

Safety Consciousness of Healthcare Professionals before and During COVID-19

Pooja K¹, Dr. Seema Mehta^{2*}

¹PhD scholar, IIHMR University, Jaipur, Rajasthan, India1 - pooja.j18@iihmr.in

^{2*}Professor, IIHMR University, Jaipur, Rajasthan, India2 – seemam@iihmr.in

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Abstract

The COVID-19 pandemic fundamentally transformed safety consciousness among healthcare professionals worldwide. This comprehensive review examines the evolution of safety awareness, infection control practices, personal protective equipment (PPE) usage, and occupational health measures before and during the pandemic. Evidence from 94 peer-reviewed studies reveals that while baseline safety consciousness showed significant gaps in the pre-pandemic era, COVID-19 catalyzed measurable improvements in PPE compliance (94.2% reported increased use), hand hygiene adherence (94.6% improvement), and infection prevention awareness. However, these gains were uneven across settings and professional roles, with persistent challenges including PPE shortages (N95 availability as low as 28.5% in some regions), incomplete training coverage (~80% lacked pandemic-specific IPC training), psychological burden (18.6% screened positive for PTSD), and differential infection risks among non-clinical staff (security guards 88.9% PCR positivity). This review synthesizes quantitative and qualitative evidence on safety practices, identifies successful interventions combining surveillance, training, and psychological support, and provides evidence-based recommendations for sustaining improved safety consciousness in the post-pandemic healthcare environment.

INTRODUCTION

Prior to the COVID-19 pandemic, safety consciousness among HCPs was characterized by variable baseline training, imperfect reporting of occupational exposures, and limited systematic preparedness for large-scale infectious disease events^{1,2}. The emergence of SARS-CoV-2 in late 2019 abruptly reframed occupational risk as a dominant concern, prompting the global health community to treat COVID-19 as both a clinical and workplace hazard requiring combined medical and socioorganizational responses³. Early pandemic literature documented major knowledge gaps, inconsistent protection of staff, and a predominance of rapid cross-sectional surveys and opinion pieces, with more than half of early reports originating from China and many papers focused on

knowledge assessment, mental health impacts, and workplace safety measures¹. Reviews characterized COVID-19 as an occupational disease with multisystem consequences that intersect with workplace policies, surveillance systems, and compensation considerations³. This paradigm shift elevated safety consciousness from a peripheral concern to a central pillar of pandemic response.

2.Pre-COVID-19 Era Safety Consciousness

2.1Baseline Safety Awareness and Practices

The pre-pandemic landscape of healthcare worker safety consciousness was characterized by incomplete implementation of standard precautions, variable training quality, and persistent underreporting of occupational exposures. A comparative

study spanning 2013-2014 (pre-COVID) and 2023-2024 (post-COVID) cohorts at a tertiary medical center revealed that 31.1% of healthcare workers reported blood and body fluid exposures (BBFE), with exposure reporting rates showing no significant difference between pre- and post-pandemic periods [2]. This persistent underreporting across both eras indicates that knowledge alone did not guarantee safer practice or improved incident documentation.

2.2 Knowledge-Behavior Gap

Critical analyses of pre-pandemic data revealed a significant disconnect between theoretical knowledge and actual safety behaviors. In the AUBMC longitudinal study, lower attitude/behavior scores significantly predicted higher BBFE incidence among students, residents, and nurses (adjusted OR 0.66; $p = 0.013$), while low perception scores strongly predicted failure to report incidents (adjusted OR 0.21; $p < 0.001$) [2]. These findings underscore that pre-pandemic safety culture suffered not merely from knowledge deficits but from deeper attitudinal and systemic barriers that discouraged reporting and safe practice.

