

Original Article

Determination of Needlestick Injuries Related to Bloodborne Pathogens among Healthcare Workers at a Tertiary Care Hospital in Dera Ismail Khan

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ABSTRACT

Background: Needlestick and sharps injuries (NSIs) are important occupational hazards for healthcare workers because percutaneous exposure may transmit bloodborne pathogens, including hepatitis B virus, hepatitis C virus, and human immunodeficiency virus. Prevention requires safe work practices, training, appropriate protective measures, effective reporting, and timely post-exposure management. **Objective:** To determine the 12-month prevalence of NSIs and describe bloodborne-pathogen training, awareness, personal protective equipment use, post-injury responses, and surveillance practices among healthcare workers in Dera Ismail Khan. **Methods:** A descriptive cross-sectional study included 280 healthcare workers from District Head Quarter Hospital and Mufti Mehmood Memorial Teaching Hospital using convenience sampling. Data were collected using a structured questionnaire and analyzed in SPSS version 23. **Results:** Ninety-six participants reported an NSI during the preceding 12 months, giving a prevalence of 34.3% (95% CI 29.0–40.0%). Formal bloodborne-pathogen training had been received by 198/280 (70.7%). NSI prevalence was 32.8% among trained and 37.8% among untrained workers (RR 0.87, 95% CI 0.62–1.22; $\chi^2=0.637$, $p=0.425$). Consistent PPE use was reported by 224/280 (80.0%) and did not differ significantly across professional groups when analyzed as always versus less-than-always use ($\chi^2=2.045$, $p=0.563$). Among 95 injured workers with a documented post-injury response, 54 washed the wound, 23 initiated PEP, and 18 reported taking no action. **Conclusion:** NSIs affected approximately one-third of surveyed healthcare workers. Training coverage and self-reported PPE use were relatively high, but post-exposure response and institutional surveillance were not universal. Multifaceted prevention incorporating training, safer devices, reporting systems, and standardized post-exposure management is warranted. **Keywords:** Needlestick Injury; Bloodborne Pathogens; Healthcare Workers; Occupational Exposure; Personal Protective Equipment; Post-Exposure Prophylaxis; Pakistan.

INTRODUCTION

Needlestick and sharps injuries (NSIs) are among the most important occupational exposures experienced by healthcare workers. Percutaneous injury involving a contaminated needle or sharp instrument may expose healthcare personnel to bloodborne pathogens, particularly hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). The risk associated with an

exposure varies according to the pathogen involved, source-patient characteristics, type and depth of injury, amount of blood involved, immunization status, and subsequent exposure management (1,2).

The burden of NSIs varies substantially across professional groups, institutions, and health systems. Global and developing-country syntheses have shown that occupational sharps exposure remains common, with recapping, unsafe handling, inadequate precautions, insufficient training, high workload, and differences in occupational role repeatedly identified as important contributors (1-4). Personnel who frequently perform phlebotomy, injections, suturing, operative procedures, laboratory work, and waste handling may therefore face particularly frequent exposure opportunities (1,3,4).

Pakistani healthcare institutions continue to report substantial NSI burdens. Recent multicentre evidence from tertiary hospitals in Punjab found a self-reported NSI prevalence of approximately 35% over six months, with sampling and needle recapping among prominent mechanisms and with incomplete reporting and post-exposure management (5). Earlier studies from Pakistan likewise identified important gaps between knowledge of NSI prevention and actual occupational practices among healthcare workers and nurses (6,7).

NSI prevention requires more than individual knowledge. Education can reduce unsafe practices, but evidence indicates greater benefit when training is combined with engineering and organizational controls. A meta-analysis evaluating NSI-prevention interventions found reductions associated with training alone and with safety-engineered devices, with the greatest pooled reduction when education and engineered devices were combined (8). A separate systematic review found that safety-engineered intravenous and phlebotomy devices reduced percutaneous injury rates compared with conventional devices (9), while more recent long-term hospital surveillance has also reported lower injury rates after implementation of safety-engineered devices in routine practice (10).

Personal protective equipment (PPE) is an important component of standard precautions, particularly for reducing contact with blood and body fluids, but conventional gloves cannot reliably prevent penetration by a needle or other sharp object. Safe handling, avoidance of unnecessary needle recapping, immediate disposal into appropriate sharps containers, adequate staffing, safe procedural technique, training, and access to engineered safety devices are therefore required alongside PPE (11,12).

