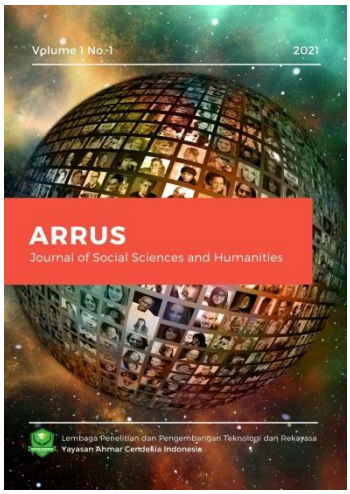
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RESEARCH ARTICLE

Social and Organisational Determinants of Protective Equipment Compliance Among Healthcare Workers: A Systematic Review

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Abstract: This study examines the social, organisational and cultural conditions that shape healthcare workers' compliance with personal protective equipment, a practice ordinarily treated as a technical rather than a social phenomenon. The review synthesises 117 peer-reviewed quantitative, qualitative and mixed-methods studies identified through a structured search of Scopus, PubMed, Web of Science, ProQuest and ScienceDirect completed in May 2026, screened and appraised in duplicate following PRISMA 2020 procedures and analysed through a best-fit framework synthesis that combined the Theoretical Domains Framework, safety-climate theory and a work-system perspective. Reported compliance ranged from 13.5% to above 98%, with most studies falling below the 80% threshold conventionally treated as adequate. Compliance was associated less with individual knowledge than with organisational conditions, namely supply reliability, clarity and perceived legitimacy of policy, supervisory presence, workload and the credibility of monitoring. Occupational hierarchy, professional socialisation and the social construction of risk accounted for systematic differences between nursing, medical and support-staff groups, while emergency settings displayed the weakest adherence. Multi-component interventions that altered the work system outperformed education-only approaches, and monitoring mechanisms were effective where staff experienced them as supportive rather than punitive. The findings indicate that protective-equipment compliance operates as an institutional and cultural accomplishment, embedded in the normative order of the workplace rather than residing in individual decision-making alone. The review translates these findings into operational indicators and starting thresholds that hospital leaders can use to keep monitoring supportive rather than punitive, particularly in emergency departments and resource-limited settings.

Keywords: Safety Culture, Organisational Behaviour, Healthcare Workers, Protective Equipment, Compliance

1. Introduction

Personal protective equipment (PPE) is a fundamental pillar of infection prevention and control (IPC) in healthcare settings. PPE includes gloves, surgical masks, respirators (N95/FFP2/FFP3), face shields, protective eyewear, gowns and aprons, deployed according

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to the type and level of infectious risk during patient-care activities. The consistent and correct use of PPE is critical in preventing healthcare-associated infections (HAIs), protecting healthcare workers (HCWs) from occupational exposure to pathogens (Zangoue et al., 2021), and reducing nosocomial transmission chains.

Framed in this way, PPE use appears to be a technical matter resolved by supply and instruction. The empirical record does not support that assumption. Protective equipment is put on and taken off by people who occupy particular positions in an occupational hierarchy, who work under supervision they may or may not regard as legitimate, who are subject to time pressure and to the expectations of colleagues, and who interpret risk through categories that are socially rather than individually produced. Compliance is therefore a social practice as much as a clinical procedure, and it is this reading that the present review develops.

Despite decades of evidence supporting PPE use, compliance among HCWs remains persistently suboptimal across global healthcare systems. Studies conducted before, during, and after the COVID-19 pandemic have consistently documented compliance rates well below recommended thresholds. For instance, video monitoring of contact precautions in a Japanese tertiary hospital found an overall PPE adherence rate of only 34.0% (Katanami et al., 2018), while an observational study in Malawi reported adherence of only 13.5% (Madziatera et al., 2020). This variability reflects the multifactorial nature of PPE compliance, encompassing individual knowledge and risk perception, availability and quality of PPE, organizational culture and leadership, workload pressures, and systemic factors at the institutional and policy levels.

The COVID-19 pandemic brought unprecedented attention to PPE compliance, exposing critical gaps in preparedness, supply chains, training and institutional support across high-, middle- and low-income countries alike (El-Sokkary et al., 2021; Lamhoot et al., 2021). The pandemic also catalysed rapid innovation in monitoring and intervention strategies, including digital surveillance tools, inspector-team mechanisms and behaviour-change frameworks, several of which demonstrated significant improvements in compliance rates when applied systematically (Datta et al., 2022; Lv et al., 2023; Shehab et al., 2021).

Several theoretical frameworks have been applied to explain and predict PPE compliance behaviour, including the Health Belief Model, the Theory of Planned Behaviour and the Theoretical Domains Framework. These models highlight the central role of perceived vulnerability, perceived severity of infection risk, perceived benefits of PPE use and self-efficacy in determining whether HCWs consistently adhere to PPE protocols (George et al., 2023). What these individual-level accounts explain less well is why workers with equivalent knowledge and comparable risk appraisal behave differently once they are placed in different wards, different hierarchies and different supply environments.

Despite a growing body of literature, existing systematic reviews have often focused narrowly on specific settings such as the emergency department (Coelho et al., 2022), on particular PPE types (e.g., masks, gloves), on specific populations (e.g., nurses), or on a single outbreak, as in the most recent Cochrane synthesis, which is confined to COVID-19 guidance (Houghton et al., 2026). A comprehensive synthesis capturing the full breadth of determinants, barriers and interventions across all HCW types, settings and geographic contexts remains lacking.

A second gap is disciplinary rather than topical. The great majority of published syntheses are framed within infection control and report determinants as a list of correlates, without organising them through social-science theory or asking what kind of social object compliance is. Questions that are routine in the sociology of organisations and of work, including how rules acquire legitimacy, how occupational hierarchy distributes discretion, how new practices become normalised, and how protective objects acquire symbolic as well as instrumental meaning, are rarely posed of PPE. Addressing them matters practically as well as theoretically, because interventions designed on a knowledge-deficit premise continue to be funded despite consistently modest returns.

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This systematic review therefore aimed to: (1) determine overall PPE compliance levels among HCWs globally; (2) identify individual, organisational, environmental and socio-cultural determinants of and barriers to compliance; (3) evaluate the effectiveness of intervention strategies and the mechanisms through which they work; (4) appraise the methodological approaches used in the existing literature; and (5) integrate the resulting evidence into a socio-ecological framework that positions protective-equipment compliance as an institutional and cultural accomplishment rather than an individual choice.

2. Literature Review

Research on protective-equipment compliance has drawn on four broad traditions: cognitive models of health behaviour, implementation and behaviour-change science, organisational and safety-culture theory, and human-factors analysis of work systems. A fifth tradition, the cultural analysis of risk and protection, has rarely been applied to PPE but offers purchase on findings the other four leave unexplained. This section sets out each in turn and derives the propositions that guided the synthesis.

2.1. Cognitive models of protective behaviour

The Health Belief Model holds that protective action follows from perceived susceptibility to a threat, perceived severity of its consequences, perceived benefits of the protective behaviour, and perceived barriers to performing it (Rosenstock, 1974). Applied to PPE, the model predicts that workers who believe themselves personally at risk and who regard protective equipment as effective will use it. The Theory of Planned Behaviour adds that intention is shaped not only by attitude but by subjective norms and by perceived behavioural control (Ajzen, 1991), which introduces the expectations of colleagues and the felt capacity to act into the account. Social Cognitive Theory contributes the construct of self-efficacy, the belief in one's own capability to execute a behaviour under difficult conditions, which predicts persistence when a task becomes uncomfortable or inconvenient (Bandura, 1977).

These models have been productive, and they explain part of the variance in reported compliance. Their limitation is well documented in the wider implementation literature: the intention-behaviour gap. Workers routinely report high intention and demonstrate low adherence, a pattern that cognitive models accommodate only by invoking barriers as a residual category. Since the barriers that matter most in healthcare, including equipment that is not where it should be and workloads that make correct donning impossible, are produced by organisations rather than by individuals, explanation must move to that level.

2.2. Behaviour-change science and the Theoretical Domains Framework

The Theoretical Domains Framework consolidates thirty-three behaviour-change theories into fourteen domains, among them knowledge, skills, beliefs about capabilities, beliefs about consequences, social and professional role and identity, environmental context and resources, social influences, emotion, and behavioural regulation (Cane et al., 2012). The associated COM-B model specifies that behaviour requires capability, opportunity and motivation simultaneously, and that an intervention which addresses only one of the three will fail when another is the binding constraint (Michie et al., 2011). This framework is valuable for the present review because it makes the diagnostic question explicit: not whether workers comply, but which of capability, opportunity or motivation is deficient in a given setting. It also explains why education-only interventions, which target capability alone, repeatedly produce small and non-sustained effects where the deficit lies in opportunity.

2.3. Safety climate, organisational culture and psychological safety

Safety climate denotes the shared perceptions that members of an organisation hold about the priority their management genuinely assigns to safety relative to competing demands such as throughput and cost (Zohar, 1980). The construct is perceptual and relational rather than individual: what matters is not whether a policy exists but whether staff read it as a real commitment. A substantial body of health-services research links organisational and

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workplace culture to patient outcomes (Braithwaite et al., 2017; Mannion & Davies, 2018), and the mechanism proposed in that literature applies directly to PPE. Where leadership visibly observes protective practice, where supervisors model it, and where reporting a lapse is not punished, protective rules acquire legitimacy and are followed in the absence of surveillance.

Psychological safety, the shared belief that a team is safe for interpersonal risk-taking, extends this account (Edmondson, 1999). Protective-equipment practice is frequently observed by colleagues of unequal rank, and correcting a senior colleague who has omitted a precaution is an interpersonal risk. Where psychological safety is low, peer correction does not occur, lapses accumulate unchallenged, and the formal rule is quietly displaced by a local norm. This provides a theorised explanation for a finding reported repeatedly in the PPE literature, namely that seniority is inversely associated with correction and that junior staff adopt the observed rather than the stated standard.

2.4. *Work systems and human factors*

The Systems Engineering Initiative for Patient Safety (SEIPS) model treats clinical work as the product of a system comprising person, tasks, tools and technologies, physical environment and organisational conditions, and holds that outcomes are shaped by the configuration of that system rather than by any single element (Carayon et al., 2006). Its revision, SEIPS 2.0, adds the adaptive work that clinicians perform to make imperfect systems function (Holden et al., 2013). Read through this lens, non-compliance is often a rational local adaptation: a worker who omits eye protection because the only available goggles fog within ninety seconds, or who skips a gown because the store cupboard is two corridors away, is responding to a defective work system. The practical corollary is that redesigning placement, fit and workflow should outperform exhortation, which is a testable proposition rather than a slogan.

2.5. *Institutional embedding and street-level discretion*

Normalization Process Theory asks what work people must do for a new practice to become routine, specifying coherence, cognitive participation, collective action and reflexive monitoring as the necessary conditions (May & Finch, 2009). Protective protocols introduced during an emergency frequently fail the first and the last of these: staff do not share an understanding of why a particular configuration is required, and no feedback loop exists through which practice is appraised and adjusted. The theory predicts that such protocols will decay once the emergency salience fades, which is consistent with the post-pandemic decline in adherence reported across several of the included settings.

Lipsky's analysis of street-level bureaucracy supplies the complementary political account (Lipsky, 2010). Frontline workers in public services exercise discretion under conditions of chronic resource scarcity, and they develop routines that ration their own effort in ways that make an impossible workload survivable. Protective procedures are among the first routines to be rationed when staffing is short, not because workers undervalue safety but because discretion is the only adjustable variable available to them. On this reading, a low compliance rate is a measurement of organisational strain as much as of worker behaviour.

