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Implementation of HIV-exposures triage strategy in emergency departments to improve nurse-triage for HIV-exposures: A pre- and post-intervention period study

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ABSTRACT

Background: Health Education in the emergency department (ED) is one of the tasks that the HIV-exposure triage implementation needs to be considered. No triage training has been evaluated.
Methods: A prospective 3-years pre- and post-intervention study in an urban academic ED was realized. The intervention was a simulation-based training on triage rules for triage nurses. Triage is based on time between HIV-exposure and ED arrival (≤48 h: level 2 (urgent); ≥48 h: level 5 (non-urgent)).
Findings: A total of 2011 HIV-exposures were included; 15.1 per cent were well triaged in pre-intervention vs. 88 per cent in post-intervention period ($P < 0.0001$). Among well-triaged patients as level 2, the post-exposure prophylaxis prescription rate increased from 30.5 to 57.6 per cent ($P < 0.0001$). Time interval quality indicators (minutes) were: ED arrival-Triage Nurse 10.9 ± 9.6 vs. 9.1 ± 4.8 ($P < 0.0001$), ED arrival-Physician 56.3 ± 26.0 vs. 49.9 ± 36.0 ($P = 0.0001$), and ED arrival to Post-exposure prophylaxis first-dose 86.9 ± 30.0 vs. 65.2 ± 42.0 ($P < 0.0001$).
Conclusions: These results suggest that time interval HIV-exposure to ED arrival can be used as a triage criterion. A continuous quality improvement program for PEP after HIV-exposure based on a nurse triage training program achieved the objectives of optimizing the triage performance by reducing the time to access the post-exposure prophylaxis first-dose.

1. Introduction

The natural history of HIV disease has been profoundly altered by the advent of effective antiretroviral therapy and HIV disease is now recognized as a manageable long-term condition [1]. Nevertheless, 1.8 million people contract HIV every year worldwide, including more than 150,000 in Europe and more than 35,000 in the United States [2]. Many tools exist to prevent HIV transmission and they are available in lot of many countries, including post-exposure prophylaxis (PEP) [3,4].

The efficacy of PEP is strongly related to the early onset of antiretroviral therapy [5–10]. Several clinical and biological arguments support the earliest possible introduction and no later than 72 h after the accident [5,9]. In France, PEP is limited to the first 48 h after HIV exposure [10]. It is estimated that most PEP are prescribed in emergency departments (ED) [10,11]. Once in the ED, these patients must be integrated into the emergency care process: i.e., triage, medical management, HIV transmission risk assessment, PEP prescription, and access to antiretroviral therapy. The process begins with nurse triage that will allow the patient to be more or less quickly managed.

The Emergency Severity Index (ESI) mentions HIV exposure in its ESI2 criteria [12]. Health Education for physicians, nurses, and support staff is one of the critical tasks that the triage implementation team needs to consider [13]. However, to our knowledge, the training programs for triage nurses for HIV-exposures have not been evaluated. There is no training method that has demonstrated its ability to improve understanding and outcomes [14]. The simulated patient method

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[15] offers several advantages in this type of training: its aim is to improve nurse sorting skills in terms of quality of the reception and quality of screening [16], and their impact on the objective indicators for access to the PEP.

The objective of the present study was to compare before and after the implementation of a triage rules with a simulated-based training program, the performance of triage process and its impact on PEP access times.

2. Material and methods

The Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) was used to design and write this report [17].

2.1. Study design and setting

This was a prospective observational study conducted as part of a continuous quality improvement program for HIV-exposures in the ED of the Bichat University Hospital. This hospital is an academic, 1000-bed hospital, and its ED has treats 85 000 patients a year. Among these patients, 600 to 800 per year were HIV-exposed.

Since 2015, nurses are made aware during their training on triage on the need for a 48 h threshold to define the urgency or not to see HIV-exposed patients. Two periods were defined: a pre-intervention period from January 1st, 2015 to December 31st, 2015 (period 1); post intervention from February 1st, 2016 to December 31st, 2017 (period 2). Triage nurses were trained during the month of January 2017 and at each arrival of new nurses. Period 2 was conducted over 2 years to analyse the maintenance of acquired skills and quality indicators of triage over time. Periods 1 and 2 being of different duration, the characteristics of the patients and the nurses were analysed over the two periods.