Prompt post-exposure action is equally important. Occupational exposure pathways should include immediate wound care, rapid reporting, structured risk assessment, source-patient evaluation when appropriate, assessment of HBV immunization and immunity, HIV post-exposure prophylaxis (PEP) when indicated, and appropriate follow-up testing. Updated occupational HIV guidance emphasizes primary prevention, immediate reporting, rapid evaluation, timely initiation of PEP when indicated, adherence to recommended regimens, and follow-up of exposed healthcare personnel (13). Recent guidance addressing occupational HBV exposure likewise emphasizes vaccination status, post-vaccination immunity, and exposure-specific prophylactic management (14).

Underreporting remains an important occupational-health problem because institutional surveillance and timely post-exposure management depend on exposure notification. Large-scale healthcare-worker data show that substantial proportions of NSIs are not reported, with perceived low risk, workload, limited awareness of reporting systems, and organizational factors contributing to non-reporting (15). Pakistani evidence has similarly demonstrated substantial underreporting among dental healthcare workers (16), while recent hospital-based evidence from other resource-constrained settings also shows incomplete exposure reporting and inconsistent post-exposure management (12).

The consequences of NSI extend beyond immediate infection risk. Healthcare workers may experience fear of infection, anxiety, sleep disturbance, intrusive recollection, and other psychological distress while awaiting testing or follow-up. A review of the psychological effects of sharps injuries identified anxiety, depression, and post-traumatic stress-related symptoms as important potential consequences and noted that psychological follow-up may be inadequate (17). Recent qualitative synthesis likewise describes fear, emotional distress, re-living the event, and concern about reprimand as recurring experiences surrounding NSIs (11).

Institutional context is especially important in resource-constrained healthcare settings. Device availability, workload, staffing patterns, safety culture, infection-control infrastructure, reporting procedures, and access to occupational-health services can influence injury occurrence and post-exposure response independently of individual worker knowledge (3,11,12). Effective prevention therefore requires an integrated systems approach rather than reliance on personal awareness alone.

Dera Ismail Khan contains major tertiary public-sector services that employ physicians, nurses, paramedical personnel, technologists, and support workers with varying levels of occupational exposure

to blood and body fluids. Local data are therefore useful for determining the burden of NSIs and identifying gaps in training, protective practices, post-exposure response, and surveillance.

The present study aimed to determine the 12-month prevalence of needlestick and sharps injuries among healthcare workers at District Head Quarter Hospital and Mufti Mehmood Memorial Teaching Hospital, Dera Ismail Khan; describe bloodborne-pathogen training and awareness, PPE use, disinfection practices, post-injury responses, and surveillance participation; assess the association between formal BBP training and NSI occurrence; and compare consistent PPE use across professional designations.

MATERIALS AND METHODS

Study Design and Setting

A descriptive cross-sectional study was conducted at District Head Quarter Hospital and Mufti Mehmood Memorial Teaching Hospital, Dera Ismail Khan, Pakistan. Both institutions are public-sector tertiary-care hospitals.

Study Population and Sample Size

The accessible study population comprised approximately 1,000 hospital staff members.

Sample size was estimated using Cochran's formula:

$$n_0 = Z^2 p(1-p) / e^2$$

using a 95% confidence level, ($Z=1.96$), assumed prevalence ($p=0.50$), and margin of error ($e=0.05$). The initial estimate was approximately 384 participants. Application of a finite-population correction for an accessible population of approximately 1,000 produced an adjusted minimum requirement of approximately 277 participants. A final sample of 280 healthcare workers was included.

Sampling

Participants were recruited using non-probability convenience sampling.

Eligibility Criteria

Healthcare workers were eligible if their occupational duties involved potential exposure to blood or other body fluids, they were available during the data-collection period, and they provided informed consent. Eligible professional categories included doctors, nurses, technologists, paramedical personnel, and relevant support staff.

Staff without direct patient-care or occupational bloodborne-pathogen exposure duties, workers on extended leave during data collection, individuals who declined participation, and questionnaires judged incomplete or unreliable were excluded.

Data Collection

Data were collected using a structured interviewer- or self-administered questionnaire.