2.6. *Risk, purity and the symbolic dimension of protection*

A final tradition, drawn from cultural anthropology, has been almost entirely absent from the PPE literature. Douglas's analysis of pollution treats protective and cleansing practices as devices for maintaining symbolic boundaries between the clean and the contaminated, boundaries that are socially defined and that do not always coincide with microbiological risk (Douglas, 1966). The relevance is direct and empirically testable. Masks, which are visible and which mark the wearer's status as protected, are consistently the best-adhered item, while eye protection, which is uncomfortable and less socially legible, is consistently the worst. Equally, the documented tendency for glove use to displace hand hygiene is intelligible as a boundary

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effect: the glove makes contamination feel contained, and the felt need to wash recedes. Goffman's account of the presentation of self adds that protective equipment is also worn for an audience of patients and colleagues (Goffman, 1959), which predicts that observed compliance will exceed unobserved compliance by a margin that is itself informative.

2.7. Synthesis of the literature and review propositions

Taken together, these traditions suggest that protective-equipment compliance is produced at four interacting levels, nested within a macro environment of policy and procurement, and fed back upon by monitoring. The integrated framework that served as the a priori coding structure, and that was subsequently refined against the evidence, is presented as Figure 2 in Section 4.10. Five propositions follow from it, and the review was organised to examine each:

P1. Knowledge is necessary but not sufficient; the association between knowledge and observed compliance will be weak relative to the association between organisational conditions and compliance.

P2. Organisational conditions, in particular equipment availability, policy legitimacy, staffing adequacy and supervisory presence, will account for more of the between-setting variation than individual characteristics.

P3. Compliance will vary systematically with position in the occupational hierarchy, independently of knowledge, reflecting professional socialisation and the distribution of discretion.

P4. Interventions that modify the work system or the monitoring regime will outperform interventions that deliver information alone.

P5. Adherence will vary by equipment type in a pattern better predicted by comfort and social visibility than by the magnitude of the risk each item mitigates.

3. Research Method and Materials

3.1. Protocol and reporting standards

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021) and its extension for reporting literature searches, PRISMA-S (Rethlefsen et al., 2021), the Committee on Publication Ethics (COPE) guidelines, and the International Committee of Medical Journal Editors (ICMJE) recommendations for manuscript preparation. The review question was specified before searching, using a PICo structure appropriate to a mixed-methods evidence base: the population comprised healthcare workers in any clinical or community care setting; the phenomenon of interest was compliance with personal protective equipment, including its determinants, barriers and the interventions directed at it; and the context encompassed any health system, irrespective of income level or pandemic phase.

3.2. Literature search strategy

The search was executed in May 2026, with the final search of every database run on [DD] May 2026; records indexed up to that date were eligible. Five electronic databases were searched: Scopus (Elsevier), PubMed (MEDLINE, National Library of Medicine), Web of Science Core Collection (Clarivate Analytics), ProQuest (ProQuest LLC) and ScienceDirect (Elsevier). The strategy was built from four concept blocks, with synonyms joined by OR within each block and the blocks joined by AND: (1) protective equipment ("personal protective equipment" OR "PPE" OR "protective gloves" OR "face mask" OR "respirator" OR "gown"); (2) compliance ("compliance" OR "adherence" OR "use"); (3) workforce ("healthcare worker" OR "nurse" OR "physician" OR "health personnel"); and (4) infection prevention ("infection prevention" OR "infection control" OR "standard precautions"). The

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core string was therefore (1) AND (2) AND (3) AND (4), translated into the field codes, truncation and phrase-searching conventions of each database.

Because the review was concerned with the social and organisational production of compliance, a supplementary string combined blocks (1), (2) and (3) with a fifth block covering "safety culture" OR "safety climate" OR "organisational culture" OR "workload" OR "leadership" OR "barriers" OR "facilitators", and its results were merged with those of the core string before deduplication. All concept blocks were applied to the article title field, so that retrieval was confined to studies in which protective-equipment compliance was the declared subject rather than one infection-control measure among many. The complete line-by-line syntax for each database, with the number of records returned at each line, is reported in Table S1 of the Supplementary Appendix, following the PRISMA-S reporting items (Rethlefsen et al., 2021). Reference lists of all included reports and of previously published reviews were hand-searched to identify studies the database strategy had missed. No language, date or geographic restriction was applied at the search stage.

The resulting yield of 187 records is small for a topic of this size, and it follows from these design decisions rather than from a truncated protocol. Requiring a record to match every concept block within its title trades sensitivity for specificity: the search retrieves studies whose primary subject is protective-equipment compliance among healthcare workers and leaves aside the much larger literature in which PPE is reported as one infection-control measure among several, which a title-and-abstract search of the same terms would also return. The precision of the strategy is reflected in the screening figures, since 142 of the 180 screened records (78.9%) proceeded to full-text assessment. The corresponding loss of sensitivity was partly offset by hand-searching and is acknowledged as a limitation in Section 4.14.

3.3. Inclusion and exclusion criteria

Studies were included if they met all of the following criteria:

Peer-reviewed original research articles (quantitative, qualitative or mixed-methods studies);

Study participants were healthcare workers (HCWs), including nurses, physicians, allied health professionals, support staff and students in clinical settings;

Studies reporting outcomes related to PPE compliance, adherence or use, or reporting determinants of, barriers to or interventions directed at such use;

Studies conducted in hospital inpatient, intensive care, emergency, outpatient, long-term care or community healthcare settings;

No restriction on year of publication or geographic location.

Studies were excluded if they met any of the following criteria:

Did not report PPE compliance as a primary or secondary outcome, and did not report determinants, barriers or interventions relating to it;

Study populations were exclusively non-HCW (e.g., patients, general public);

Grey literature (conference abstracts without full text, editorials, letters to the editor, or opinion pieces without original data);

Duplicate publications reporting the same study population;

Systematic reviews or meta-analyses; these were screened for additional primary studies but were not included as primary data.

3.4. Study selection process

The initial search across all five databases retrieved 187 records (Scopus, n = 58; PubMed, n = 46; Web of Science, n = 33; ProQuest, n = 27; ScienceDirect, n = 23). After deduplication

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using reference-management software, 7 duplicate records were removed, yielding 180 unique records for screening. Two reviewers independently screened titles and abstracts against the eligibility criteria, excluding 38 records at this stage. Full texts were sought for the remaining 142 reports, of which 5 could not be retrieved. The 137 reports assessed in full were reduced by a further 20 exclusions: 8 reported no compliance outcome or determinant, 5 concerned exclusively non-HCW populations, 4 were grey literature without full text, and 3 reported a study population already represented in an included report. A total of 117 studies were retained for synthesis, and 63 records were excluded across all stages. Agreement between the two reviewers, measured with Cohen's kappa, was κ = [0.XX] at title-abstract screening and κ = [0.XX] at full-text assessment, interpreted against the conventional benchmarks in which values of 0.61–0.80 denote substantial and 0.81–1.00 almost perfect agreement (McHugh, 2012); agreement is reported for each stage because coder decisions are a recognised source of variation in systematic reviews (Belur et al., 2021). Disagreements were resolved by discussion, with a third reviewer arbitrating where consensus could not be reached. The selection process is summarised in Figure 1.

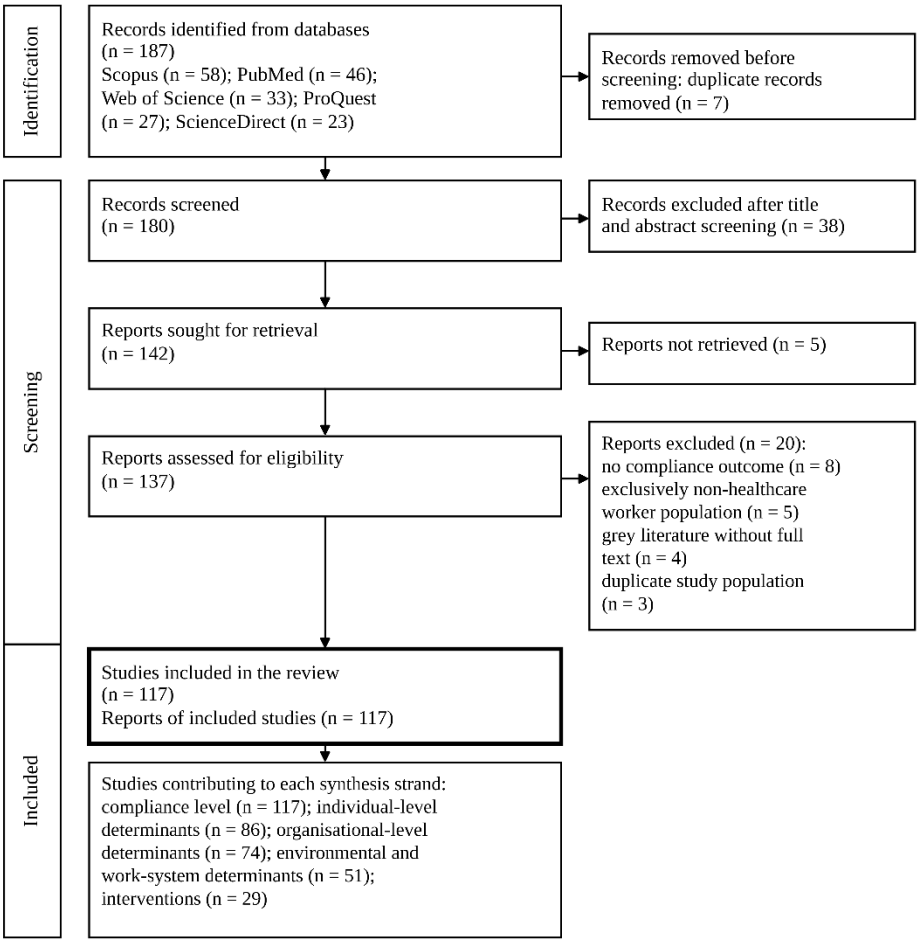


Figure 1. PRISMA 2020 flow diagram of the study-selection process

3.5. *Data extraction and coding*

Data were extracted independently by two reviewers using a standardised data-extraction form. Extracted variables included study identifier (author, year, country); study design; setting (type of healthcare facility, ward or unit); population (HCW type, sample size); method of measuring compliance (direct observation, video monitoring, self-report, audit); PPE outcomes (compliance rates, types of PPE assessed); determinants and barriers identified; intervention strategies implemented; and main findings.

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A second extraction pass coded each reported determinant to the level of the framework at which it operated (individual, organisational, work-system or socio-cultural) and to the corresponding domain of the Theoretical Domains Framework. Codes that did not fit the a priori structure were retained and reviewed, and two were promoted to framework elements during analysis: the perceived legitimacy of institutional rules, and the moral economy governing the use of scarce equipment in resource-limited settings. The method of measuring compliance was recorded separately because it is a known source of bias, with self-report consistently yielding higher estimates than direct observation.

3.6. *Quality appraisal*

The methodological quality of included studies was appraised using validated tools appropriate to study design: the Mixed Methods Appraisal Tool (MMAT) for mixed-methods and non-randomised intervention studies (Hong et al., 2018); the Newcastle-Ottawa Scale (NOS), in the version adapted for cross-sectional designs (Herzog et al., 2013), for cross-sectional and observational studies; the Consolidated Criteria for Reporting Qualitative Research (COREQ) for qualitative studies (Tong et al., 2007); and the CONSORT 2010 checklist for randomised controlled trials. Appraisal was performed independently by two reviewers; agreement on the three-level quality rating was weighted $\varkappa$ = [0.XX], and disagreements were resolved by consensus. Studies were not excluded on the basis of quality score alone; methodological quality was instead carried into the synthesis as a weighting consideration, and conclusions resting substantially on lower-quality evidence are identified as such in the discussion. The distribution of appraisal outcomes is reported in Table 2.