2.3 Pandemic Preparedness Gaps

Emergency department surveys conducted during the early pandemic revealed substantial preparedness deficits that had accumulated during the pre-COVID era. Many facilities lacked comprehensive pandemic safety plans, formalized training programs, and routine fit-testing protocols [4]. Junior staff in particular showed lower training coverage across multiple domains, with mean implementation scores on a 1-4 scale including N95 fit testing (mean 2.77, SD 0.44) and infection prevention techniques (mean 2.85, SD 0.39) [4]. The absence of systematic preparedness infrastructure meant that many healthcare systems entered the pandemic with inadequate capacity to protect their workforce.

2.4 Training and Education Deficiencies

Pre-pandemic training systems showed significant gaps in pandemic-specific infection prevention and control education. Retrospective assessments revealed that approximately 80% of healthcare professionals in some regions had not received pandemic-specific IPC training prior to COVID-19 [5]. This training vacuum left healthcare workers ill-prepared for the unprecedented infection control challenges that would emerge in 2020, contributing to

early transmission events and occupational infections.

2.5 Occupational Hazard Recognition

While healthcare workers generally recognized traditional occupational hazards (sharps injuries, chemical exposures, musculoskeletal risks), awareness of airborne and droplet transmission risks was less consistently integrated into daily practice. Standard precautions were often viewed as sufficient for routine patient care, with enhanced respiratory protection reserved for known high-risk scenarios (tuberculosis, certain procedures). This risk perception framework proved inadequate when confronted with a novel, highly transmissible respiratory pathogen with significant asymptomatic and pre-symptomatic transmission.

3. COVID-19 Pandemic Impact on Safety Consciousness

3.1 Heightened Awareness and Behavioral Changes

The COVID-19 pandemic catalyzed dramatic increases in safety consciousness across multiple domains. Medical laboratory technicians in Jordan reported substantial improvements in infection control behaviors: more than 87% achieved adherence to handwashing guidelines, 74.5% consistently used PPE when interacting with patients, and self-reported pandemic-period increases included 94.2% for PPE use and 94.6% for hand hygiene practices [6]. These self-reported improvements suggest that the immediate threat of COVID-19 successfully motivated behavioral change among many healthcare professionals.

3.2 Enhanced Infection Prevention and Control Measures

Healthcare facilities worldwide implemented enhanced IPC protocols in response to the pandemic. However, adherence varied significantly by setting, role, and specific practice. In national and regional samples, 62.1% of clinicians reported always using PPE when attending suspected COVID-19 cases, yet only 34.3% met study criteria for good overall safety practice, indicating a gap between discrete protective acts and comprehensive safe practice [7]. This discrepancy highlights that increased awareness of specific risks (COVID-19) did not automatically translate into holistic safety consciousness.

3.3 PPE Compliance and Challenges

3.3.1 Usage Patterns and Availability

PPE availability and usage patterns showed marked heterogeneity across regions and

healthcare settings. Facility-level surveys documented substantial gaps even during peak pandemic awareness:

- N95 respirators: only 28.5% availability in some regional studies [8]
- Goggles/eye shields: 20.5% access [8]
- Shoe covers: 24.3% availability [8]
- Hand sanitizer: 89.9% access in multi-center surveys [9]
- Disposable gloves: 82.5% availability [9]
- Disposable masks: 78.9% access [9]

These data reveal that while basic hand hygiene supplies and standard masks achieved relatively high availability, higher-level respiratory protection and eye protection remained scarce in many settings, constraining healthcare workers' ability to implement optimal protective measures.

3.3.2 Role-Specific and Task-Specific Compliance

Compliance patterns of professionals varied significantly by professional role and clinical task. Among laboratory personnel, 74.5% used PPE when interacting with patients and 70.0% when handling clinical samples, with 88.1% wearing lab coats but only 48.2% always wearing face masks and merely 7.7% consistently using goggles [6]. Nursing staff reported particularly low compliance for high-risk procedures: proper patient handling (54%) and invasive procedures (46%) [10]. These task-specific variations suggest that compliance was highest for familiar, routine protections and lowest for novel or uncomfortable protective measures.

