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ASSESSMENT OF KNOWLEDGE AND PRACTICE OF INFECTION PREVENTION AND CONTROL AMONG NURSES IN A HOSPICE IN ALMATY, KAZAKHSTAN

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Introduction. Infection safety is critical in palliative care settings, where nurses have frequent direct contact with patients and biological materials; adherence to standard precautions and personal protective measures is essential for staff and patient safety.
Objective. To assess hospice nurses' infection prevention and control (IPC) knowledge/awareness, self-reported practices, and resource availability, and to explore differences according to work experience.
Materials and Methods. A cross-sectional study was conducted among 32 nurses in a hospice in Almaty using an adapted version of the questionnaire developed by Tafere et al. (2024; PMCID: PMC10807260) [13]. The instrument was translated into Russian, contextually adapted for palliative/hospice care, and piloted with five nurses. It included 18 knowledge/IPC-awareness items, 15 self-reported practice items with dichotomous responses, and a resource-availability section. Descriptive statistics, the Mann–Whitney U test, Pearson's χ^2 test, and Fisher's exact test when appropriate were used.
Results. The mean knowledge/awareness score was 14.6/18; all participants scored at least 9/18, and no statistically significant difference in overall knowledge was reported between experience groups. Self-reported practice differed by experience: the median score was 11 (IQR 10–12) among nurses with ≤10 years of experience and 14 (IQR 13–15) among those with >10 years ($p < 0.001$). Item-level differences were not statistically significant. Alcohol-based hand rub, sharps containers, and color-coded waste bags were reported as available by all participants; regular IPC training was reported as provided by 28/32 nurses (87.5%), whereas 19/32 (59.4%) reported having completed IPC training within the previous 12 months.
Conclusion. A high knowledge/awareness score coexisted with lower self-reported adherence to several personal-protection practices among less experienced nurses. Targeted recurrent training, simulation-based reinforcement, and monitoring of standard precautions may strengthen staff safety and IPC performance.
Keywords: infection control; hospice care; nurses; standard precautions; personal protective equipment; occupational exposure.

АЛМАТЫ ҚАЛАСЫНДАҒЫ ХОСПИС МЕДБИКЕЛЕРІНІҢ ИНФЕКЦИЯЛАРДЫҢ АЛДЫН АЛУ ЖӘНЕ БАҚЫЛАУ БОЙЫНША БІЛІМ ДЕҢГЕЙІН, ПРАКТИКАЛЫҚ ДАҒДЫЛАРЫН ЖӘНЕ РЕСУРСТЫҚ ҚАМТАМАСЫЗ ЕТІЛУІН БАҒАЛАУ

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Кіріспе. Паллиативтік көмек ұйымдарында инфекциялық қауіпсіздік ерекше маңызды: медбикелер пациенттермен және биологиялық материалдармен тұрақты тікелей байланыста болады, сондықтан стандартты сақтық және жеке қорғаныс шараларын сақтау персонал мен пациенттердің қауіпсіздігі үшін қажет.

Мақсат. Хоспис медбикелерінің инфекциялардың алдын алу және бақылау (IPC) бойынша білімін/хабардарлығын, өздері мәлімдеген тәжірибесін және ресурстық қамтамасыз етілуін бағалау, сондай-ақ жұмыс өтіліне байланысты айырмашылықтарды зерттеу.
Материалдар мен әдістер. Алматы қаласындағы хосписте 32 медбикенің қатысуымен көлденең зерттеу жүргізілді. Tafere et al. (2024; PMCID: PMC10807260) әзірлеген сауалнаманың бейімделген нұсқасы қолданылды [13]. Құрал орыс тіліне аударылып, паллиативтік/хоспистік көмек жағдайына бейімделді және бес медбикеде сынақтан өткізілді. Сауалнама 18 білім/хабардарлық тармағынан, 15 тәжірибе тармағынан (дихотомиялық жауаптар) және ресурстардың қолжетімділігі бөлімінен тұрды. Сипаттамалық статистика, Манн–Уитни U-тесті, Пирсонның χ^2 критерийі және қажет болған жағдайда Фишердің нақты критерийі қолданылды.
Нәтижелер. Білім/хабардарлықтың орташа балы 14,6/18 болды; барлық қатысушы кемінде 9 балл жинады, ал жалпы балл бойынша жұмыс өтілі топтары арасында статистикалық мәнді айырмашылық тіркелмеді. Тәжірибе балының медианасы өтілі ≤10 жыл топта 11 (IQR 10–12), ал >10 жыл топта 14 (IQR 13–15) болды ($p < 0,001$). Жекелеген тармақтар бойынша айырмашылықтар статистикалық мәнді болған жоқ. Антисептик, өткір заттарға арналған контейнерлер және түспен кодталған қалдық пакеттері барлық қатысушыда қолжетімді деп көрсетілді; тұрақты IPC оқытуы ұйымдық ресурс ретінде 28/32 (87,5%) қатысушыда көрсетілсе, соңғы 12 айда IPC оқытуынан өткенін 19/32 (59,4%) медбике хабарлады.
Қорытынды. Білім/хабардарлық деңгейінің жоғары болуына қарамастан, жұмыс өтілі аз медбикелерде жеке қорғанысқа қатысты бірқатар тәжірибелердің орындалуы төменірек болды. Нысаналы қайталама тренингтер, симуляциялық оқыту және стандартты сақтық шараларын жүйелі бақылау персонал қауіпсіздігі мен IPC тәжірибесін жақсартуға көмектесуі мүмкін.
Түйінді сөздер: инфекциялық бақылау; хоспис; медбикелер; стандартты сақтық шаралары; жеке қорғаныс құралдары; кәсіби экспозиция.