Each instrument was converted into three quality bands using cut-offs fixed before appraisal began. On the adapted NOS, which awards up to 10 stars across selection (up to 5), comparability (up to 2) and outcome (up to 3), studies scoring 7–10 stars were rated high, 5–6 moderate and 0–4 low quality. On the MMAT, studies meeting all five design-specific criteria were rated high, three or four moderate and two or fewer low; because the MMAT developers discourage reliance on a single summary score, the criterion-level ratings were also retained and examined during synthesis. For COREQ and CONSORT, ratings were based on the proportion of checklist items adequately reported, with at least 75% rated high, 50–74% moderate and below 50% low (COREQ: 24–32, 16–23 and 0–15 of 32 items; CONSORT: 19–25, 13–18 and 0–12 of 25 items). Quasi-experimental studies appraised with both the MMAT and the NOS were assigned the lower of the two ratings. The component rubrics for each instrument are reported in Table S2 of the Supplementary Appendix.

3.7. *Data synthesis and analytic strategy*

Owing to substantial methodological and clinical heterogeneity across the included studies, in study design, PPE type, HCW category, setting and outcome measure, a quantitative meta-analysis was neither appropriate nor attempted. No pooled effect size, confidence interval or formal test of statistical heterogeneity was calculated, consistent with Cochrane and PRISMA guidance discouraging the pooling of clinically and methodologically heterogeneous evidence. Where primary studies reported descriptive statistics, these were extracted and tabulated to characterise the range and central tendency of reported outcomes, and heterogeneity was appraised qualitatively by examining variation in design, population, setting and measurement method.

The synthesis followed a best-fit framework approach (Carroll et al., 2013), in which an a priori framework assembled from existing theory is used as the initial coding structure and is then revised against evidence that will not fit it. The framework presented in Figure 2 served this purpose. Findings were first coded deductively to its levels and domains, after which unassigned findings were analysed thematically and used to extend the framework, following established guidance on narrative synthesis in systematic reviews (Popay et al., 2006). Quantitative and qualitative evidence were synthesised in parallel and then integrated at the

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level of each framework element, so that measured associations and reported experiences could be compared rather than merged.

3.8. *Reflexivity and positionality*

The review team comprised public-health researchers, a health-policy specialist, a health-information specialist and clinicians, working in Indonesian and Malaysian institutions. This composition shaped the synthesis in two respects that are stated here so that readers may weigh them. First, the team's familiarity with resource-constrained settings sensitised the analysis to supply and staffing constraints, which may be given greater prominence here than in reviews conducted wholly within well-resourced systems. Second, several reviewers hold clinical qualifications, which assists interpretation of practice descriptions but risks normalising professional assumptions about where responsibility for compliance properly lies. Coding was therefore conducted in pairs that combined a clinical and a non-clinical reviewer, and the framework was revised only by consensus across both.

4. Results and Discussion

4.1. *Search outcome and characteristics of included studies*

The search of five databases, completed in May 2026, yielded 187 records. Following removal of 7 duplicates, 180 unique records were screened and 117 studies were retained for synthesis, with 63 records excluded across the screening, retrieval and eligibility stages (Figure 1).

The included studies represented a broad geographic distribution, spanning Africa (Ethiopia, Malawi, Nigeria, Egypt, the Democratic Republic of the Congo), Asia (Japan, Vietnam, India, South Korea, China, Israel, the United Arab Emirates, Jordan, Kuwait, Saudi Arabia, Singapore, Indonesia), Europe (Germany, Switzerland, Austria, Cyprus, the United Kingdom, Sweden, Poland, Greece), Oceania (Australia, New Zealand) and the Americas (the United States, Canada, Brazil). Studies from Nigeria and the Democratic Republic of the Congo examined infection-prevention practice and protective-equipment compliance during the COVID-19 pandemic (Abubakar et al., 2022; Ilesanmi et al., 2021; Michel-Kabamba et al., 2021). Study designs included cross-sectional surveys, observational studies, quasi-experimental and interventional studies, qualitative studies, randomised controlled trials and mixed-methods studies. HCW populations comprised nurses, who were the most frequently studied group, physicians, mixed HCW groups, allied health professionals including radiographers (Abuzaid et al., 2022) and dental professionals (Alkadi et al., 2024), and ancillary groups such as laundry (Tamene et al., 2020) and wastewater workers (Wright et al., 2019). Settings included general wards, intensive care units (Drews et al., 2025), COVID-19-designated wards (Min et al., 2021), emergency departments (Howard et al., 2022; Lamhoot et al., 2021), operating rooms, radiology departments, dental clinics, a hemato-oncology hospital (Elbahr et al., 2025) and nursing homes (Pettersson et al., 2026). Representative characteristics and outcomes are presented in Table 1.

Table 1. Representative characteristics and reported compliance outcomes of included studies

Study	Country	Design, setting and measurement	Reported outcome
Ganczak & Szych (2007)	Poland	Cross-sectional survey; surgical nurses	Protective eyewear the least used item of all PPE assessed
Jeong et al. (2008)	South Korea	Cross-sectional survey; operating-room nurses	12% double gloving; 2% eye protection
Efstathiou et al. (2011)	Cyprus	Qualitative focus groups; hospital nurses	Workload, supply and risk perception the dominant barriers
Cusini et al. (2015)	Switzerland	Before-and-after study; contact-precaution rooms	Hand-hygiene compliance 52% to 85% after removing mandatory glove use
Chughtai et al. (2016)	Vietnam	Cross-sectional survey; hospital HCWs	Compliance varied by mask type; cloth masks least consistently used
Katanami et al. (2018)	Japan	Video monitoring; tertiary hospital contact precautions	34.0% overall adherence; 27.9% nurses, 100% infectious-disease physicians
Krein et al. (2018)	United States	Qualitative and observational; ICU and general wards	Education-only effects inconsistent and not sustained

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Study	Country	Design, setting and measurement	Reported outcome
Williams et al. (2019)	Canada	Prospective multicentre donning observation	Correct PPE donning 56.4% to 79.7% after human-factors redesign
Loibner et al. (2019)	Austria	Experimental usability study; protective suits	Heat stress and discomfort limit tolerable wear time
Madziatera et al. (2020)	Malawi	Observational cross-sectional; tertiary hospital wards	13.5% proper PPE procedure; goggles absent in 70.8% of wards
Tamene et al. (2020)	Ethiopia	Qualitative interviews; mixed HCWs	Supply, workload and workplace norms the primary barriers
El-Sokkary et al. (2021)	Egypt	Cross-sectional survey; first COVID-19 wave	46.8% of respondents compliant
Lamhoot et al. (2021)	Israel	Observational; ED compared with COVID-19 ward	ED consistently the lowest-compliance setting
Shehab et al. (2021)	Kuwait	Prospective observational; dedicated inspector team	PPE compliance 56% to 89% within one study period
Datta et al. (2022)	United States	Quality-improvement study; facility-wide	Median weekly face-mask compliance 82.2% to 92.6%
George et al. (2023)	India	Cross-sectional survey; mixed HCWs	High knowledge scores coexisting with low observed compliance
Lv et al. (2023)	China	Self-control real-world study; three-level inspector mechanism	Check-item compliance above 98%
Weldetinsae et al. (2023)	Ethiopia	Cross-sectional survey; mixed HCWs	28.2% proper PPE use
Amos et al. (2024)	United States	Pilot observational study; paediatric units	Overall unit adherence 50% to 61%

Note. The selection is illustrative rather than a complete study-level evidence table. PPE = personal protective equipment; HCW = healthcare worker.

4.2. *Methodological quality of the evidence base*

Appraisal outcomes, banded with the cut-offs set out in Section 3.6, are summarised in Table 2. The evidence base is dominated by cross-sectional designs assessed with the Newcastle-Ottawa Scale, of which a minority reached high quality; the most frequent weaknesses were non-probability sampling, absence of sample-size justification and reliance on unvalidated self-report instruments. Qualitative studies appraised with COREQ performed comparatively well on data-collection and analysis criteria but reported researcher reflexivity inconsistently. Interventional studies were the smallest group and the most methodologically varied: the three randomised trials were adequately reported, but most before-and-after studies lacked a concurrent control, so that secular trend and the Hawthorne effect cannot be excluded from their estimates. The practical consequence is stated plainly here and carried through the discussion: conclusions about the direction of determinants rest on a reasonably broad base, whereas conclusions about the magnitude of intervention effects rest on a narrow and partly uncontrolled one.

Table 2. Methodological quality appraisal of included studies by design and tool

Study design	Appraisal tool	Studies (n)	High (n)	Moderate (n)	Low (n)	Most frequent methodological limitation
Cross-sectional survey	NOS (adapted; 0–10 stars)	54	11	31	12	Non-probability sampling; unvalidated self-report instruments
Observational (direct or video)	NOS (adapted; 0–10 stars)	24	9	12	3	No sample-size justification; single-site designs
Qualitative	COREQ (32 items)	19	8	9	2	Researcher reflexivity and positioning not reported
Mixed methods	MMAT 2018 (5 criteria)	12	4	6	2	Integration of quantitative and qualitative strands not described
Quasi-experimental (before-and-after)	MMAT and NOS (lower rating retained)	5	1	3	1	No concurrent control; secular trend not excluded

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Study design	Appraisal tool	Studies (n)	High (n)	Moderate (n)	Low (n)	Most frequent methodological limitation
Randomised controlled trial	CONSORT 2010 (25 items)	3	2	1	0	Allocation concealment incompletely reported
Total		117	35	62	20	

Note. MMAT = Mixed Methods Appraisal Tool; NOS = Newcastle-Ottawa Scale; COREQ = Consolidated Criteria for Reporting Qualitative Research; CONSORT = Consolidated Standards of Reporting Trials. Quality bands: adapted NOS, high 7–10, moderate 5–6 and low 0–4 stars; MMAT, high 5, moderate 3–4 and low 0–2 criteria met; COREQ, high 24–32, moderate 16–23 and low 0–15 of 32 items; CONSORT 2010, high 19–25, moderate 13–18 and low 0–12 of 25 items. Quasi-experimental studies took the lower of their MMAT and NOS ratings. Inter-rater agreement on the quality band, weighted κ = [0.XX]. Component rubrics are given in Table S2 of the Supplementary Appendix.

4.3. *Reported levels of compliance*

PPE compliance rates varied extensively across the included studies, ranging from 13.5% to above 98%, with the majority of studies reporting compliance below the 80% threshold conventionally treated as adequate. Notable findings include:

The lowest reported compliance (13.5%) was for standard PPE procedures at a tertiary hospital in Malawi (Madziatera et al., 2020);

Video-monitored PPE adherence in a Japanese tertiary hospital was 34.0% overall, varying from 27.9% among nurses to 100% among infectious-disease physicians (Katanami et al., 2018);

Emergency department settings consistently demonstrated lower compliance than intensive care units or dedicated COVID-19 wards (Lamhoot et al., 2021);

Multimodal interventions and PPE-inspector mechanisms produced marked improvement, with one study documenting an increase from 56% to 89% after deploying a dedicated PPE-inspector team (Shehab et al., 2021);

A facility-wide intervention combining audit-and-feedback, leadership engagement and communication improved median weekly face-mask compliance from 82.2% to 92.6% (Datta et al., 2022);

Removal of a mandatory glove-use policy for low-risk dry contact increased hand-hygiene compliance from 52% to 85% within contact-precaution rooms (Cusini et al., 2015).

Measurement method accounted for a substantial part of this dispersion. Studies using direct or video observation reported systematically lower compliance than studies using self-report, and the gap between the two was wide enough in several settings to exceed the effect of any intervention evaluated. This is consistent with the presentational account advanced in Section 2.6: what is measured by self-report is in part the respondent's account of a professional self, and what is measured by covert observation is closer to routine practice. The implication for the field is methodological, and it is a precondition for the comparability of future estimates.