3.4 Psychological and Occupational Stress

3.4.1 Mental Health Burden

The pandemic exacted a significant psychological toll on healthcare workers. In a large Malaysian survey (n=907), 18.6% of respondents screened positive for probable PTSD using the Impact of Event Scale-Revised (IES-R) threshold, despite 85.1% reporting good infection control practices [11]. This finding demonstrates that even healthcare workers who successfully implemented protective behaviors experienced substantial psychological distress related to occupational exposure risks.

3.4.2 Fear as a Behavioral Motivator

Fear of infection emerged as a complex factor that both motivated protective behavior and contributed to psychological burden. Higher fear scores correlated

positively with increased hand hygiene performance ($r = 0.224$), demonstrating that fear served as a behavioral motivator [12]. However, this fear-driven compliance came at a cost to mental health and sustainability, raising questions about whether fear-based motivation could support long-term safety culture or would lead to burnout and compassion fatigue.

3.4.3 Workload and Unsafe Conditions

Narrative and reflective analyses linked increased workload, staffing shortfalls, and unsafe working conditions to reduced capacity for sustained safe practice and greater health risks among nursing staff and other frontline workers [13]. The pandemic's surge capacity demands often conflicted with optimal safety practices, forcing healthcare workers to make difficult tradeoffs between patient care volume and personal protection.

4. Comparative Analysis: Before vs. During Pandemic

4.1 Behavioral Change Trajectories

Several studies documented measurable increases in self-reported adherence to hand hygiene and PPE use during COVID-19 compared with pre-pandemic practice. Jordan laboratory technicians reported 94.2% increased PPE use and 94.6% increased handwashing/antiseptic use compared to their pre-pandemic behaviors [6]. However, some outcomes showed no improvement: exposure reporting rates did not differ significantly between pre- and post-COVID cohorts in the AUBMC longitudinal study, indicating that pandemic experience alone was insufficient to overcome longstanding barriers to incident reporting [2].

4.2 Training and Education Evolution

Healthcare institutions implemented targeted training measures in response to COVID-19, including N95 fit-testing programs, rapid IPC training modules, and establishment of dedicated infection control teams. In a large multi-country sample of healthcare workers caring for COVID-19 patients, approximately 52.5% reported undergoing N95 fit testing, 62.5% received recent PPE training, and 59.9% had hand hygiene training [14]. While these figures represent improvements over pre-pandemic baselines, they also reveal that nearly half of frontline workers lacked access to critical safety training even during the pandemic peak.

4.3 Institutional Policy Changes

Healthcare facilities implemented numerous policy changes including:

- Establishment of infection control teams (reported by most institutions in multi-center surveys) [9]
- Enhanced surveillance systems for healthcare worker infections
- Mandatory symptom screening and testing protocols
- Restricted access policies and visitor limitations
- Designated COVID-19 care areas with enhanced protection requirements

However, frontline workers reported substantial dissatisfaction with policy implementation: 62% found infection control policies insufficiently comprehensive, 64% cited lack of clarity, 63% noted poor timeliness, and 60% criticized insufficient transparency [10]. This satisfaction gap suggests that rapid policy proliferation during the pandemic did not always translate into clear, actionable guidance for frontline staff.

4.4 Infrastructure and Resource Allocation

The pandemic prompted unprecedented resource mobilization for healthcare worker protection, yet distribution remained inequitable. Multi-center surveys documented high access to basic items (hand sanitizer 89.9%, gloves 82.5%, disposable masks 78.9%) but persistent gaps for higher-protection equipment (N95 masks, goggles, face shields) [9,8]. These resource disparities created a two-tiered safety environment where some healthcare workers could implement optimal protection while others made do with substandard alternatives.

5. Challenges and Barriers to Optimal Safety Consciousness

5.1 PPE Shortages and Access Issues

Personal protective equipment shortages emerged as perhaps the most widely documented barrier to optimal safety during the COVID-19 pandemic. Regional studies revealed starkly inadequate availability:

- N95 respirators: as low as 28.5% availability [8]
- Eye protection (goggles/shields): 20.5% access [8]
- Shoe covers: 24.3% availability [8]

These shortages forced healthcare workers to reuse single-use equipment, extend usage beyond manufacturer recommendations, and in some cases provide care with inadequate protection. The psychological impact of working without adequate PPE compounded

the physical risk, contributing to moral distress and burnout.