The questionnaire covered demographic and occupational characteristics, including age, sex, professional designation, and duration of professional experience. Bloodborne-pathogen variables included previous formal training, general awareness of bloodborne pathogens, and awareness of transmission routes.

Occupational-practice variables included self-reported PPE use, occurrence of a needlestick or sharps injury during the preceding 12 months, immediate action after injury, and adherence to disinfection protocols.

Institutional-surveillance variables included respondent awareness of a formal BBP surveillance program, reported frequency of screening, and reported consent for blood-sample collection during surveillance.

The primary outcome was self-reported occurrence of at least one needlestick or sharps injury during the preceding 12 months.

Statistical Analysis

Data were coded and analyzed using IBM SPSS Statistics version 23. Categorical variables were summarized using frequencies and percentages.

The association between formal BBP training and 12-month NSI occurrence was assessed using Pearson's chi-square test. A crude risk ratio and 95% confidence interval were additionally calculated from the reported 2×2 table.

The original PPE data included four response levels: always, sometimes, rarely, and never. Because the original professional-designation × four-level PPE table contained numerous sparse expected cells, a supplementary analysis compared consistent PPE use, defined as an “always” response, with all less-consistent responses across the four professional groups. The exact professional denominators and reported “always” percentages permitted deterministic reconstruction of these counts. A two-sided *p* value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the relevant institutional review board. Written informed consent was obtained before participation. Participant confidentiality was maintained throughout data collection and analysis.

RESULTS

Participant Characteristics

A total of 280 healthcare workers participated.

Most participants were male, accounting for 234/280 (83.6%), while 46 (16.4%) were female. The largest age group was 18–30 years, comprising 144 participants (51.4%), followed by 31–45 years in 117 (41.8%) and 46–60 years in 19 (6.8%).

Paramedical personnel represented the largest professional group, with 162 participants (57.9%). Nurses accounted for 59 (21.1%), other technical or support staff for 32 (11.4%), and doctors for 27 (9.6%).

Professional experience exceeded six years in 130 participants (46.4%); 75 (26.8%) had 4–6 years of experience, 64 (22.9%) had 1–3 years, and 11 (3.9%) had less than one year.

Table 1. Demographic and Occupational Characteristics of Healthcare Workers

Characteristic	Category	n	%
Sex	Male	234	83.6
	Female	46	16.4
Age group	18–30 years	144	51.4
	31–45 years	117	41.8
	46–60 years	19	6.8
Professional designation	Doctor	27	9.6
	Nurse	59	21.1
	Paramedic	162	57.9
	Other staff	32	11.4
Professional experience	<1 year	11	3.9
	1–3 years	64	22.9
	4–6 years	75	26.8
	>6 years	130	46.4

Training, Awareness, and Infection-Control Practices

Formal training concerning bloodborne pathogens had been received by 198 participants (70.7%), whereas 82 (29.3%) reported no formal training.

General awareness of bloodborne pathogens was reported by 212 participants (75.7%), and 204 (72.9%) reported awareness of relevant transmission routes.

Consistent PPE use was reported by 224/280 participants (80.0%). Twenty-nine (10.4%) reported using PPE sometimes, 19 (6.8%) rarely, and eight (2.9%) never.

Routine disinfection procedures were reportedly followed always by 219 participants (78.2%), sometimes by 28 (10.0%), rarely by 19 (6.8%), and never by 14 (5.0%).

Table 2. Bloodborne-Pathogen Training, Awareness, and Infection-Control Practices

Variable	Response	n	%
Formal BBP training	Yes	198	70.7
	No	82	29.3
General BBP awareness	Yes	212	75.7
	No	68	24.3
Awareness of transmission routes	Yes	204	72.9
	No	76	27.1
PPE use	Always	224	80.0
	Sometimes	29	10.4
	Rarely	19	6.8
	Never	8	2.9
Disinfection-protocol adherence	Always	219	78.2
	Sometimes	28	10.0
	Rarely	19	6.8
	Never	14	5.0

Needlestick and Sharps Injuries

Ninety-six of 280 participants reported at least one NSI during the preceding 12 months, corresponding to a prevalence of 34.3% (95% CI 29.0–40.0%). The remaining 184 participants (65.7%) reported no injury during this period.