4.4. *Individual-level determinants*

Individual-level factors were the most frequently studied determinants of PPE compliance (Drews et al., 2025; Kaye & Marais, 2025; Kim et al., 2024). Knowledge of infection-prevention procedures and standard precautions, examined in surveys of nurses and dental professionals (Al-Faouri et al., 2021; Alkadi et al., 2024; Ghabayen et al., 2023; Lim et al., 2021), was consistently associated with better compliance, although several studies noted that high knowledge did not automatically translate into high compliance (George et al., 2023), indicating that motivational and structural supports are also necessary. Risk perception was a strong predictor: HCWs with higher perceived vulnerability to infection demonstrated greater PPE adherence, whereas low perceived risk was associated with reduced compliance. Surveys of nurses in Egypt and Indonesia examined perceptions and other individual characteristics alongside reported adherence (Elshaer & Agage, 2022; Ningsih et al., 2024). Prior PPE training was among the strongest predictors of compliance identified across multiple studies

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(Sharma et al., 2022). Professional category was also influential; nurses consistently demonstrated higher compliance than physicians or support staff, while emergency department staff showed comparatively lower compliance (Lamhoot et al., 2021).

The pattern supports Proposition 1. Knowledge functions as a threshold condition rather than a gradient: below a minimum, compliance is impossible, but above it further knowledge adds little where opportunity is constrained. Studies that measured knowledge and observed behaviour in the same sample repeatedly found high scores on the former coexisting with low rates of the latter, which is precisely the configuration the COM-B model predicts when capability is adequate and opportunity is not (Michie et al., 2011). Interventions premised on closing a knowledge deficit are therefore well matched to a minority of settings and poorly matched to most.

4.5. *Organisational-level determinants*

Unavailability of appropriate PPE was identified as a primary barrier in multiple studies, particularly in resource-limited settings (Madziatera et al., 2020; Tamene et al., 2020). Institutional policy, leadership engagement and the presence of dedicated infection-control link nurses or PPE-inspector mechanisms significantly improved adherence (Ghorbanmovahhed et al., 2023; Lv et al., 2023; Shehab et al., 2021). High workload and time pressure were negatively associated with compliance, particularly in intensive care units and emergency departments. Regular audit-and-feedback, including real-time video or artificial-intelligence-assisted monitoring, was consistently associated with improved compliance.

Read through safety-climate theory, these are not independent variables but expressions of a single organisational signal. Where equipment is reliably stocked, where supervisors are visibly present, and where a reported lapse leads to a system fix rather than a reprimand, staff infer that the institution means what its policy says, and adherence follows without surveillance. Where supply is intermittent and policy changes without explanation, the same policy is read as a formality, and compliance becomes contingent on being watched. Several qualitative studies described this inference explicitly, with participants distinguishing between rules the hospital enforced on itself and rules it merely imposed on them. The distinction is one of perceived legitimacy, and it emerged with sufficient consistency to be added to the framework during analysis. Legitimacy is also shaped from outside the hospital, since national regulation that specifies service-quality standards, such as Indonesia's Ministry of Health Regulation No. 30 of 2022 (Adji, 2024), defines the formal benchmarks that local infection-prevention policy is expected to implement.

Workload operates by a different mechanism and deserves separate statement. Correct donning and doffing take time that short-staffed units do not have, and under those conditions omission is a rationing decision rather than a lapse of motivation, in the sense described by Lipsky (2010). This has a direct policy consequence: compliance targets set without reference to staffing ratios transfer an organisational failure onto individual workers, and the evidence reviewed here gives no reason to expect such targets to be met. Workload is in turn one element of a wider set of working conditions, and studies of Indonesian hospitals report that employee characteristics and quality of work life are associated with staff performance (Haksama et al., 2025), which places protective-equipment omission under pressure among the same conditions that shape performance generally.

4.6. *Environmental and work-system determinants*

Ward or unit type influenced compliance, with intensive care units and COVID-19-designated wards generally showing higher compliance than general wards or emergency departments. Compliance was also higher for patients with a confirmed infectious diagnosis than for those of unknown or low-risk status (Katanami et al., 2018; Neuwirth et al., 2020). Ergonomic issues with PPE, including poor mask fit, fogging of eye protection and heat stress, were identified as additional context-specific barriers, particularly in high-burden or resource-limited settings (Loibner et al., 2019; Russell et al., 2021). Integrated respirator and

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face-protection designs intended to reduce this burden are now being evaluated in multisite human-factors trials (Price et al., 2022).

The gradient by patient status is theoretically informative. Transmission risk is highest precisely where infectious status is unknown, so a rational risk calculus would predict the opposite of the observed pattern. What the pattern tracks is not measured risk but categorised risk: the labelled patient activates the protective routine, and the unlabelled patient does not. This is the boundary effect described in Section 2.6, and it indicates that the operative cue is a social classification rather than an epidemiological estimate. Interventions that make the cue explicit, such as door signage specifying the required configuration, should therefore be expected to work through classification rather than through persuasion, which is consistent with the gains reported from standardised signage placement (Williams et al., 2019).

4.7. *Occupational hierarchy, professional identity and socialisation*

Differences between professional groups were among the most consistent findings in the evidence base, and they persisted where knowledge was controlled. Nurses generally recorded the highest adherence, physicians intermediate and variable rates, and ancillary and support staff the lowest, while within medicine the infectious-disease specialty recorded near-complete adherence and surgical and emergency specialties the least. Three mechanisms reported across the qualitative studies account for this ordering better than any individual attribute, and together they support Proposition 3.

The first is the distribution of discretion. Senior clinicians can depart from a protocol without sanction, and junior staff cannot, so observed seniority effects partly measure who is permitted to deviate rather than who wishes to. The second is role modelling: junior staff and students reported adopting the practice they observed rather than the practice they were taught, which makes senior non-compliance reproduce itself across cohorts at a rate no training programme can offset. The third is professional socialisation into a specialty-specific conception of risk, in which infectious-disease practice treats precaution as constitutive of competent work while emergency practice treats speed as constitutive of it, so that an identical omission carries opposite professional meanings in the two settings.

These mechanisms also explain why peer correction was reported as rare in precisely the settings where it would matter most. Correcting a senior colleague is an interpersonal risk, and in units with low psychological safety it is not taken (Edmondson, 1999). The practical implication is that interventions directed at junior staff, who are the usual target of training, address the group least able to change the prevailing norm.

4.8. *Equity, scarcity and the moral economy of protection*

Studies conducted in low- and middle-income settings described a qualitatively different problem from those conducted in well-resourced systems, and aggregating the two obscures it. Where goggles were absent from seven in ten wards (Madziatera et al., 2020) and gowns were rationed, the reported behaviour was not non-compliance in any ordinary sense but allocation under scarcity. Participants described deciding which colleague, which shift and which patient contact warranted the last available item, and these decisions followed moral rather than clinical criteria: seniority, perceived vulnerability of the worker, and the visibility of the risk to others. A compliance rate computed in such a setting measures procurement failure, and improvement strategies derived from well-resourced systems, which assume availability and target behaviour, are misdirected when applied there. The ordering is not peculiar to hospitals: in Indonesia, malaria infection among under-5 children tracked household structural and environmental conditions together with the use of an insecticide-treated net (Roosihermiatie et al., 2024), the same precedence of material conditions over individual factors that this review finds for protective equipment in clinical settings.

This has a bearing on how global compliance benchmarks should be read. The 80% threshold conventionally treated as adequate was derived in systems where supply is not the binding

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constraint. Applied without that qualification, it converts a question about the distribution of resources into a judgement about the diligence of the workers at the end of the supply chain, which the evidence reviewed here does not support. The qualification matters most where infection prevention and control programmes are least developed, and the first WHO global survey of health-care facilities found implementation weakest in low-income countries (Tomczyk et al., 2022). Where the constraint is relieved, it is relieved upstream of the hospital, since fiscal and tax instruments shape the resilience of medical-device and consumable supply at national level (Adji et al., 2025), which is the level at which a shortage of protective equipment is created or averted.

4.9. *Equipment type, symbolic visibility and the glove paradox*

Compliance varied significantly by PPE type. Mask compliance was consistently the highest-performing item, while protective eyewear and goggles showed the poorest adherence across multiple operating-room and surgical-nursing studies. Glove use was widely practised but was associated with reduced hand-hygiene compliance in several studies, prompting reconsideration of mandatory glove policies for low-risk dry contact; studies from Switzerland found that removing the mandatory glove-use requirement significantly improved hand-hygiene compliance (Cusini et al., 2015). The question has since been tested experimentally in a cluster randomised trial comparing direct gloving with hand hygiene performed before glove donning (Thom et al., 2023).

Proposition 5 is supported, and the ordering is not explained by risk magnitude. Eye protection mitigates a well-documented mucosal exposure route yet is the least used item, while masks, whose protective margin in several of the studied contexts is smaller, are the most used. What distinguishes them is comfort and social visibility: a mask is immediately legible to patients and colleagues as evidence that the wearer is behaving properly, and goggles are uncomfortable and unobserved. The glove finding is the clearest instance of the same logic. Gloves make contamination feel contained, and the felt need for hand hygiene recedes accordingly, which is a boundary effect rather than a knowledge deficit and explains why removing a protective requirement improved overall practice. Determinants across all four levels are mapped to theory in Table 3.

Table 3. Determinants and barriers mapped to framework level, theoretical domain and intervention implication

Framework level	Determinants and barriers	Theoretical Domains Framework domain	Intervention implication	Illustrative evidence
Individual	Knowledge of standard precautions; perceived vulnerability and severity; self-efficacy; prior training; clinical experience	Knowledge; beliefs about consequences; beliefs about capabilities	Competency-based and simulation training; individualised feedback; calibration of risk appraisal	George et al. (2023); Kim et al. (2024); Weldetinsae et al. (2023)
Organisational	Equipment supply and access; clarity and perceived legitimacy of policy; leadership; workload; supervision; safety climate	Environmental context and resources; social influences; behavioural regulation	Supply assurance; simple protocols; leadership rounds; link nurses; audit-and-feedback; staffing adequacy	Badran et al. (2021); Ghorbanmovahhed et al. (2023); Tamene et al. (2020)
Work-system and task	Unit acuity, urgency and interruptions; patient infectious status; layout and signage; equipment fit, comfort and heat load	Environmental context and resources; skills; memory, attention and decision processes	Workflow redesign; point-of-care placement; ergonomic procurement; visual cues at the point of entry	Katanami et al. (2018); Lamhoot et al. (2021); Loibner et al. (2019); Russell et al. (2021)
Social and cultural	Occupational hierarchy; role modelling by seniors; team norms and peer correction; symbolic visibility of equipment; moral economy of scarcity	Social and professional role and identity; social influences; emotion	Role-modelling interventions targeted at senior clinicians; psychological safety for peer correction; address scarcity before behaviour	Efstathiou et al. (2011); Krein et al. (2018); Moore et al. (2021); Tamene et al. (2020)

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Framework level	Determinants and barriers	Theoretical Domains Framework domain	Intervention implication	Illustrative evidence
Monitoring and feedback	Delayed or absent feedback; limited visibility of practice variation; perceived punitiveness of surveillance	Behavioural regulation; reinforcement; goals	Observer or video audit; inspector mechanisms; immediate non-punitive feedback; dashboard reporting	Datta et al. (2022); Horesh et al. (2025); Lv et al. (2023); Shehab et al. (2021)

Note. TDF = Theoretical Domains Framework; PPE = personal protective equipment. Framework levels follow Figure 2.