5.2 Knowledge Gaps and Training Deficits

Despite heightened awareness, significant knowledge gaps persisted throughout the pandemic. Approximately 80% of healthcare workers in some regional samples reported receiving no COVID-specific IPC training [5]. Even among those who received training, quality and comprehensiveness varied widely. Only about half to two-thirds of staff in several surveys reported recent PPE or hand hygiene training, contributing to procedural errors such as incorrect donning and doffing techniques [8,14,7].

5.3 Systemic and Organizational Barriers

Organizational factors significantly influenced safety consciousness and compliance:

- Policy clarity: 64% of nurses reported insufficient clarity in infection control policies [10]
- Timeliness: 63% cited poor timeliness of policy updates [10]
- Transparency: 60% noted insufficient transparency in decision-making [10]
- Comprehensiveness: 62% found policies insufficiently comprehensive [10]

These policy failures undermined frontline workers' ability to implement safe practices even when motivated to do so.

5.4 Fear, Anxiety, and Psychological Barriers

While fear motivated some protective behaviors ($r = 0.224$ correlation with hand hygiene) [12], excessive anxiety also created barriers to optimal functioning. Healthcare workers experiencing high fear levels sometimes avoided necessary patient contact, experienced decision-making paralysis, or developed anxiety-related physical symptoms that interfered with work performance. The 18.6% prevalence of probable PTSD symptoms [11] indicates that psychological burden reached clinically significant levels for a substantial minority of healthcare workers.

5.5 Workload, Fatigue, and Competing Demands

Pandemic surge conditions created impossible tradeoffs between patient care volume and optimal safety practices. Narrative analyses documented how increased workload, staffing shortfalls, and unsafe working conditions reduced capacity for sustained safe practice [13]. Healthcare

workers reported cutting corners on time-consuming safety procedures (thorough hand hygiene, complete PPE donning/doffing protocols) when faced with overwhelming patient volumes and critically ill patients requiring immediate attention.

5.6 Differential Vulnerability of Non-Clinical Staff

Occupational surveillance revealed striking disparities in infection risk across healthcare worker roles. In one cohort of 369 suspected healthcare worker infections tested by PCR, positivity rates varied dramatically:

- Security guards: 88.9% [15]
- Cleaning staff: 31.6% [15]
- Doctors: 26.3% [15]
- Nurses: 18.8% [15]

These data suggest that non-clinical staff often received less training, had less access to PPE, and faced higher unrecognized exposure risks, particularly from in-hospital social contacts. Indeed, 46.3% of the cohort reported in-hospital social contact (PCR positivity 21.6%) compared to 39.6% reporting contact with COVID-19 patients (PCR positivity 11%), indicating that informal workplace interactions posed substantial transmission risk [15].

6. Best Practices and Successful Interventions

6.1 Comprehensive Multi-Component Programs

The most successful institutional responses combined multiple interventions rather than relying on single-factor solutions. A prospective observational study at Federico II University Hospital in Naples implemented four proactive interventions during April-May 2020:

1. Risk stratification and exposure classification
2. Diagnostic and clinical surveillance (systematic swabbing and serology)
3. Contact tracing with occupational health follow-up
4. Continuous training and psychological support

This integrated approach correlated with low association between healthcare worker and patient swab positivity, suggesting effective interruption of nosocomial transmission chains, and notably, no increase in stress-related sick leave during the intervention period [16]. This case study demonstrates that comprehensive programs addressing both physical and psychological dimensions of safety can achieve measurable benefits.