In both periods, triage is based solely on the time between HIV-exposure and ED arrival: < 48 h: triage level is 2. ED arrival time until medical examination by the ED physician is < 20 min; ≥ 48 h: triage level is 5. ED arrival time until medical examination by the ED physician is < 120 min. The fast-track doctor, close to the triage nurse office, received all the files for this reason (whatever the triage level). When PEP was prescribed, the patient was accompanied by ED staff to the chemist. The chemist checked for possible drug interactions and contra-indications and delivered the 5-day treatment kit. He made sure that the first dose of PEP was taken. The patient, together with the prescription of the drugs, received a card of advice adapted to the prescribed treatment and an appointment at Infectious Diseases Unit within 48–72 h. The aim was the continuation of the PEP, counselling and orientation in pre-exposure prophylaxis if necessary. Untreated patients received guidance at the screening centre for counselling and prevention. Since 2017, a pre-exposure prophylaxis consultation has been offered.

Due to the turnover of nurses in the ED during these relatively long periods, nurses' characteristics were compared over the two periods.

2.2. Selection of participants

All adults attending the ED of Bichat University Hospital (Paris, France) from January 1st, 2015 to December 31st, 2017 following HIV-exposure were included. For each patient meeting the inclusion criteria, a standard electronic case report form was completed by the triage nurse. The following variables were collected: registration time, nurse triage time, HIV-exposure date and time, triage level. The emergency physician registered the type of exposure (sexual; health care worker; other professional categories and intravenous drug user). Patients were informed and therefore aware that anonymized data could be used for research conducted in the ward. They could refuse by simply notifying the triage nurse of their objection to the use of the data.

2.3. Interventions

During the pre-intervention period, the triage nurses received the procedures of the service including triage of HIV-exposures, platelets and field training by experienced triage nurses. A 8-hour theoretical training in triage rules is carried out for all new recruits. Prior to the post-intervention period, a 2-hour simulated-based training program course for triage nurses has been introduced in order to improve the performance of triage nurses concerning the HIV-exposure and triage rules. This simulated-based training program course included theoretical (15 min) and practical (105 min) training using a simulated patient, was regularly repeated in the workplace in groups of 5 nurses until all triage nurses were trained, including new arrivals. The method of calculating this indicator and the importance of reducing the delay between ED arrival and PEP administration were discussed. This course centred on patient centred care, aiming to reduce the access time to the PEP, to increase patient satisfaction, and to not create differences between the different types of HIV exposure as previously reported [18,19]. Simulated-based training program details are published in a pedagogical journal [20].

2.4. Outcomes measurements

Our goal was to create a culture of patient safety [19]. We defined quality indicators based on the respect of procedures as well as the delay in minutes between: ED arrival and the care by the triage nurse, ED arrival and the doctor examination, ED arrival and the PEP administration for treated patients, and ED arrival and exit.

2.5. Analysis

In order to describe the study population, quantitative variables have been expressed as mean and standard deviation or median and interquartile (Q1; Q3), and qualitative variables as numbers of patients and percentages. The Kolmogorov-Smirnov test was used to check normal distribution for assessed measures. A Chi-2 or Fisher's test to compare qualitative variables and a Student's *t*-test or Kruskal-Wallis test were used to compare quantitative variables between study groups. The ANOVA test was used to compare pre- and post-intervention time interval quality indicators. The significance threshold was set at $p = 0.005$ [21]. Statistical analyses were performed using Statistica® software (StatSoft).

2.6. Ethics statement

Data collection and storage by the Urqual® Emergency Database was approved by the French National Commission for Data Protection and Liberties. Anonymized data was extracted from the hospital database. The Emergency Ethics Committee for Biomedical Research of Assistance Publique-Hôpitaux de Paris approved this study.

3. Results

3.1. The characteristics of study subjects

During the 3-year study period, 2011 patients were registered after HIV-exposure. The main characteristics of the groups before and after the new triage rules are presented in Table 1.

Triage nurses' characteristics were collected over the two periods. No difference was found. There were 50 nurses in period 1 and 45 in period 2. The mean age (years) was 28 ± 8 in period 1 vs. 27 ± 7 in period 2 ($p = 0.76$). There were respectively 11 men and 39 women vs. 6 men and 39 women ($p = 0.27$). The level of experience (median, Q1, Q3) in another ED before recruitment was respectively 4 years (2; 7) and 4 years (1; 7) during these two periods ($p = 0.95$).

Table 1
Main characteristics of the study population.

	Pre-intervention n = 536		Post-intervention n = 1475		P
	n	%	n	%	
	mean ± SD		mean ± SD		
Sex (male/female)	321/215		986/489		0.004
Type of HIV exposure					0.00004
Sexual	313	58.4	1020	69.2	
Health care worker	157	29.3	321	21.8	
Other	66	12.3	134	9	
Type of day					0.06
Week days	386	72	997	67.6	
Weekend days	150	28	478	32.4	
Time of ED consultation					0.4
Day (8 h to 18 h)	323	60.3	840	57	
Night (19 to midnight)	182	24.6	389	26.4	
Dark night (midnight to 7 h)	81	15.1	246	16.6	
HIV status of the contact					0.8
Unknown	115	21.6	337	23.1	
Negative	414	78	1118	76.5	
Positive	2	0.4	6	0.4	
HIV-exposure to ED arrival time (hours) (hours)	19.1 ± 34		19.4 ± 36.3		0.8

ED Emergency Department.