4.10. *An integrated framework*

Figure 2 presents the framework in its revised form, following the two extensions made during synthesis. Its claim is that compliance is produced by the interaction of four levels nested within a macro environment of policy and procurement, and that monitoring operates as a feedback loop onto the work system rather than as a direct influence on individual motivation. Two features distinguish it from the determinant lists that dominate the field. First, the levels are specified as interacting rather than additive, so that an organisational deficit can nullify an individual strength, which is what the knowledge-behaviour gap describes. Second, the socio-cultural level is given parity with the others rather than being treated as residual, which is what allows the equipment-type ordering, the patient-status gradient and the hierarchy effects to be explained by one mechanism instead of three.

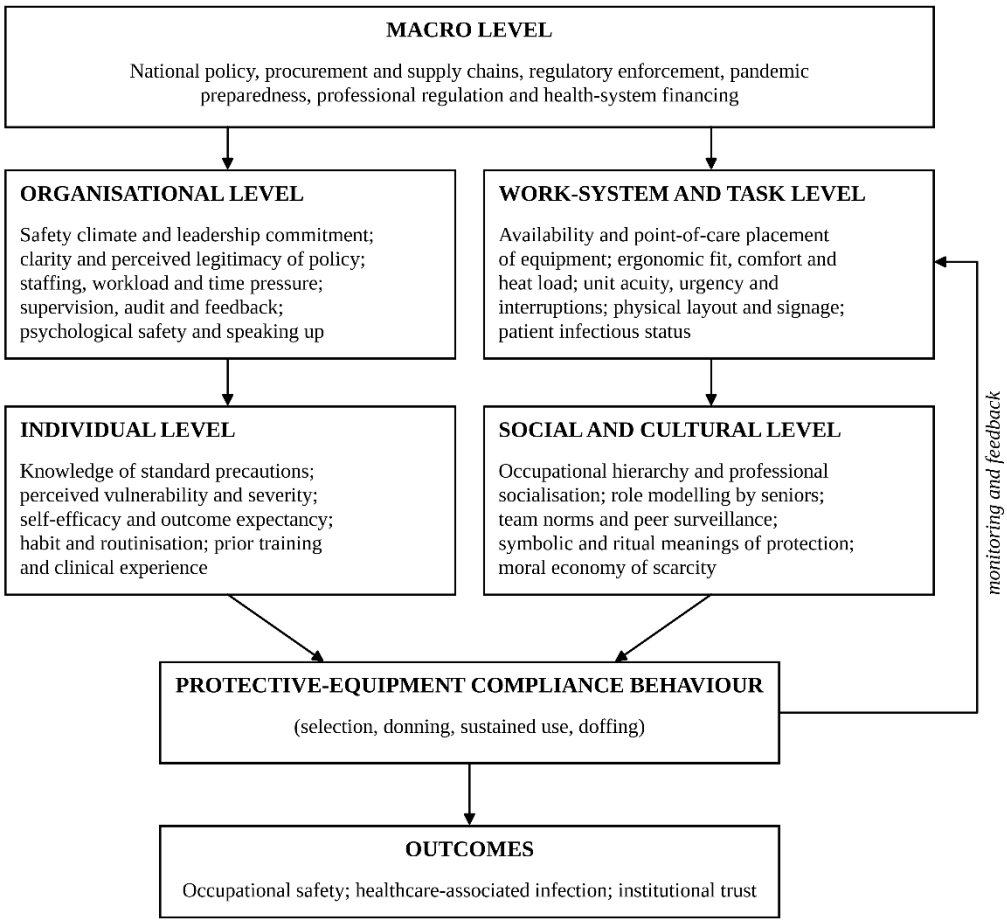


Figure 2. Integrated socio-ecological framework of protective-equipment compliance among healthcare workers

4.11. *Interventions and the mechanisms through which they work*

A range of interventions were evaluated across the included studies. Education and training alone produced inconsistent and often non-sustained improvements in compliance

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behaviour (Barratt et al., 2020; Krein et al., 2018), although skills-based training frameworks have been extended to, and evaluated among, non-clinical hospital staff (Liow et al., 2021). Multimodal strategies combining education, audit-and-feedback, leadership engagement and environmental redesign showed the most consistent improvements; one multimodal intervention increased face-mask compliance from 82.2% to 92.6% (Datta et al., 2022). Dedicated PPE-inspector teams significantly improved compliance, with reported increases from 56% to 89% within a single study period (Shehab et al., 2021), corroborated by a large-scale three-level inspector mechanism in China that achieved check-item compliance exceeding 98% (Lv et al., 2023). Human-factors design improvements, including standardised signage placement and integrated mask and face-shield designs, increased correct PPE donning from 56.4% to 79.7% in a prospective multi-centre study (Williams et al., 2019). Policy interventions eliminating mandatory glove use for low-risk dry contact improved hand-hygiene compliance substantially (Cusini et al., 2015). Workflow redesign through designated PPE-free zones has been evaluated across several acute-care sites (Visnovsky et al., 2019), and in a specialist hemato-oncology hospital hand-hygiene compliance measurement was coupled with targeted interventions (Elbahr et al., 2025).

Proposition 4 is supported, and the mechanism is specifiable. Interventions succeeded in proportion to how much of the work system they altered: those that changed where equipment sits, how it fits, and what the environment cues produced larger and more durable gains than those that changed what workers know. Monitoring interventions require a further qualification that the headline effect sizes conceal. Inspector and surveillance mechanisms produced the largest reported improvements in the evidence base, but the qualitative studies conducted alongside them reported that their effect depended on how they were experienced. Where monitoring was framed as support and its findings were used to fix the system, improvement persisted; where it was framed as enforcement, staff described performing compliance in the presence of observers, which is an increase in observed adherence without a corresponding change in routine practice. This pattern accords with the most recent Cochrane review of audit and feedback, which found effects to be largest when feedback addresses high-priority problems, compares performance with a benchmark and is accompanied by support for action (Ivers et al., 2025). Sustainability data were sparse: few studies followed up beyond six months, and those that did reported decay towards baseline wherever the intervention had not been embedded into normal supervisory work, as Normalization Process Theory would predict (May & Finch, 2009). Interventions and their mechanisms are summarised in Table 4.

Table 4. Intervention strategies, proposed mechanisms and reported effects

Intervention type	Proposed mechanism	Reported effect	Evidence on durability	Example study
Education and training alone	Raises capability while leaving opportunity unchanged	Small and inconsistent gains	Decay within weeks to months	Barratt et al. (2020); Krein et al. (2018)
Multimodal programme combining education, audit, leadership and redesign	Addresses capability, opportunity and motivation simultaneously	Face-mask compliance 82.2% to 92.6%	Sustained across the study period; no long-term follow-up	Datta et al. (2022)
Dedicated inspector team	Adds proximate supervision and immediate correction	Compliance 56% to 89%	Not followed beyond the intervention period	Shehab et al. (2021)
Three-level inspector mechanism	Institutionalises monitoring within the supervisory structure	Check-item compliance above 98%	Maintained while the structure was retained	Lv et al. (2023)
Real-time and artificial-intelligence-assisted monitoring	Scalable observation with instantaneous feedback	Feasibility demonstrated; effect estimates preliminary	Insufficient data	Horesh et al. (2025); Lv et al. (2023)
Human-factors and signage redesign	Alters the work system and the cues available at the point of decision	Correct donning 56.4% to 79.7%	Persisting while the redesign remained in place	Williams et al. (2019)
Policy simplification removing mandatory glove use	Removes a boundary effect that had displaced hand hygiene	Hand-hygiene compliance 52% to 85%	Sustained at follow-up	Cusini et al. (2015)

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Intervention type	Proposed mechanism	Reported effect	Evidence on durability	Example study
Rapid-cycle behaviour-change strategy	Targets local norms and unit routines	Improvement reported in an emergency department	Short follow-up only	Curtis et al. (2022)

Note. Effect sizes are as reported in the primary studies and are not pooled. Most before-and-after studies lacked a concurrent control group, so reported changes should be read as upper-bound estimates.

4.12. *Theoretical and practical implications*

This review, synthesising 117 studies across diverse geographic and clinical contexts, supports a reading of protective-equipment compliance as an institutional and cultural accomplishment rather than an individual decision. Its theoretical contribution is to show that a socio-ecological framework incorporating a socio-cultural level accounts for findings that behavioural and human-factors models leave unexplained, specifically the ordering of adherence by equipment type, the gradient by patient classification and the persistence of hierarchy effects net of knowledge. The second contribution is diagnostic: by specifying which level a given deficit occupies, the framework indicates which class of intervention is appropriate, and thereby explains the repeated failure of education-led programmes in settings where the binding constraint is opportunity rather than capability. A Cochrane qualitative evidence synthesis published after our search was completed reached a convergent conclusion, namely that many barriers to adherence are structural rather than individual failings (Houghton et al., 2026).

For managers, the practical implications follow from the same logic. Supply reliability, staffing adequacy and point-of-care placement are preconditions rather than complements to behavioural work, and compliance targets set without them transfer institutional failure to frontline staff. Monitoring should be designed as feedback into the work system rather than as enforcement against individuals, since the evidence indicates that the latter raises observed compliance without changing routine practice. Senior clinicians, not junior staff, are the decisive target for role-modelling interventions, because observed practice propagates downward faster than instruction. For policymakers, the evidence from resource-limited settings indicates that compliance benchmarks are uninterpretable without concurrent reporting of equipment availability, and that reporting the two together would do more to direct resources appropriately than refining the behavioural targets alone. Section 4.13 and Table 5 translate these implications into operational rules, indicators and starting thresholds.

4.13. *Operational guidance for hospital leadership*

The synthesis shows what hospital leaders should change, but it does not by itself specify how monitoring can raise routine practice without becoming enforcement. Table 5 therefore converts the findings into operational rules, indicators and starting thresholds. The thresholds are pragmatic starting points derived from the patterns in the reviewed evidence and from international guidance on infection prevention and control (IPC) programmes (World Health Organization, 2024); they have not themselves been tested in trials, and each should be recalibrated against local baseline data after the first audit cycle.

The central design principle is to separate a learning channel from an accountability channel. Link nurses and other unit-based observers should own the learning channel: they observe practice, give immediate verbal feedback at the point of care and report results only in aggregate at unit level, without naming individuals. Qualitative work with link nurses identifies time and managerial support as conditions for the role (Dekker et al., 2022), so the role should carry rostered hours rather than being added to a full clinical load. The accountability channel should be reserved for the small number of events that remain once system causes have been excluded, and should follow just-culture principles (van Baarle et al., 2022), under which system-induced error is met with system repair, at-risk drift with coaching, and only reckless disregard with sanction. In practice, a unit whose observed compliance falls below the 80% benchmark on two consecutive monthly audits, or which

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records a stock-out of a mandated item, should trigger a work-system review of supply, staffing, layout and equipment fit within seven days, using simple SEIPS tools (Holden & Carayon, 2021), before any individual-level action is considered. An individual should enter the accountability channel only when a lapse recurs after feedback and supply and workload explanations have been ruled out. As a ceiling, formal disciplinary referrals should account for fewer than 5% of observed lapses; a higher proportion indicates that monitoring is functioning as enforcement.

Leaders also need evidence on whether staff experience oversight as supportive. Five indicators can be tracked routinely. First, voluntary reports of PPE breaches, near misses and stock-outs should remain stable or rise after monitoring is introduced, because reporting is an act of trust that punitive oversight suppresses. Second, at least 80% of such reports should receive documented feedback or closure within 14 days. Third, a majority of audit findings should end in a system fix rather than an individual sanction. Fourth, a brief psychological-safety pulse survey, administered at least annually and analysed by unit, should show stable or improving scores, since psychological safety is the condition under which colleagues correct one another (Edmondson & Bransby, 2023). Fifth, compliance measured in announced audits should be compared with compliance measured by unannounced or video observation; a gap wider than about 15 percentage points signals that staff are performing compliance for the observer, the behavioural signature of punitive monitoring described in Section 4.11. Observation should also sample senior clinicians in proportion to their share of patient contacts, because their practice is the one that propagates (Section 4.7), and feedback is most effective when it is benchmarked, focused on a few high-priority behaviours and paired with an action plan (Ivers et al., 2025).