Table 3. Needlestick Injury, Post-Injury Response, and Surveillance

Domain	Response	n	%
NSI in preceding 12 months, N=280	Yes	96	34.3
	No	184	65.7
Documented immediate response, n=95	Washed wound	54	56.8
	Initiated PEP	23	24.2
	No action	18	18.9
Formal surveillance program, N=280	Yes	190	67.9
	No	40	14.3
	Did not know	50	17.9
Reported screening frequency	Every 6 months	174	62.1
	After exposure only	69	24.6
	Never	33	11.8
	Annually	4	1.4
Consent for surveillance blood sampling	Yes	185	66.1
	No	95	33.9

A post-injury response was documented for 95 of the 96 injured participants. Among these 95 respondents, 54 (56.8%) reported washing the wound, 23 (24.2%) reported initiating PEP, and 18 (18.9%) reported taking no action. One injured participant did not have a response represented in the supplied post-injury categories.

Regarding institutional surveillance, 190/280 participants (67.9%) reported that a formal BBP surveillance program existed, 40 (14.3%) reported that it did not, and 50 (17.9%) did not know.

Six-monthly screening was reported by 174 participants (62.1%), screening only after an exposure by 69 (24.6%), no screening by 33 (11.8%), and annual screening by four (1.4%). Consent for blood-sample collection within the reported surveillance process was reported by 185 participants (66.1%).

Association Between Formal Training and NSI

Among the 198 workers who had received formal BBP training, 65 (32.8%) reported an NSI and 133 (67.2%) did not. Among 82 workers without formal training, 31 (37.8%) reported an NSI and 51 (62.2%) did not.

The prevalence of reported NSI was therefore numerically lower among formally trained workers, but the difference was not statistically significant. The crude risk ratio was 0.87 (95% CI 0.62–1.22), and Pearson's chi-square test gave $\chi^2=0.637$, $df=1$, $p=0.425$.

Consistent PPE Use Across Professional Groups

From the professional-group denominators and reported "always" PPE percentages, consistent use was reconstructed as 23/27 doctors (85.2%), 50/59 nurses (84.7%), 127/162 paramedical personnel (78.4%), and 24/32 other staff (75.0%).

When PPE use was analyzed as always versus less-than-always, no statistically significant difference was detected among the four professional groups ($\chi^2=2.045$, $df=3$, $p=0.563$).

Table 4. Inferential Analyses

Analysis	Comparison	Effect/Statistic	p Value
Formal BBP training × NSI	Trained: 65/198 (32.8%) vs untrained: 31/82 (37.8%)	RR 0.87 (95% CI 0.62–1.22); $\chi^2=0.637$	0.425
Designation × consistent PPE use	Doctor 23/27; nurse 50/59; paramedic 127/162; other 24/32	$\chi^2=2.045$, $df=3$	0.563

DISCUSSION

Approximately one-third of surveyed healthcare workers reported a needlestick or sharps injury during the preceding year. This represents a substantial occupational-exposure burden despite formal BBP training in more than two-thirds of participants and self-reported consistent PPE use in four-fifths of the sample.

The 34.3% 12-month prevalence is compatible with the broad burden described across diverse healthcare systems. Global and developing-country systematic reviews have reported substantial NSI occurrence among healthcare workers, although estimates vary considerably according to setting, occupational group, study methods, and recall period (1,2). More recent meta-analyses from Ethiopia and Iran likewise demonstrate high exposure burdens and identify recapping, inadequate precautions, insufficient training, and work-environment factors among recurring correlates (3,4). The present estimate is also close to recent multicentre Pakistani data reporting an NSI prevalence of approximately 35% over six months in tertiary-care personnel (5).

The present study identified no statistically significant association between formal training status and NSI occurrence. Injury prevalence was 32.8% among trained personnel and 37.8% among those without formal training, producing a crude risk ratio of 0.87 with a confidence interval that included no difference. This result should not be interpreted as evidence that training is ineffective. A binary training variable in a cross-sectional questionnaire does not capture training quality, recency, practical competency, refresher frequency, or subsequent behavioral adherence. In addition, workers performing more invasive or high-risk procedures may receive more training while simultaneously experiencing more exposure opportunities, creating potential confounding by occupational role, workload, and procedural intensity. Recent systematic and qualitative evidence similarly indicates that NSIs arise from an interaction of training, workload, experience, recapping, safety culture, equipment availability, and workplace processes rather than from knowledge alone (3,4,11).