3.2. Impact of implementation of a triage rules on quality indicators

In period 1, 59/497 patients (11.9%) were well screened as level 2 vs. 1249/1400 (89.2%) in period 2 ($p < 0.0001$). In period 1, 22/39 (56.4%) patients were well screened as level 5 vs. 49/75 (65.3%) in period 2 ($p = 0.0001$). A total of 81/536 (15.1%) were well screened during Period 1 and 1298/1475 (88%) during Period 2 ($p < 0.0001$). Fig. 1 shows the evolution of quality indicators of triage and triage rules. Distribution of the triage level according to the categories of delay between exposure to HIV and arrival in the ED are presented in Table 2.

During period 1, 438/455 patients (96.3%) who accessed less than 48 h after HIV exposure were under-triaged as level 3 to 5. In addition, 17/455 patients (3.7%) who consulted more than 48 h after the exposure, were over-triaged as level 2 to 4. During period 2, 151/177 patients (85.3%) were under-triaged and 26/177 patient (14.7%) were over-triaged.

Table 2
Distribution of time interval between HIV-exposure and ED arrival as a function of triage level in pre- and post-intervention periods.

	Time between HIV-exposure and ED arrival				P*	P¥
	≤4h n (%)	> 4h to ≤24 h n (%)	> 24 h to ≤48 h n (%)	> 48 h n (%)		
Pre-intervention period						0.000001
Triage level					0.00001	
2	30 (11.9)	22 (12.9)	7 (9.5)	2 (5.1)		
3	108 (42.7)	51 (30)	21 (28.4)	7 (18)		
4	109 (43.1)	85 (50)	32 (43.2)	8 (20.5)		
5	6 (2.4)	12 (7.1)	14 (18.9)	22 (56.4)		
Post-intervention period						
Triage level					0.00001	
2	574 (95)	490 (88)	185 (77.4)	22 (29.3)		
3	2 (0.3)	9 (1.6)	5 (2.1)	1 (1.3)		
4	5 (0.8)	7 (1.3)	7 (2.9)	3 (4)		
5	23 (3.8)	51 (9.2)	42 (17.6)	49 (65.3)		

* Comparison of triage levels distribution for each study period.
¥ Comparison between pre- and post-intervention period.

Time interval quality indicators in periods 1 and 2 are given in table 3. We found a significant reduction in all these quality indicators ($p < 0.0001$ for all of them).

3.3. Impact of implementation of a triage rules on PEP prescription

Finally, 974/2011 (48.4%) received PEP. In patients with a time interval between HIV exposure and ED arrival of less than 48 h, the percentage of patients treated reached 955/1849 (51.7%), whereas in patients with a delay greater than or equal to 48 h this figure was 19/162 (11.7%) ($p = 0.00001$). Among well-triaged patients as level 2, patients receiving PEP increased from 30.5% (18/59) in period 1 to