Emergency departments, where adherence was lowest (Lamhoot et al., 2021), require further adaptation because acuity, crowding and interruption are permanent features of the work rather than temporary disturbances. Four adaptations follow from the reviewed evidence. Protective equipment should be stocked at the entrances to triage, resuscitation and isolation bays rather than in a central store, so that the correct item is within reach at the moment of decision. Pre-assembled kits for aerosol-generating and other high-risk procedures remove the selection step under time pressure. A trained observer or doffing partner should be assigned during high-risk procedures and surges, which converts monitoring into real-time support; real-time feedback is among the facilitators of adherence identified for emergency nurses (Coelho et al., 2022). Finally, audits should be spread across peak and off-peak periods, and departmental compliance should be reported alongside concurrent occupancy and staffing, so that falls during surges prompt a staffing response rather than reprimand. A rapidly implemented behaviour-change strategy in a regional emergency department shows that such unit-level adaptation is feasible (Curtis et al., 2022).

In resource-limited settings the immediate operational goal is to remove allocation decisions from individual workers at the bedside, where Section 4.8 showed they are made on informal moral criteria. Five workflow changes serve that goal. First, a daily stock count against agreed par levels for each ward, displayed on a visible stock board, makes shortages known before a shift begins. Second, an explicit written allocation rule, agreed in advance by the IPC committee, should rank uses by transmission risk, giving priority to aerosol-generating procedures and to patients with suspected or confirmed airborne or droplet-transmitted infection, so that staff apply a policy rather than make a personal judgement. Third, a named PPE steward on each shift should apply the rule and record every stock-out as a safety incident, escalated to management within 24 hours. Fourth, where national guidance permits extended use or reprocessing, these practices should be governed by written protocols rather than improvised. Fifth, compliance should be calculated only over opportunities at which the required item was available and reported together with the stock-out rate, so that procurement failure is not recorded as non-compliance, and omissions during documented stock-outs should never be sanctioned. A short, non-punitive debrief after shifts in which rationing occurred acknowledges the moral burden that scarcity places on staff and keeps

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incident reporting alive. These rules, with their indicators and starting thresholds, are summarised in Table 5.

Table 5. Operational guide for hospital leadership: actions, indicators and suggested starting thresholds

Domain	Operational action	Indicator to monitor	Suggested starting threshold or trigger
Learning channel	Unit-based link nurses or observers with rostered time; immediate verbal feedback at the point of care; unit-level reports without names	Observed opportunities per unit per month; time from observation to feedback	≥ 50 opportunities per unit per month; feedback within the same shift; monthly unit report
Trigger for system review	Work-system review of supply, staffing, layout and equipment fit, using SEIPS tools, before any individual action	Unit observed compliance; stock-outs of mandated items	< 80% on two consecutive monthly audits, or any stock-out: review completed within 7 days
Accountability channel	Just-culture process applied only after system causes are excluded and a lapse recurs after feedback	Disciplinary referrals as a share of observed lapses	< 5% of observed lapses
Perceived supportiveness of oversight	Encourage voluntary reporting; close the loop on every report; annual unit-level psychological-safety pulse survey	Voluntary reports of breaches, near misses and stock-outs; reports closed with feedback; findings ending in a system fix; survey score	Reports stable or rising; ≥ 80% closed within 14 days; > 50% of findings end in a system fix; score stable or improving
Observer effect	Pair announced audits with periodic unannounced or video observation	Gap between announced and unannounced compliance	Gap > 15 percentage points: revise the monitoring approach
Hierarchy	Sample senior clinicians in proportion to their patient contacts; senior role-modelling rounds	Share of observations covering senior medical staff	Proportional to senior staff's share of patient contacts
Emergency department	PPE stations at triage, resuscitation and isolation entrances; pre-assembled procedure kits; doffing partner during high-risk procedures and surges; audits across peak and off-peak periods	ED compliance reported with concurrent occupancy and staffing	Falls during surges trigger a staffing response, not reprimand
Resource-limited settings	Daily par-level stock board; written allocation rule ranked by transmission risk; shift PPE steward; written protocols for extended use or reprocessing	Stock-out rate; availability-adjusted compliance	Stock-outs escalated within 24 h; compliance computed only where the item was available; no sanctions for omissions during stock-outs

Note. Thresholds are pragmatic starting points synthesised from the reviewed evidence and international IPC programme guidance; they have not been tested in trials and should be recalibrated against local baseline data. A sample of 50 observed opportunities estimates a unit compliance rate to within about ±14 percentage points (95% confidence). ED = emergency department; IPC = infection prevention and control; PPE = personal protective equipment; SEIPS = Systems Engineering Initiative for Patient Safety.

4.14. *Strengths and limitations*

Strengths of this review include a multi-database search reported line by line (Table S1), duplicate screening and appraisal with reported agreement statistics, the inclusion of diverse study designs and geographic contexts, the use of an explicit theoretical framework for synthesis, and adherence to PRISMA 2020, COPE and ICMJE reporting standards. Limitations include the inability to perform a formal meta-analysis owing to methodological heterogeneity; potential publication bias toward studies reporting significant findings; the predominance of self-reported compliance data in several studies, which is subject to social-desirability bias; non-standardised measurement of PPE compliance across studies; the title-restricted search, which favoured specificity over sensitivity and may have missed studies that report compliance only in their abstracts or full texts, a risk partly offset by hand-searching reference lists; and the restriction of the search to five databases, which may have under-represented regional literature not indexed in them. The framework synthesis itself carries a known risk, in that an a priori structure can direct attention toward the categories it already contains; this was mitigated by retaining and analysing unassigned findings, two of which were promoted to framework elements, but it cannot be excluded.

4.15. *Directions for future research*

Five priorities follow from the gaps identified here. First, measurement requires standardisation: compliance should be reported with the observation method stated, and self-

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reported estimates should not be pooled with observed ones. Second, intervention studies need concurrent controls and follow-up beyond six months, since the existing evidence cannot distinguish durable change from the Hawthorne effect. Third, the socio-cultural level identified in this synthesis has been studied almost entirely through small qualitative studies and warrants direct quantitative examination, in particular the relationship between psychological safety, peer correction and observed adherence. Fourth, research conducted in resource-limited systems should report equipment availability alongside compliance as a matter of routine, so that the two components of the problem can be distinguished rather than conflated. Fifth, the operational indicators and thresholds proposed in Table 5 are pragmatic and should themselves be evaluated prospectively, for example in stepped implementation designs that compare units adopting separate learning and accountability channels with units that do not.

5. Conclusion

Protective-equipment compliance among healthcare workers is shaped by a complex, multilevel interplay of individual knowledge and risk perception, organisational infrastructure and policy, work-system design, and the social and cultural order of the workplace. This systematic review of 117 studies, identified through a search of five international databases completed in May 2026, demonstrates that compliance varies widely and remains generally below recommended thresholds across most settings and worker categories, and that the variation is better explained by organisational and social conditions than by what individual workers know.

The review's central claim is that compliance is an institutional and cultural accomplishment rather than an individual choice. Knowledge operates as a threshold rather than a gradient; position in the occupational hierarchy predicts adherence net of knowledge; adherence by equipment type follows comfort and social visibility rather than risk magnitude; and in resource-limited systems a low compliance rate measures procurement failure rather than diligence. Interventions succeed in proportion to how much of the work system they alter, and monitoring improves routine practice only where staff experience it as support rather than enforcement.

Improving protective-equipment compliance therefore requires moving beyond education-led approaches toward system-level change: assuring supply and staffing as preconditions rather than complements, designing equipment and environments that make the correct action the easy one, directing role-modelling interventions at senior clinicians rather than at junior staff, and building monitoring that feeds back into the work system. For hospital leaders this means separating the learning function of monitoring from its accountability function, reserving individual sanctions for the few lapses that remain after supply, staffing and work-system causes have been excluded, and tracking whether staff experience oversight as support; in resource-limited settings it means replacing informal bedside rationing with explicit allocation rules and reporting compliance only alongside equipment availability. Ensuring protective-equipment compliance is not a matter of individual behaviour but a shared organisational and systemic

References

Abubakar, U., Usman, M. N., Baba, M., Sulaiman, A., Kolo, M., Adamu, F., & Jaber, A. A. (2022). Practices and perception of healthcare workers towards infection control measures during the COVID-19 pandemic: A cross-sectional online survey from Nigeria. Journal of Infection in Developing Countries, 16(9), 1398–1405. https://doi.org/10.3855/jidc.14066

Abuzaid, M. M., Elshami, W., & Tekin, H. O. (2022). Infection control and radiation safety practices in the radiology department during the COVID-19 outbreak. PLoS ONE, 17(12), e0279607. https://doi.org/10.1371/journal.pone.0279607

This open access article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 license.

ISSN: 2776-7930 (Print) / 2807-3010 (Online)

Adji, A. S. (2024). Analysis of Ministry of Health Regulation No. 30 of 2022 on hospital service quality in Indonesia. ARRUS Journal of Social Sciences and Humanities, 4(3), 310–318. https://doi.org/10.35877/soshum2582

Adji, A. S., Satrioaji, A. M., Haksama, S., & Purwanto, A. D. (2025). The fiscal policy and tax implications for medical device resilience in Indonesia. ARRUS Journal of Social Sciences and Humanities, 5(1), 796–803. https://doi.org/10.35877/soshum3527

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alkadi, L., Farook, F. F., Binmoghaiseeb, I., Alyousef, Y., Alabdulwahab, A., Aljohani, R., & Asiri, A. (2024). Knowledge and compliance with infection prevention and control practices in prosthodontic procedures among dental students and professionals. Healthcare, 12(24), 2536. https://doi.org/10.3390/healthcare12242536

Al-Faouri, I., Okour, S. H., Alakour, N. A., & Alrabadi, N. (2021). Knowledge and compliance with standard precautions among registered nurses: A cross-sectional study. Annals of Medicine and Surgery, 62, 419–424. https://doi.org/10.1016/j.amsu.2021.01.058

Amos, T. B., Griffin, C., Schaffzin, J. K., Ankrum, A., & Scaggs Huang, F. (2024). Adherence to personal protective equipment practices during the COVID-19 pandemic: A pilot study. Infection Prevention in Practice, 6(2), 100369. https://doi.org/10.1016/j.infpip.2024.100369

Badran, E. F., Jarrah, S., Masadeh, R., Al Hammad, A., Al Shimi, R., Salhout, S., Al Wahabi, N., Al Jaberi, M., Rayyan, A., & Madi, T. (2021). Assessment of perceived compliance and barriers to personal protective equipment use among healthcare workers during the COVID-19 pandemic's second wave surge: "Walk to talk" cross-sectional correlational study. Disaster Medicine and Public Health Preparedness, 17, e45. https://doi.org/10.1017/dmp.2021.289

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Barratt, R., Shaban, R. Z., & Gilbert, G. L. (2020). Characteristics of personal protective equipment training programs in Australia and New Zealand hospitals: A survey. Infection, Disease & Health, 25(4), 253–261. https://doi.org/10.1016/j.idh.2020.05.005

Belur, J., Tompson, L., Thornton, A., & Simon, M. (2021). Interrater reliability in systematic review methodology: Exploring variation in coder decision-making. Sociological Methods & Research, 50(2), 837–865. https://doi.org/10.1177/0049124118799372

Braithwaite, J., Herkes, J., Ludlow, K., Testa, L., & Lamprell, G. (2017). Association between organisational and workplace cultures, and patient outcomes: A systematic review. BMJ Open, 7(11), e017708. https://doi.org/10.1136/bmjopen-2017-017708

Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. Implementation Science, 7, 37. https://doi.org/10.1186/1748-5908-7-37

Carayon, P., Schoofs Hundt, A., Karsh, B.-T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: The SEIPS model. Quality & Safety in Health Care, 15(Suppl. 1), i50–i58. https://doi.org/10.1136/qshc.2005.015842

Carroll, C., Booth, A., Leaviss, J., & Rick, J. (2013). "Best fit" framework synthesis: Refining the method. BMC Medical Research Methodology, 13, 37. https://doi.org/10.1186/1471-2288-13-37

Chughtai, A. A., Seale, H., Dung, T. C., Hayen, A., Rahman, B., & MacIntyre, C. R. (2016). Compliance with the use of medical and cloth masks among healthcare workers in Vietnam. Annals of Occupational Hygiene, 60(5), 619–630. https://doi.org/10.1093/annhyg/mew008

Coelho, A. R. N., Soares, A. D. C., & Torres, A. R. N. (2022). Determinants of nurses' adherence to personal protective equipment in the emergency department: Scoping review. Revista de Enfermagem Referência, 6(1), e21027. https://doi.org/10.12707/RV21027

Curtis, K., Jansen, P., Mains, M., O'Hare, A., Scotcher, B., Alcorn, D., Nahidi, S., Harris, J., Brouillard, D., Morton, S., & Shaban, R. Z. (2022). Rapid development and implementation of a behaviour

This open access article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 license.