Evidence from intervention studies supports a multifaceted prevention approach. Tarigan et al. found reductions in NSIs with training and with safety-engineered devices, with the strongest pooled reduction when both approaches were combined (8). Ballout et al. similarly found that safety-engineered intravenous and phlebotomy devices reduced healthcare-worker injury rates compared with conventional devices (9). More recent long-term hospital data have also documented lower injury rates after implementation of safety-engineered devices, supporting the practical value of engineering

controls when incorporated into routine systems of care (10). Prevention should therefore be regarded as a systems problem rather than a knowledge problem alone (11).

Consistent PPE use was reported by 80% of participants. Doctors and nurses reported the highest proportions of “always” use, followed by paramedical and other personnel, but the reconstructed binary comparison showed no statistically significant difference among professional groups.

PPE remains important for protection against blood and body-fluid exposure, particularly mucocutaneous exposure, but conventional gloves cannot reliably prevent a sharp device from penetrating the skin. High self-reported PPE use can therefore coexist with substantial NSI prevalence when recapping, unsafe handling, procedural urgency, workload, inadequate disposal systems, equipment shortages, or lack of engineered safety devices remain unaddressed (3,11,12).

The post-injury response findings are clinically important. Among 95 injured participants with a documented response, 54 reported washing the wound, 23 reported initiating PEP, and 18 reported taking no immediate action. Because the questionnaire did not identify the implicated pathogen, source-patient status, prophylaxis indication, vaccination status, or regimen used, not every exposure would necessarily warrant the same pharmacological intervention. Nevertheless, occupational exposure should prompt immediate wound care, reporting, structured risk assessment, and pathogen-specific follow-up (12-14). Earlier regional evidence has likewise demonstrated incomplete post-exposure responses following NSIs among healthcare workers (18).

Current occupational HIV guidance emphasizes rapid reporting and evaluation and timely initiation of PEP when indicated (13). For HBV, post-exposure management depends substantially on prior vaccination and immune status, with prophylaxis tailored to the exposed worker and source-patient context (14). The present findings therefore reinforce the need for an accessible occupational-exposure pathway in which staff can rapidly obtain expert assessment rather than deciding independently whether an injury is clinically important.

Beyond infectious risk, NSIs can produce meaningful psychological consequences. Healthcare workers may experience fear of acquiring infection, anxiety while awaiting results, sleep disturbance, intrusive thoughts, or other stress reactions, and available evidence suggests that psychological follow-up is not always routinely integrated into post-exposure care (17). Qualitative synthesis also identifies fear, emotional distress, and concern about blame or reprimand as recurring experiences after occupational sharps injuries (11). Confidential and supportive post-exposure pathways should therefore address both clinical and psychological needs.

A formal surveillance program was reported by approximately two-thirds of participants, but nearly one-third either reported that no such program existed or were unaware of it. This finding is important because surveillance depends on worker awareness, timely reporting, and institutional responsiveness. Large-scale evidence shows that underreporting can substantially obscure the true burden of NSIs and that reporting behavior is influenced by training, reporting-system accessibility, perceived risk, workload, and organizational culture (15). Similar problems have been documented in other hospital settings where substantial proportions of occupational blood and body-fluid exposures were not reported (12).

Similarly, 11.8% reported never being screened and approximately one-quarter described screening only after a known exposure. Screening practices need to be interpreted according to institutional policy and the pathogen involved, but the variation suggests that occupational-health processes were not experienced uniformly across the workforce. Standardized pathways are particularly important because HIV and HBV post-exposure decisions are time-sensitive and depend on exposure-specific risk assessment rather than indiscriminate testing or prophylaxis (13,14).

Underreporting may further reduce the apparent institutional burden of NSIs. Pakistani evidence has shown that a substantial proportion of sharps injuries are never formally reported (16), and large-scale international evidence similarly documents considerable non-reporting of occupational needlestick and sharps injuries (15). The present survey assessed whether an injury occurred but did not provide a direct injury-reporting rate, so the extent of underreporting within these two hospitals cannot be quantified.

