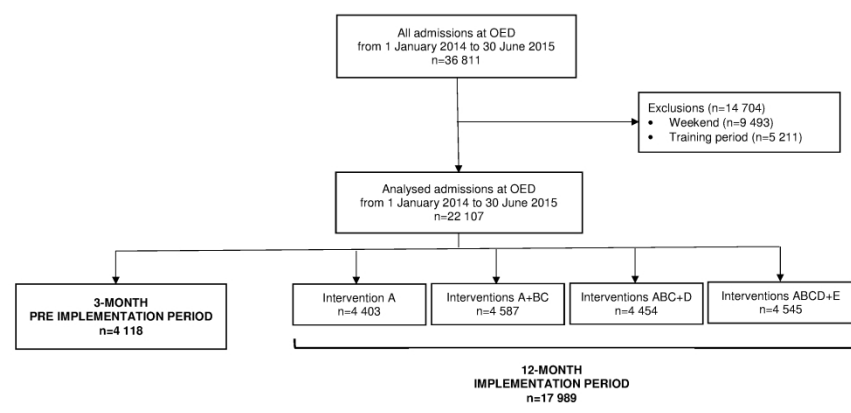
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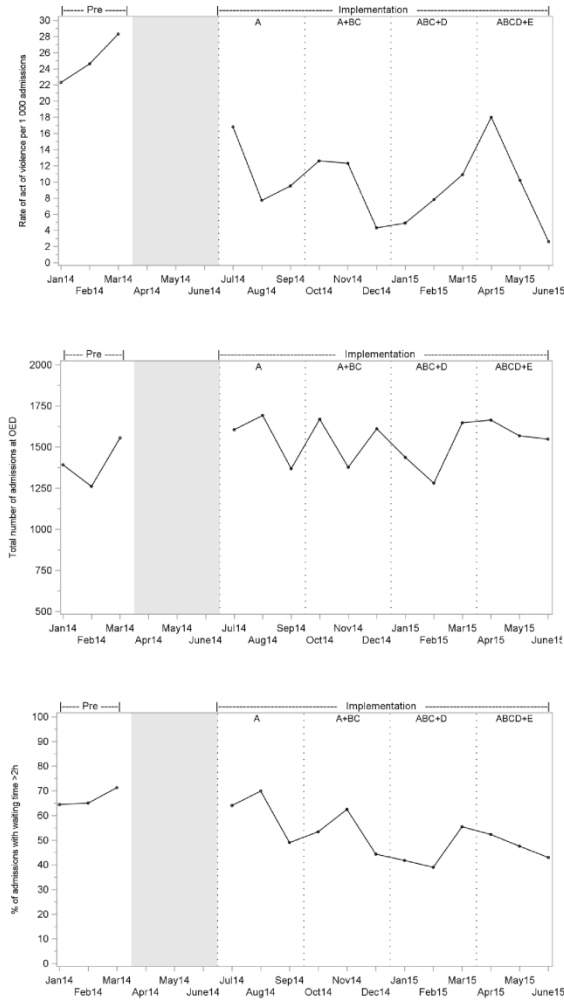
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Study flow chart of admissions at Ophthalmology Emergency Department.
 Legend: Components: A: computerised triage algorithm, BC: signage and messages broadcast on TV in the waiting rooms, D: mediator, E: video surveillance.



Observed time series of the A) rates of admission at OED with acts of violence, B) total number of admissions at OED and C) rates of admissions with waiting time greater than 2 hours by month before and during implementation of the prevention program.

Abbreviation: OED: Ophthalmology Emergency Department

Legend: the grey band represents the 3-month training period. The dotted lines inside the scatter plots represents the implementation of component A (computerised triage algorithm), component BC (signage and messages broadcast on TV in the waiting rooms), component D (mediator) and component E (video surveillance).

209x297mm (300 x 300 DPI)

Reporting checklist for quality improvement study.