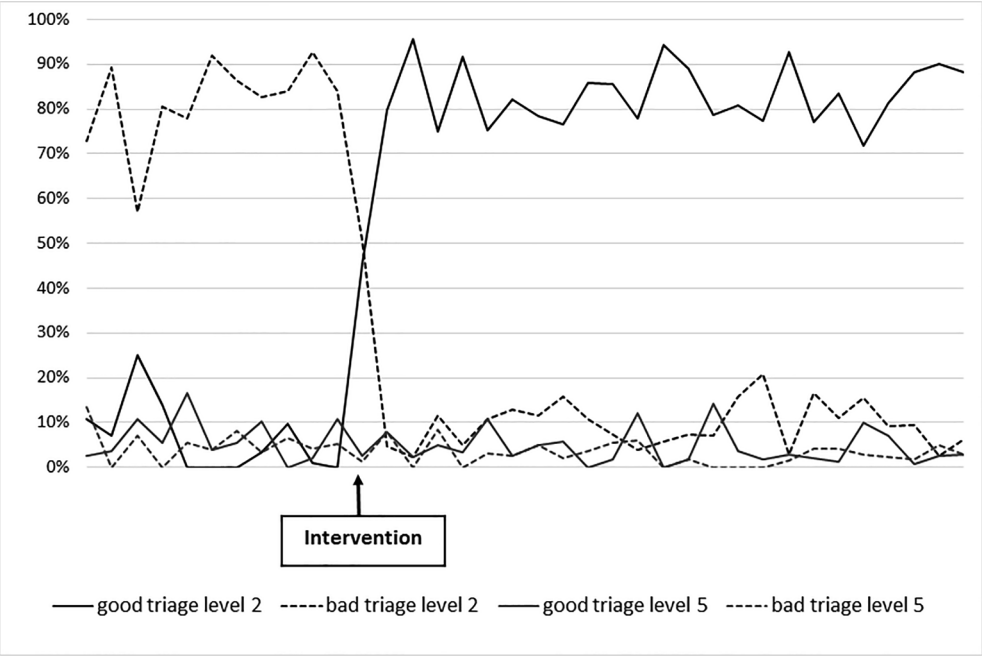

Fig. 1. Percentage of good and bad triage for level 2 (< 48 h after HIV exposure) and level 5 (≥ 48 h after HIV-exposure).

Table 3
Triage performance indicators comparison between pre- and post-intervention periods.

	Pre-intervention		Post-intervention		P
	n = 536		n = 1475		
	n mean ± SD	%	n mean ± SD	%	
Triage level					0.00001
2	61	11.4	1271	86.2	
3	187	34.9	17	1.2	
4	234	43.7	22	1.5	
5	54	10.1	165	11.2	
Time interval quality indicators (minutes)					
ED arrival to Triage Nurse	10.9 ± 9.6		9.1 ± 4.8		0.00006
ED arrival to Physician	56.3 ± 26		49.9 ± 36		0.0001
ED arrival to PEP first dose	86.9 ± 30		65.2 ± 42		0.000001
ED total length of stay	79.9 ± 29		78.6 ± 47		0.5

ED Emergency Department.

57.6% (719/1249) in period 2 ($p < 0.0001$). Among well-triaged patients as level 5, 9.1% of the patients (2/22) were treated in period 1 whereas, there was no PEP prescription in period 2. The delays between ED arrival and the first dose of PEP were significantly shortened with a median < 89 min in period 1 and < 60 min in period 2 (Fig. 2).

4. Discussion

The urgency or not to examine HIV-exposed patients and to prescribe PEP depends on the delay between HIV exposure and ED arrival with a threshold at 48 h. Triage nurses can easily retrieve this information during triage process. We found that implementation of triage rules had a significant impact on changes in professional practice and the clinical impact on the ED patients: the ratio of patients correctly screened significantly increased from 15.1% to 88% and remained stable up to 3 years of evaluation. Moreover, it significantly reduced delays between ED arrival to triage nurse, ED arrival to ED physician, and especially the delay between ED arrival and the first dose of PEP.

International recommendations support PEP administration as soon as possible after exposure [5–10]. Therefore, HIV exposure has to be considered as a therapeutic emergency. Emergency triage is a decision-making process that identifies patients who need immediate attention [22]. Increasing emergency attendances, longer waiting times, and overloading emergencies could make it very difficult to respond very quickly to HIV exposure requiring PEP, but also a reasonable timely consultation for patients who do not require PEP [23]. The process of triage of patients is one of the tools to ensure the prioritization of these urgent clinical situations but not life-threatening. Nevertheless, none of the recommendations specify the triage rules to be proposed to HIV-exposures. Our study indicates that there is a strong association between HIV exposure to ED arrival time interval and the PEP prescription, since more than 98% of treated patients had a delay of less than 48 h. Given the complexity and multiplicity of variables involved in the PEP prescribing decision [5–10], our results indicate that this simple data to collect can be used as a triage criterion in the ED setting.

The first element to be improved was the quality of triage and respect of procedure. Our intervention allowed us to reach an excellent level of triage for patients in levels 2 and 5 according to the clinical situation. We also observed that triage errors in period 1 were more often under-triage, i.e. patients with < 48 h of HIV exposure to ED arrival triaged as level 3 to 5. The triage nurses gave these patients a lower priority, whereas in period 2, the few wrongly triaged cases were rather over-triaged, i.e. patients with delays ≥ 48 h triaged in priorities 2 to 4, thus benefiting of a shorter waiting time from ED arrival to physician examination. We assume these results show an improvement in the knowledge and actions of triage nurses who are better able to prioritize HIV exposures after simulated-based training program. The post-intervention evaluation over a period of 3 years showed that the effect of the intervention is stable. Therefore, it can be taken for granted as standard practice for nurse triages.