ISSN: 2776-7930 (Print) / 2807-3010 (Online)

change strategy to improve COVID-19 personal protective equipment use in a regional Australian emergency department. Australasian Emergency Care, 25(4), 273–282. https://doi.org/10.1016/j.auec.2022.01.003

Cusini, A., Nydegger, D., Kaspar, T., Schweiger, A., Kuhn, R., & Marschall, J. (2015). Improved hand hygiene compliance after eliminating mandatory glove use from contact precautions—Is less more? American Journal of Infection Control, 43(9), 922–927. https://doi.org/10.1016/j.ajic.2015.05.019

Datta, R., Glenn, K., Pellegrino, A., Tuan, J., Linde, B., Kayani, J., Patel, K., Calo, L., Dembry, L. M., & Fisher, A. (2022). Increasing face-mask compliance among healthcare personnel during the coronavirus disease 2019 (COVID-19) pandemic. Infection Control & Hospital Epidemiology, 43(5), 616–622. https://doi.org/10.1017/ice.2021.205

Dekker, M., van Mansfeld, R., Vandenbroucke-Grauls, C. M. J. E., Lauret, T. E., Schutijser, B. C. F. M., de Bruijne, M. C., & Jongerden, I. P. (2022). Role perception of infection control link nurses; a multi-centre qualitative study. Journal of Infection Prevention, 23(3), 93–100. https://doi.org/10.1177/17571774211066786

Douglas, M. (1966). Purity and danger: An analysis of concepts of pollution and taboo. Routledge & Kegan Paul.

Drews, F. A., Mayer, J., Leecaster, M., Visnovsky, L., Huber, T., & Samore, M. H. (2025). Infection prevention behaviors and perceptions of nurses in a medical intensive care unit. Antimicrobial Stewardship & Healthcare Epidemiology. Advance online publication. https://doi.org/10.1017/ash.2025.10231

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. Administrative Science Quarterly, 44(2), 350–383. https://doi.org/10.2307/2666999

Edmondson, A. C., & Bransby, D. P. (2023). Psychological safety comes of age: Observed themes in an established literature. Annual Review of Organizational Psychology and Organizational Behavior, 10, 55–78. https://doi.org/10.1146/annurev-orgpsych-120920-055217

Efstathiou, G., Papastavrou, E., Raftopoulos, V., & Merkouris, A. (2011). Factors influencing nurses' compliance with Standard Precautions in order to avoid occupational exposure to microorganisms: A focus group study. BMC Nursing, 10, 1. https://doi.org/10.1186/1472-6955-10-1

Elbahr, U., Alwazzan, N., Delos Reyes, C. S., Pastrana, J., Vineeth, C., Sipahi, H., Malayil, R., Fadel, E., Sipahi, R., Delos Reyes, C., Pala Öztürk, Ç., Sürmeli, Z., & Sipahi, O. R. (2025). Hand hygiene compliance rates and the interventions to increase hand hygiene compliance among healthcare workers in a tertiary-care educational hemato-oncology hospital: A prospective observational study. Mediterranean Journal of Infection, Microbes and Antimicrobials, 14, 1–6. https://doi.org/10.4274/mjima.galenos.2025.25435

Elshaer, N., & Agage, H. (2022). Nurses' perception and compliance with personal protective equipment and hand hygiene during the third wave of COVID-19 pandemic. Journal of the Egyptian Public Health Association, 97, 12. https://doi.org/10.1186/s42506-022-00109-1

El-Sokkary, R. H., Khater, W. S., El-Kholy, A., Mohy Eldin, S., Gad, D. M., Bahgat, S., Negm, E. E. M., El Kholy, J. A., Mowafy, S., Mahmoud, E., & Mortada, E. M. (2021). Compliance of healthcare workers to the proper use of personal protective equipment during the first wave of COVID-19 pandemic. Journal of Infection and Public Health, 14(10), 1404–1410. https://doi.org/10.1016/j.jiph.2021.07.017

Ganczak, M., & Szych, Z. (2007). Surgical nurses and compliance with personal protective equipment. Journal of Hospital Infection, 66(4), 346–351. https://doi.org/10.1016/j.jhin.2007.05.007

George, J., Shafqat, N., Verma, R., & Patidar, A. B. (2023). Factors influencing compliance with personal protective equipment (PPE) use among healthcare workers. Cureus, 15(2), e35269. https://doi.org/10.7759/cureus.35269

Ghabayen, F., ALBashtawy, M., Abdelkader, R. H., Jarrah, S., Eshah, N., Abdalrahim, A., Saifan, A., Alkhawaldeh, A., Rayan, A., Ayed, A., Al-Amer, R., Mohammad, K. I., Al-Dwaikat, T., Al Omari, O., ALBashtawy, S., ALBashtawy, B., & Al Dameery, K. (2023). Knowledge and

This open access article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 license.

ISSN: 2776-7930 (Print) / 2807-3010 (Online)

compliance with standard precautions among nurses. SAGE Open Nursing, 9, 23779608231189966. https://doi.org/10.1177/23779608231189966

Ghorbanmovahhed, S., Shahbazi, S., Gilani, N., Ostadi, A., Shabanloei, R., & Gholizadeh, L. (2023). Effectiveness of implementing of an infection control link nurse program to improve compliance with standard precautions and hand hygiene among nurses: A quasi-experimental study. BMC Medical Education, 23, 265. https://doi.org/10.1186/s12909-023-04208-1

Goffman, E. (1959). The presentation of self in everyday life. Doubleday.

Haksama, S., Rahmarista, D., Lusno, M. F. D., Prayoga, D., Sriram, S., Adji, A. S., Zeinsar, S. R., & Shedyta, S. Z. (2025). The role of employee characteristics and quality of work life in improving performance at Mother and Children Glamour Husada Kebun Hospital, Bangkalan, Indonesia. Health Dynamics, 2(2), 56–66. https://doi.org/10.33846/hd20203

Herzog, R., Álvarez-Pasquin, M. J., Díaz, C., Del Barrio, J. L., Estrada, J. M., & Gil, Á. (2013). Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? A systematic review. BMC Public Health, 13, 154. https://doi.org/10.1186/1471-2458-13-154

Holden, R. J., & Carayon, P. (2021). SEIPS 101 and seven simple SEIPS tools. BMJ Quality & Safety, 30(11), 901–910. https://doi.org/10.1136/bmjqs-2020-012538

Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: A human factors framework for studying and improving the work of healthcare professionals and patients. Ergonomics, 56(11), 1669–1686. https://doi.org/10.1080/00140139.2013.838643

Hong, Q. N., Fabregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M.-P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M.-C., Vedel, I., & Pluye, P. (2018). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. Education for Information, 34(4), 285–291. https://doi.org/10.3233/EFI-180221

Horesh, Y., Oz Rokach, R., Kolben, Y., & Nachman, D. (2025). Real-time monitoring of personal protective equipment adherence using on-device artificial intelligence models. Sensors, 25(7), 2003. https://doi.org/10.3390/s25072003

Houghton, C., Meskell, P., Delaney, H., Sheehan, S., O Donoghue, C., Glenton, C., Booth, A., Jorem, G., Chan, X. H. S., Devane, D., & Biesty, L. M. (2026). Factors that impact on healthcare workers' adherence with infection prevention and control (IPC) guidelines for COVID-19: A qualitative evidence synthesis. Cochrane Database of Systematic Reviews, 2026(9), CD016384. https://doi.org/10.1002/14651858.CD016384

Howard, M. J., Chambers, C. N. L., & Mohr, N. M. (2022). New Zealand Emergency Department COVID-19 Preparedness: A cross-sectional survey and narrative view. BMJ Open, 12(2), e053611. https://doi.org/10.1136/bmjopen-2021-053611

Ilesanmi, O. S., Afolabi, A. A., Akande, A., Raji, T., & Mohammed, A. (2021). Infection prevention and control during COVID-19 pandemic: Realities from health care workers in a north central state in Nigeria. Epidemiology and Infection, 149, e15. https://doi.org/10.1017/S0950268821000017

Ivers, N., Yogasingam, S., Lacroix, M., Brown, K. A., Antony, J., Soobiah, C., Simeoni, M., Willis, T. A., Crawshaw, J., Antonopoulou, V., Meyer, C., Solbak, N. M., Murray, B. J., Butler, E. A., Lepage, S., Giltenane, M., Carter, M. D., Fontaine, G., Sykes, M., … Grimshaw, J. M. (2025). Audit and feedback: Effects on professional practice. Cochrane Database of Systematic Reviews, 2025(3), CD000259. https://doi.org/10.1002/14651858.CD000259.pub4

Jeong, I., Cho, J., & Park, S. (2008). Compliance with standard precautions among operating room nurses in South Korea. American Journal of Infection Control, 36(10), 739–742. https://doi.org/10.1016/j.ajic.2008.04.253

Katanami, Y., Hayakawa, K., Shimazaki, T., Sugiki, Y., Takaya, S., Yamamoto, K., Kutsuna, S., Kato, Y., & Ohmagari, N. (2018). Adherence to contact precautions by different types of healthcare workers through video monitoring in a tertiary hospital. Journal of Hospital Infection, 100(1), 70–75. https://doi.org/10.1016/j.jhin.2018.01.001

This open access article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 license.