Based on the SQUIRE guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the SQUIRE reporting guidelines, and cite them as:

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	Reporting Item	Page Number
	#1 Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patientcenteredness, timeliness, cost, efficiency, and equity of healthcare)	1
	#02a Provide adequate information to aid in searching and indexing	1
	#02b Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions	1
Problem description	#3 Nature and significance of the local problem	6
Available knowledge	#4 Summary of what is currently known about the problem, including relevant previous studies	5
Rationale	#5 Informal or formal frameworks, models, concepts, and / or theories used to explain the problem, any reasons or	5 - 6

1		assumptions that were used to develop the intervention(s), and	
2		reasons why the intervention(s) was expected to work	
3			
4	Specific aims	#6 Purpose of the project and of this report	6
5			
6	Context	#7 Contextual elements considered important at the outset of	7
7		introducing the intervention(s)	
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9			
10	Intervention(s)	#08a Description of the intervention(s) in sufficient detail that others	8
11		could reproduce it	
12			
13			
14		#08b Specifics of the team involved in the work	8
15			
16	Study of the	#09a Approach chosen for assessing the impact of the intervention(s)	6
17	Intervention(s)		
18			
19			
20		#09b Approach used to establish whether the observed outcomes	6, 12,13
21		were due to the intervention(s)	
22			
23			
24	Measures	#10a Measures chosen for studying processes and outcomes of the	9
25		intervention(s), including rationale for choosing them, their	
26		operational definitions, and their validity and reliability	
27			
28			
29		#10b Description of the approach to the ongoing assessment of	9
30		contextual elements that contributed to the success, failure,	
31		efficiency, and cost	
32			
33			
34		#10c Methods employed for assessing completeness and accuracy	9
35		of data	
36			
37			
38	Analysis	#11a Qualitative and quantitative methods used to draw inferences	12,13
39		from the data	
40			
41			
42		#11b Methods for understanding variation within the data, including	12,13
43		the effects of time as a variable	
44			
45			
46	Ethical	#12 Ethical aspects of implementing and studying the intervention(s)	15,30
47	considerations	and how they were addressed, including, but not limited to,	
48		formal ethics review and potential conflict(s) of interest	
49			
50			
51		#13a Initial steps of the intervention(s) and their evolution over time	See note
52		(e.g., time-line diagram, flow chart, or table), including	1
53		modifications made to the intervention during the project	
54			
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56		#13b Details of the process measures and outcome	9
57			
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1		#13c	Contextual elements that interacted with the intervention(s)	15
2				
3		#13d	Observed associations between outcomes, interventions, and	20
4			relevant contextual elements	
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7		#13e	Unintended consequences such as unexpected benefits,	See note
8			problems, failures, or costs associated with the intervention(s).	2
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11		#13f	Details about missing data	See note
12				3
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15	Summary	#14a	Key findings, including relevance to the rationale and specific	27
16			aims	
17				
18		#14b	Particular strengths of the project	27
19				
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21	Interpretation	#15a	Nature of the association between the intervention(s) and the	27
22			outcomes	
23				
24		#15b	Comparison of results with findings from other publications	27
25				
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27		#15c	Impact of the project on people and systems	27
28				
29		#15d	Reasons for any differences between observed and anticipated	22
30			outcomes, including the influence of context	
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33		#15e	Costs and strategic trade-offs, including opportunity costs	See note
34				4
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37	Limitations	#16a	Limits to the generalizability of the work	28
38				
39		#16b	Factors that might have limited internal validity such as	28
40			confounding, bias, or imprecision in the design, methods,	
41			measurement, or analysis	
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44		#16c	Efforts made to minimize and adjust for limitations	28
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47	Conclusion	#17a	Usefulness of the work	29
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49		#17b	Sustainability	29
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52		#17c	Potential for spread to other contexts	28
53				
54		#17d	Implications for practice and for further study in the field	29
55				
56		#17e	Suggested next steps	29
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1	Funding	#18	Sources of funding that supported this work. Role, if any, of the	30
2			funding organization in the design, implementation,	
3			interpretation, and reporting	
4				
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Author notes

1. 8, figure 1
2. n/a (not measured)
3. n/a (self-reported)
4. n/a (not measured)

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