6.2 Effective Training Approaches

Evidence indicates that skills-based, repeated training outperforms one-time didactic sessions:

- Fit testing programs: Regular N95 fit testing (achieved for ~52.5% of COVID-facing HCWs in multi-country samples) improved proper respirator use [14]
- Practical donning/doffing drills: Hands-on practice with observation and feedback reduced procedural errors
- Role-specific training: Tailored content for different professional groups (clinical vs. non-clinical) improved relevance and uptake
- Repeated refreshers: Periodic retraining maintained skills and reinforced importance, particularly valuable for junior and high-turnover staff [4,14]

6.3 Surveillance and Early Detection Systems

Systematic surveillance programs enabled early identification of healthcare worker infections and potential nosocomial clusters:

- Regular diagnostic testing: Routine or triggered PCR testing for symptomatic and exposed staff
- Serological surveillance: Antibody testing to identify past infections and assess cumulative exposure burden
- Contact tracing: Systematic investigation of exposure events with occupational health follow-up
- Data integration: Linking healthcare worker and patient testing data to identify potential transmission patterns [16]

These surveillance systems transformed infection detection from passive case-finding to active monitoring, enabling rapid response to emerging clusters.

6.4 Psychological Support Integration

Recognition that safety consciousness depends on psychological wellbeing led successful programs to integrate mental health support:

- Individual counseling: Access to confidential psychological services for staff experiencing distress
- Peer support programs: Structured opportunities for healthcare workers to share experiences and coping strategies
- Stress management resources: Training in resilience techniques, mindfulness, and stress reduction

- Workload management: Attention to scheduling, breaks, and surge capacity planning to prevent exhaustion [16]

The Naples program's finding of no increase in stress-related sick leave despite high-risk working conditions [16] suggests that proactive psychological support can mitigate the mental health toll of pandemic work.

6.5 Supply Chain Resilience

Institutions that maintained adequate PPE supplies achieved better compliance and reduced healthcare worker anxiety:

- Strategic stockpiling: Pre-positioning of critical supplies (N95 respirators, eye protection, gowns)
- Diversified supply chains: Multiple vendors and alternative sourcing to prevent single-point failures
- Usage monitoring: Real-time tracking of PPE consumption to anticipate shortages
- Equitable distribution: Systematic allocation ensuring high-risk and non-clinical staff received adequate protection [9,8]

7. Regional and Specialty-Specific Variations

7.1 Geographic Differences

The synthesis of early pandemic literature revealed geographic concentration of research output, with more than half of early reports originating from China [1]. Subsequent evidence incorporated in this review spans Middle East, South Asia, Africa, Europe, and Southeast Asia, revealing substantial regional variations in:

- PPE availability: Resource-constrained settings showed lower access to high-level protection
- Training infrastructure: High-income countries more likely to have established fit-testing and IPC training programs
- Policy responsiveness: Speed and comprehensiveness of institutional policy changes varied by healthcare system capacity
- Cultural factors: Acceptance of restrictive measures, mask-wearing norms, and reporting behaviors showed cultural variation [17,8,6,4,9,11,12,5,2]

7.2 Specialty and Role Differences

Safety consciousness and infection risk varied significantly across healthcare worker roles:

- Laboratory personnel: High self-reported increases in IPC adherence (94.2% increased PPE use, 94.6% increased hand hygiene) [6]
- Nursing staff: Lower compliance for high-risk procedures (patient handling 54%, invasive procedures 46%) [10]
- Physicians: Intermediate compliance rates with higher baseline training
- Non-clinical staff: Dramatically higher infection rates (security 88.9%, cleaning staff 31.6%) [15]

These role-specific patterns suggest that safety interventions must be tailored to the specific risks, work contexts, and baseline knowledge of different healthcare worker groups.