We evaluated the impact of triage on PEP prescription as the second component of performance. In period 1, PEP was prescribed to just over 30% of patients triaged as level 2, and in period 2 in 58% of patients. This shows the importance of the quality of triage. This significant improvement in the PEP delivering rate was associated in the post interventional period with a decrease in time interval quality indicators, which are the third parameter of performance. We found a reduction in waiting time from ED arrival to triage zone and from ED arrival to

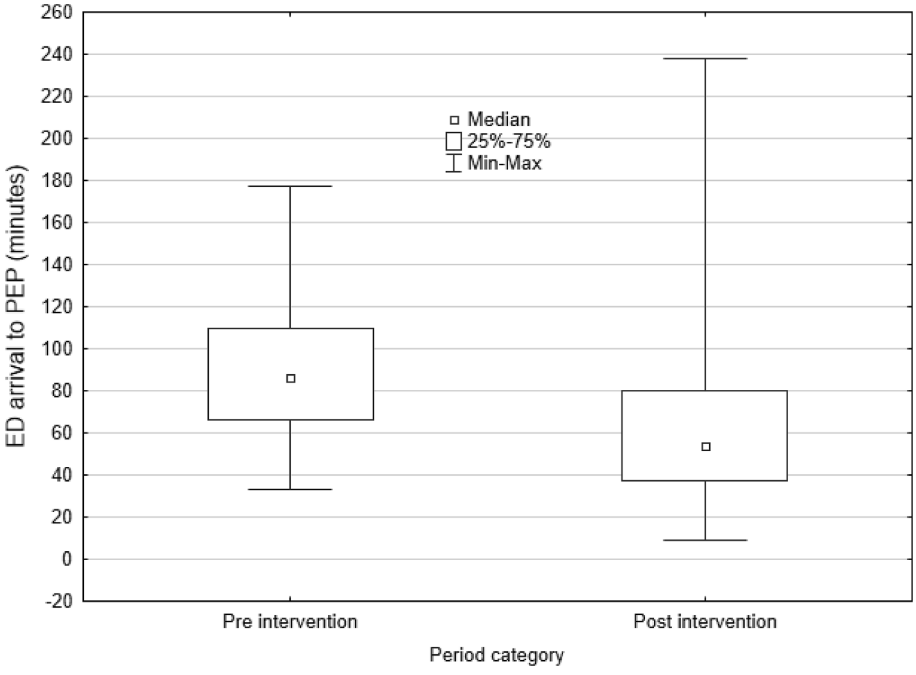

Fig. 2. Evolution of main time interval quality indicator: ED arrival to PEP first dose.

physician examination. Waiting time until medical examination seems to us an important quality indicator, because it is the doctor who collects all the details of the type of HIV exposure and these characteristics in order to define the level of risk and the need for PEP. On the other hand, ED total length of stay has not been modified, probably because this indicator measures other processes leading to the final patient exit.

The indicator that seemed most relevant to measure the effectiveness of our clinical process and our intervention is the delay between ED arrival and the effective administration of the first dose of PEP to the patient. It has been proposed, for example, to evaluate nurses' performance in reducing the delay between arrival and ECG of patients suspected of coronary events [24]. We found a significant reduction in this time interval quality indicator between the two periods of the study of more than 25%. We found that this time was less than 60 min in more than 50% of patients treated in period 2.

Finally, we can estimate that the time-based triage strategy between HIV exposure and ED arrival is applicable and that it allows most patients requiring PEP to be identified. The prioritization of these patients by our triage nurses, and the reduction of nurse triage and physician waiting times, indicate that the simulated-based training program course has had an impact on the work dynamic of the service. While nurses and triage nurses have acquired knowledge, skills, attitudes and behaviour that can reduce waiting times and prioritize HIV-exposures, ED physicians have also benefited of these courses. Indeed, the ED arrival to physician delay has been significantly reduced.

The present study is not without limitation. The study conducted over such a long period exposed the ED to nurses leaving and the arrival of new ones during both periods. However, nurses with the same characteristics over the two periods and especially the same level of experience limit the effect of these changes on the quality of triage. In addition, the systematic training of newly arrived nurses in the ED before starting triage allows for better respect of the current protocols.

5. Conclusion

This research demonstrates the feasibility of implementing a strategy for the continuous improvement of the quality of HIV treatment in ED based on triage rules and the value of nurse triage training using simulated patients. Triage rules implementation has made it possible to optimize the performance of triage by prioritizing patients to be considered as therapeutic emergencies and to reduce the time taken to access PEP, as well as reducing waiting times for untreated patients who just need reassurance. Based on our findings, a simple strategy for triage of HIV exposure accidents based on time delay between HIV exposure and ED arrival time should be implemented in the Emergency Department.

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