The predominance of paramedical staff is relevant to interpretation because this group constituted nearly 58% of the sample. Different professional roles have different exposure opportunities. Physicians, nurses, phlebotomy personnel, operating-room staff, waste handlers, laboratory workers, and support personnel encounter distinct combinations of devices, procedures, workloads, and environmental hazards; pooled prevalence may therefore be influenced by workforce composition (1,3,4,11).

The predominantly male sample also reflects the specific workforce captured by the convenience sample and should not be interpreted as representative of healthcare workers throughout Pakistan. Similarly, almost half of participants had more than six years of professional experience, but the study did not provide a cross-tabulation of experience with NSI occurrence.

Several study strengths should be recognized. The sample slightly exceeded the finite-population-adjusted target, two tertiary public-sector hospitals were represented, and the questionnaire covered both injury occurrence and several aspects of prevention and surveillance. The training $\times$ NSI table also permitted calculation of an interpretable crude risk ratio rather than reliance on a p value alone.

The principal limitations arise from the cross-sectional design, convenience sampling, and reliance on self-reported behavior and 12-month injury recall. Social-desirability bias may inflate reported PPE or disinfection adherence, while recall error may affect injury reporting. Formal training was assessed only as a yes/no exposure and could not be characterized by quality or timing.

The original multi-category professional-designation $\times$ PPE table also contained sparse expected cells. Reclassification to consistent versus less-consistent PPE use produced a more stable descriptive comparison but does not answer whether PPE use itself was associated with NSI risk. That question would require a direct PPE $\times$ injury cross-tabulation or participant-level multivariable analysis.

The study also did not report injury mechanism, contaminated device type, procedure being performed, use of recapping, injury severity, source-patient infection status, departmental location, vaccination status, or whether the injury was officially reported. These variables would be particularly valuable for designing targeted preventive interventions because recent evidence consistently links NSI risk to specific procedures, recapping, workload, equipment availability, and organizational context (1,3,4,11).

Future prospective surveillance should therefore capture each exposure event in real time, including worker cadre, department, device, procedure, mechanism, PPE, engineered safety features, reporting, source-patient assessment, vaccination status, PEP indication, PEP uptake, and follow-up outcome. Prospective event-based systems can support more accurate surveillance, identify modifiable injury mechanisms, and strengthen targeted prevention and post-exposure management (11,15).

CONCLUSION

Needlestick and sharps injuries affected 34.3% of surveyed healthcare workers during the preceding 12 months. Formal bloodborne-pathogen training was common, but the observed difference in NSI prevalence between trained and untrained workers was not statistically significant.

Self-reported consistent PPE use was high and did not differ significantly across professional designations when analyzed as always versus less-than-always use. Post-injury response remained variable, and a notable proportion of exposed workers reported no immediate action. Although PEP was initiated by only a minority of injured respondents, the study did not contain sufficient exposure-specific information to determine how many injuries met pathogen-specific indications for prophylaxis.

These findings support a comprehensive occupational-safety strategy combining effective training, safer sharps technology, accessible reporting, standardized exposure assessment, and prompt pathogen-specific post-exposure management rather than relying on training alone (8-14).

RECOMMENDATIONS

Healthcare institutions should implement regularly refreshed, practical NSI-prevention training incorporating simulated sharps handling, immediate post-exposure response, and reporting procedures. Training should be integrated with organizational and engineering controls rather than delivered as a stand-alone intervention (8,11).

Safety-engineered needles, needleless systems, and appropriate sharps-disposal equipment should be introduced or expanded where feasible, with monitoring of real-world use and injury trends (9,10).

Hospitals should maintain a confidential, simple, and non-punitive exposure-reporting pathway available at all times. Every reported exposure should trigger immediate wound care, structured risk assessment, appropriate source evaluation, pathogen-specific management, counselling, and follow-up (12,13,15).

Occupational-health services should maintain documented hepatitis B immunization and immunity programs for personnel at risk of blood exposure and establish clear institutional pathways for HIV and hepatitis exposure management (13,14).

Prospective institutional surveillance should record injury mechanisms, procedures, devices, departments, worker groups, reporting behavior, and post-exposure outcomes so prevention resources can be targeted to the settings and processes generating the greatest risk (11,15).

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