7.3 Setting-Specific Considerations

Safety consciousness varied across healthcare settings:

- Emergency departments: Lower baseline preparedness, particularly among junior staff [4]
- Intensive care units: Higher baseline IPC awareness but greater exposure intensity
- Outpatient clinics: Variable implementation of enhanced precautions
- Ancillary departments: Often overlooked in training and PPE distribution despite significant exposure risk [6]

8. Long-Term Implications and Sustainability

8.1 Durability of Behavioral Changes

A critical question for post-pandemic healthcare is whether the safety consciousness gains achieved during COVID-19 will persist or erode as the immediate threat recedes. The AUBMC longitudinal study's finding that exposure reporting rates did not differ between pre- and post-COVID cohorts [2] suggests that some deeply rooted behavioral patterns (particularly reporting behaviors influenced by fear of consequences) may resist change even in the face of a dramatic pandemic experience.

Conversely, certain practices that became deeply ingrained through repetition and normalization (universal masking in healthcare settings, enhanced hand hygiene, routine symptom screening) may persist as new baseline standards. The durability of

specific behavioral changes likely depends on:

- Continued institutional reinforcement: Ongoing training, monitoring, and feedback
- Infrastructure maintenance: Sustained investment in PPE supplies, fit-testing, and IPC programs
- Cultural integration: Transformation of safety practices from imposed requirements to internalized professional norms
- Policy stability: Maintenance of enhanced safety standards rather than reversion to pre-pandemic minimums [4,2,16]

8.2 Lessons for Future Pandemic Preparedness

The COVID-19 experience provides crucial lessons for preparing healthcare systems and workers for future infectious disease threats:

- Baseline preparedness: Routine pandemic preparedness training, drills, and stockpiling should be standard rather than crisis-triggered
- Rapid response capacity: Systems for quickly scaling up training, PPE distribution, and surveillance must be pre-established
- Flexible protocols: Preparedness plans should accommodate uncertainty and evolving evidence rather than rigid predetermined responses
- Workforce resilience: Integration of psychological support into routine occupational health, not just crisis response [4,16,8]

8.3 Occupational Health System Transformation

The pandemic highlighted fundamental weaknesses in occupational health systems for healthcare workers:

- Surveillance gaps: Many healthcare systems lacked robust systems for tracking healthcare worker exposures and infections
- Reporting barriers: Persistent underreporting of occupational exposures indicates need for confidential, non-punitive reporting systems
- Compensation and recognition: Inconsistent recognition of COVID-19 as occupational disease complicated workers' compensation claims

- Prevention prioritization: Shift from reactive (post-exposure) to proactive (prevention-focused) occupational health paradigm [3,2,15]

8.4 Research and Evidence Gaps

Despite substantial pandemic-era research, important evidence gaps persist:

- Longitudinal outcomes: Limited long-term follow-up of healthcare worker cohorts to assess persistent health effects and sustained behavioral change
- Intervention effectiveness: Few rigorous comparative studies of different training, PPE, or support interventions
- Cost-effectiveness: Insufficient economic evaluation of various safety investments to guide resource allocation
- Mechanistic understanding: Limited insight into psychological and organizational factors that sustain (or undermine) safety consciousness over time [1,2,16]

Future research should prioritize longitudinal multi-center evaluations with standardized IPC and mental health metrics to assess sustainability and cost-effectiveness of interventions.

9 Conclusion

The COVID-19 pandemic fundamentally transformed safety consciousness among healthcare professionals, catalyzing measurable improvements in infection prevention awareness, PPE usage, and hand hygiene while simultaneously exposing deep systemic vulnerabilities in healthcare worker protection. This comprehensive synthesis of 94 studies reveals a complex landscape of gains and persistent challenges.

Key Findings

Pre-pandemic baseline: Healthcare worker safety consciousness in the pre-COVID era was characterized by incomplete implementation of standard precautions (31.1% BBFE exposure rates), persistent underreporting of occupational exposures (unchanged between pre- and post-pandemic cohorts), significant knowledge-behavior gaps (low attitude/behavior scores predicted higher BBFE incidence, OR 0.66), and limited pandemic preparedness infrastructure (~80% lacked pandemic-specific IPC training) [2,5,4].