ISSN: 2776-7930 (Print) / 2807-3010 (Online)

Kaye, G., & Marais, D. (2025). Why do staff comply? A study to determine factors influencing staff adherence to PPE and hand hygiene policy and standards within an acute healthcare setting. Journal of Infection Prevention, 26(4), 161–170. https://doi.org/10.1177/17571774251334045

Kim, E.-J., Park, Y.-H., & Choi, H.-R. (2024). Factors influencing nurses' compliance related to the use of personal protective equipment during the COVID-19 pandemic: A descriptive cross-sectional study. Nursing Open, 11(7), e2235. https://doi.org/10.1002/nop2.2235

Krein, S. L., Mayer, J., Harrod, M., Weston, L. E., Gregory, L., Petersen, L., Samore, M. H., & Drews, F. A. (2018). Identification and characterization of failures in infectious agent transmission precaution practices in hospitals: A qualitative study. JAMA Internal Medicine, 178(8), 1016–1022. https://doi.org/10.1001/jamainternmed.2018.1898

Lamhoot, T., Ben Shoshan, N., Eisenberg, H., Fainberg, G., Mhiliya, M., Cohen, N., Bisker-Kassif, O., Barak, O., Weiniger, C., & Capua, T. (2021). Emergency department impaired adherence to personal protective equipment donning and doffing protocols during the COVID-19 pandemic. Israel Journal of Health Policy Research, 10, 41. https://doi.org/10.1186/s13584-021-00477-7

Liow, M. H. L., Lee, L. C., Tan, N. C. K., Tan, H. K., Chow, W., Wee, G. L. E., Wong, S. H., Paramasivam, J., Tan, K., & Ling, M. L. (2021). Personal protective equipment training for non-healthcare workers in the Covid-19 pandemic: Effectiveness of an evidence-based skills training framework. Infection, Disease & Health, 27(1), 38–48. https://doi.org/10.1016/j.idh.2021.09.040

Lim, S. H., Bouchoucha, S. L., Aloweni, F., & Bte Suhari, N. A. (2021). Evaluation of infection prevention and control preparedness in acute care nurses: Factors influencing adherence to standard precautions. Infection, Disease & Health, 26(2), 132–138. https://doi.org/10.1016/j.idh.2020.11.005

Lipsky, M. (2010). Street-level bureaucracy: Dilemmas of the individual in public services (30th anniversary expanded ed.). Russell Sage Foundation.

Loibner, M., Hagauer, S., Schwantzer, G., Berghold, A., & Zatloukal, K. (2019). Limiting factors for wearing personal protective equipment (PPE) in a health care environment evaluated in a randomised study. PLoS ONE, 14(1), e0210775. https://doi.org/10.1371/journal.pone.0210775

Lv, Y., Xiang, Q., Jiang, X., Zhang, B., Wu, J., & Cao, H. (2023). Effectiveness of inspector mechanism for the emergency infection prevention and control in the SARS-CoV-2 epidemic period: A self-control real-word study. BMC Infectious Diseases, 23, 858. https://doi.org/10.1186/s12879-023-08682-2

Madziatera, D., Msofi, K. S., Phiri, T. V., Mkandawire, S. D., & Comber, A. (2020). Availability, accessibility and proper use of personal protective equipment in wards at Queen Elizabeth Central Hospital (QECH) Blantyre, Malawi: An observational study. Malawi Medical Journal, 32(3), 124–131. https://doi.org/10.4314/mmj.v32i3.4

Mannion, R., & Davies, H. (2018). Understanding organisational culture for healthcare quality improvement. BMJ, 363, k4907. https://doi.org/10.1136/bmj.k4907

May, C., & Finch, T. (2009). Implementing, embedding, and integrating practices: An outline of normalization process theory. Sociology, 43(3), 535–554. https://doi.org/10.1177/0038038509103208

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. Biochemia Medica, 22(3), 276–282. https://doi.org/10.11613/BM.2012.031

Michel-Kabamba, N., Ngatu, N. R., Leon-Kabamba, N., Katumbo-Mukemo, A., Mukuku, O., Ngoyi-Mukonkole, J., Ngoie-Mwamba, G., Kilolo-Ngoie, E., Bwana-Kangulu, I., Kafusthi-Mukemo, D., Banza-Ndala, D. B., Kabila-Mutombo, D., Balela-Kabasu, M.-C., Kanyiki-Katala, M., Syed-Mahfuz, A. H., Murakami, A., Kanda, K., Mashima, Y., Oscar-Luboya, N., & Hirao, T. (2021). Occupational COVID-19 prevention among Congolese healthcare workers: Knowledge, practices, PPE compliance, and safety imperatives. Tropical Medicine and Infectious Disease, 6(1), 6. https://doi.org/10.3390/tropicalmed6010006

This open access article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 license.

ISSN: 2776-7930 (Print) / 2807-3010 (Online)

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science, 6, 42. https://doi.org/10.1186/1748-5908-6-42

Min, H. S., Moon, S., Jang, Y., Cho, I., Jeon, J., & Sung, H. K. (2021). The use of personal protective equipment among frontline nurses in a nationally designated COVID-19 hospital during the pandemic. Infection & Chemotherapy, 53(4), 705–717. https://doi.org/10.3947/ic.2021.0094

Moore, R., Hayward, A., & Necaise, K. (2021). Through their eyes: Health care worker compliance with personal protective equipment during the COVID-19 pandemic. Journal of Nursing Care Quality, 36(4), 294–301. https://doi.org/10.1097/NCQ.0000000000000540

Neuwirth, M. M., Mattner, F., & Otchwemah, R. (2020). Adherence to personal protective equipment use among healthcare workers caring for confirmed COVID-19 and alleged non-COVID-19 patients. Antimicrobial Resistance & Infection Control, 9, 199. https://doi.org/10.1186/s13756-020-00864-w

Ningsih, A. S., Suryani, D., & Hariyono, W. (2024). Variables influencing nurses' adherence to personal protective equipment (PPE) utilization at PKU Muhammadiyah Hospital Bantul. Epidemiology and Society Health Review, 6(1), 1–10. https://doi.org/10.26555/eshr.v6i1.9687

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hrobjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71

Pettersson, J., Almgren, M., Östman, T., Johansson, A. F., & Backman, A. (2026). Infection prevention and control in nursing homes under pandemic-level pressure: Qualitative insights from Swedish care workers. Antimicrobial Resistance & Infection Control, 15, 55. https://doi.org/10.1186/s13756-026-01744-5

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme. Lancaster University.

Price, A., Lin, Y. L., Levin, A. S., Tumietto, F., Almeida, R., Almeida, A., Ciofi-Silva, C. L., Fontana, L., Oliveira, N., Parisi, N. F., Mainardi, G. M., Cordeiro, L., Roselli, M., Shepherd, P., Morelli, L., Mehrabi, N., Price, K., Chan, W., Srinivas, S., … Chu, L. (2022). Perceived workload using separate (filtering facepiece respirator and face shield) and powered air-purifying respirator and integrated lightweight protective air-purifying respirator: Protocol for an international multisite human factors randomized crossover feasibility study. JMIR Research Protocols, 11(12), e36549. https://doi.org/10.2196/36549

Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., Koffel, J. B., & PRISMA-S Group. (2021). PRISMA-S: An extension to the PRISMA statement for reporting literature searches in systematic reviews. Systematic Reviews, 10, 39. https://doi.org/10.1186/s13643-020-01542-z

Roosihermiatie, B., Putro, G., Adji, A. S., Yuana, W. T., Siahaan, S. A. S., Rukmini, R., & Rustika, R. (2024). Factors associated with malaria infection in under-5 children in Papua Province, Indonesia: An observational study. Osong Public Health and Research Perspectives, 15(6), 508–520. https://doi.org/10.24171/j.phrp.2024.0152

Rosenstock, I. M. (1974). Historical origins of the health belief model. Health Education Monographs, 2(4), 328–335. https://doi.org/10.1177/109019817400200403

Russell, L., Campani, L., Jones, J., & Healy, B. (2021). Fluid-repellent surgical mask (FRSM) fit – One size does not fit all. Clinical Medicine, 21(4), e283–e286. https://doi.org/10.7861/clinmed.2021-0054

Sharma, M., Sharma, D., Sharma, A. K., Mohanty, A., Khapre, M., & Kalyani, C. V. (2022). Barriers faced by health-care workers in use of personal protective equipment during COVID pandemic at tertiary care hospital Uttarakhand, India: A qualitative study. Journal of Education and Health Promotion, 11, 74. https://doi.org/10.4103/jehp.jehp_406_21

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Shehab, M., Shuaibi, S., Qadhi, I., & Alfadhli, A. (2021). Effectiveness of inspectors' team in increasing compliance with personal protective equipment use and reducing COVID-19 infection spread among healthcare workers. Infection Prevention in Practice, 3(2), 100137. https://doi.org/10.1016/j.infpip.2021.100137

Tamene, A., Afework, A., & Mebratu, L. (2020). A qualitative study of barriers to personal protective equipment use among laundry workers in government hospitals, Hawassa, Ethiopia. Journal of Environmental and Public Health, 2020, 5146786. https://doi.org/10.1155/2020/5146786

Thom, K. A., Rock, C., Robinson, G. L., Reisinger, H. S., Baloh, J., Li, S., Diekema, D. J., Herwaldt, L. A., Johnson, J. K., Harris, A. D., & Perencevich, E. N. (2023). Direct gloving vs hand hygiene before donning gloves in adherence to hospital infection control practices: A cluster randomized clinical trial. JAMA Network Open, 6(10), e2336758. https://doi.org/10.1001/jamanetworkopen.2023.36758

Tomczyk, S., Twyman, A., de Kraker, M. E. A., Coutinho Rehse, A. P., Tartari, E., Toledo, J. P., Cassini, A., Pittet, D., & Allegranzi, B. (2022). The first WHO global survey on infection prevention and control in health-care facilities. The Lancet Infectious Diseases, 22(6), 845–856. https://doi.org/10.1016/S1473-3099(21)00809-4

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care, 19(6), 349–357. https://doi.org/10.1093/intqhc/mzm042

van Baarle, E., Hartman, L., Rooijakkers, S., Wallenburg, I., Weenink, J.-W., Bal, R., & Widdershoven, G. (2022). Fostering a just culture in healthcare organizations: Experiences in practice. BMC Health Services Research, 22, 1035. https://doi.org/10.1186/s12913-022-08418-z

Visnovsky, L. D., Zhang, Y., Leecaster, M. K., Safdar, N., Barko, L., Haroldsen, C., Mulvey, D. L., Nevers, M., Shaughnessy, C., Stratford, K. M., Drews, F. A., Samore, M. H., & Mayer, J. (2019). Effectiveness of a multisite personal protective equipment (PPE)-free zone intervention in acute care. Infection Control & Hospital Epidemiology, 40(7), 761–766. https://doi.org/10.1017/ice.2019.111

Weldetinsae, A., Alemu, Z. A., Tefaye, K., Gizaw, M., Alemahyehu, E., Tayachew, A., Derso, S., Abate, M., Getachew, M., Abera, D., Mebrhatu, A., Kefale, H., Habebe, S., Assefa, T., Mekonnen, A., Tollera, G., & Tessema, M. (2023). Adherence to infection prevention and control measures and risk of exposure among health-care workers: A cross-sectional study from the early period of COVID-19 pandemic in Addis Ababa, Ethiopia. Health Science Reports, 6(6), e1365. https://doi.org/10.1002/hsr2.1365

Williams, V. R., Leis, J. A., Trbovich, P., Agnihotri, T., Lee, W., Joseph, B., Glen, L., Avaness, M., Jinnah, F., Salt, N., & Powis, J. E. (2019). Improving healthcare worker adherence to the use of transmission-based precautions through application of human factors design: A prospective multi-centre study. Journal of Hospital Infection, 103(1), 101–105. https://doi.org/10.1016/j.jhin.2019.03.014

World Health Organization. (2024). Global report on infection prevention and control 2024. https://www.who.int/publications/i/item/9789240103986

Wright, T., Adhikari, A., Yin, J., Vogel, R., Smallwood, S., & Shah, G. (2019). Issue of compliance with use of personal protective equipment among wastewater workers across the southeast region of the United States. International Journal of Environmental Research and Public Health, 16(11), 2009. https://doi.org/10.3390/ijerph16112009

Zangoue, M., Safari, H., Royce, S. G., Zangooie, A., Rezapour, H., Zangouei, A., & Fereidouni, M. (2021). The high level of adherence to personal protective equipment in health care workers efficiently protects them from COVID-19 infection. Work, 69(4), 1191–1196. https://doi.org/10.3233/WOR-210634

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. Journal of Applied Psychology, 65(1), 96–102. https://doi.org/10.1037/0021-9010.65.1.96

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