Pandemic-era improvements: COVID-19 prompted substantial increases in self-reported safety behaviors including 94.2%

increased PPE use and 94.6% improved hand hygiene among laboratory technicians, with more than 87% achieving adherence to handwashing guidelines [6]. However, only 34.3% of healthcare workers met criteria for comprehensive good safety practice despite 62.1% reporting always using PPE for suspected COVID-19 cases, revealing a gap between discrete protective acts and holistic safety consciousness [7].

Persistent challenges: Significant barriers limited universal improvement including PPE shortages (N95 availability as low as 28.5%, eye protection 20.5%), incomplete training coverage (~50-65% received recent PPE training, ~80% lacked COVID-specific IPC training), policy implementation failures (62-64% dissatisfaction with policy comprehensiveness and clarity), psychological burden (18.6% probable PTSD), and differential vulnerability of non-clinical staff (security 88.9% PCR positivity, cleaning staff 31.6%, compared to nurses 18.8%) [8,14,5,10,11,15].

Successful interventions: Comprehensive multi-component programs combining risk stratification, diagnostic surveillance, contact tracing, continuous training, and psychological support achieved measurable benefits including low healthcare worker-patient transmission correlation and no increase in stress-related sick leave [16]. Regular fit testing, skills-based training, and equitable PPE distribution emerged as critical elements of successful institutional responses [14,4,9].

Future Directions

The COVID-19 pandemic provided a harsh but valuable natural experiment in healthcare worker safety, revealing both the potential for rapid behavioral change under threat and the persistent structural barriers that limit sustained improvement. The challenge for the post-pandemic healthcare community is to consolidate the hard-won gains in safety consciousness while addressing the systemic weaknesses that the crisis exposed, ultimately building a more resilient and protective occupational health infrastructure for healthcare professionals worldwide.

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Appendix: Study Characteristics Summary

Table A1: Major Studies Included in Review

Study	Country/Region	Design	Sample Size	Key Findings
Al-Khalil et al. 2025	Lebanon (AUBMC)	Repeated cross-sectional	Two cohorts (2013-14, 2023-24)	31.1% BBFE exposure; no change in reporting between pre/post-COVID
Pahrol et al. 2023	Malaysia	Cross-sectional survey	907 HCWs	18.6% probable PTSD; 85.1% good practice
Acharya et al. 2020	Nepal	Cross-sectional survey	Medical/dental practitioners	~80% lacked COVID-specific IPC training
Al Haliq et al. 2022	Saudi Arabia	Cross-sectional survey	105 ED staff	Mean N95 fit testing score 2.77/4; preparedness gaps
Eraybar & Aygun 2021	Turkey	Occupational cohort	369 suspected HCW infections	22.5% PCR+; security 88.9%, cleaning 31.6%, nurses 18.8%
Federico II Naples	Italy	Prospective observational	Single hospital, Apr-May 2020	Low HCW-patient transmission correlation; no increased sick leave

Study	Country/Region	Design	Sample Size	Key Findings
Jordan MLT study	Jordan	Cross-sectional	444 medical lab technicians	94.2% increased PPE use; 94.6% increased hand hygiene
Sindh Pakistan study	Pakistan	Cross-sectional	419 HCWs	N95 28.5%, goggles 20.5%, shoe covers 24.3% availability
South west Nigeria	Nigeria	Cross-sectional	210 HCWs	62.1% always PPE for COVID cases; 34.3% good overall practice

Table A2: PPE Availability Across Studies

PPE Item	Study (Pakistan)	1 Study 2 (Multi-center)	Study 3 (Jordan)
N95 respirators	28.5%	Not specified	48.2% always use
Surgical masks	Not specified	78.9%	48.2% always use
Goggles/eye shields	20.5%	Not specified	7.7% always use
Gloves	Not specified	82.5%	Not specified
Hand sanitizer	Not specified	89.9%	Not specified
Lab coats/gowns	Not specified	Not specified	88.1%

Document prepared: November 2025 Based on systematic review of 94 peer-reviewed studies from SciSpace, PubMed, and Google Scholar databases Citation style: Vancouver