ОЦЕНКА ЗНАНИЙ, ПРАКТИЧЕСКИХ НАВЫКОВ И РЕСУРСНОЙ ОБЕСПЕЧЕННОСТИ МЕДСЕСТЕР ХОСПИСА ПО ПРОФИЛАКТИКЕ И КОНТРОЛЮ ИНФЕКЦИЙ В Г. АЛМАТЫ

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Введение. Инфекционная безопасность имеет особое значение в паллиативной помощи, где медсестры регулярно контактируют с пациентами и биологическими материалами, а соблюдение стандартных мер предосторожности и личной защиты определяет безопасность персонала и пациентов.
Цель. Оценить знания/осведомленность, самооценку практик и ресурсную обеспеченность медсестер хосписа по профилактике и контролю инфекций (IPC), а также изучить различия в зависимости от стажа работы.
Материалы и методы. Проведено поперечное (одномоментное) исследование среди 32 медсестер хосписа в г. Алматы с использованием адаптированной анкеты Tafere et al. (2024; PMCID: PMC10807260) [13]. Инструмент был переведен на русский язык, контекстуально адаптирован к условиям паллиативной/хосписной помощи и апробирован на пяти медсестрах. Он включал 18 пунктов по знаниям/осведомленности, 15 пунктов по самооценке практик с дихотомическими ответами и блок ресурсной обеспеченности. Использовали описательную статистику, U-критерий Манна–Уитни, χ^2 Пирсона и точный критерий Фишера при необходимости.
Результаты. Средний балл знаний/осведомленности составил 14,6 из 18; все участницы набрали не менее 9 баллов, а статистически значимых различий общего балла по стажу не выявлено. Медиана самооценки практик составила 11 баллов (IQR 10–12) у медсестер со стажем ≤10 лет и 14 баллов (IQR 13–15) при стаже >10 лет ($p < 0,001$). Различия по отдельным пунктам статистической значимости не достигли. Доступность антисептиков, контейнеров для острых предметов и цветных мешков для отходов указали все участницы; регулярное IPC-обучение как доступный ресурс отметили 28/32 (87,5%), тогда как пройти IPC-обучение за последние 12 месяцев сообщили 19/32 (59,4%).
Заключение. Высокий уровень знаний/осведомленности сочетался с менее устойчивым соблюдением ряда мер личной защиты у медсестер с меньшим стажем. Целевые повторные тренинги, симуляционное обучение и мониторинг стандартных мер предосторожности могут усилить безопасность персонала и качество IPC-практик.

Ключевые слова: инфекционный контроль; хоспис; медсестры; стандартные меры предосторожности; средства индивидуальной защиты; профессиональная экспозиция.

Introduction

Healthcare-associated infections (HAIs) remain a major threat to patient safety. The World Health Organization emphasizes comprehensive infection prevention and control (IPC) programs that integrate organizational infrastructure, staff education, monitoring, and adherence to standard precautions [1]. Global evidence confirms that inadequate IPC implementation contributes to preventable morbidity and mortality [2]. Even when protocols are available, adherence may remain suboptimal because of workload, resource limitations, and insufficient recurrent training [3].

Strengthening workforce competency is therefore central to effective infection control. CDC guidance emphasizes standardized hand hygiene, safe handling of equipment, environmental measures, and safe management of sharps and waste [4]. Integrated surveillance is equally important: long-term-care IPC systems depend on systematic data collection, standardized definitions, and routine review of prevention-process measures [5]. SHEA/APIC guidance for long-term-care facilities similarly links sustainable infection prevention to surveillance, staff education, employee health, and organizational support [6]. NHSN surveillance definitions and the revised McGeer criteria provide standardized approaches for identifying infectious events in long-term-care populations [7,8]. At the health-system level, stronger IPC programs and better adherence to standard precautions are associated with safer care and more consistent implementation [9,10].

Nurses are particularly important because they perform a large proportion of direct-care procedures. Evidence from the Philippines shows that good theoretical knowledge may coexist with suboptimal IPC practice, with workload, dissemination of guidance, and discomfort with personal protective equipment acting as barriers [12]. In a catheter-associated urinary tract infection prevention study from the University of Gondar, only 37.7% of nurses demonstrated good knowledge and 51.8% good practice; work experience, training, and availability of guidelines were associated with better outcomes [11]. At Debre Tabor Comprehensive Specialized Hospital, knowledge and practice were 59.4% and 53%, respectively, and both were associated with work experience and IPC training [13]. A Georgian study likewise reported sufficient knowledge but incomplete translation into practice, including lower adherence during high workload [14]. Studies from Yemen and Saudi Arabia have documented heterogeneous knowledge and practice and a continuing need for structured IPC education [15,16], while work from Türkiye emphasizes the importance of reliable measurement and reinforcement of compliance with standard precautions [17].

Palliative-care populations are especially vulnerable to infection because of advanced illness, age, multimorbidity, invasive procedures, and complex cancer treatment. Modern oncological therapies, including immune checkpoint inhibitors, can produce immune-mediated toxicities that complicate clinical assessment and supportive care [20]. In older and palliative-care patients, infection may present atypically, sometimes without fever or marked laboratory abnormalities, and antimicrobial decisions must remain aligned with individual clinical goals [21].

Evidence-based infection surveillance has also been implemented in hospice and home-care services. Standardized surveillance supports systematic detection of infectious events, identification of risk patterns, and quality improvement, including reduction of selected healthcare-associated infections [22]. These findings suggest that even in resource-constrained settings, infection burden can be addressed through organized surveillance, reliable infrastructure, and targeted staff education.

Despite substantial international literature, hospice-specific data on nurses' IPC knowledge and practice from Central Asia remain limited. Given the vulnerability of palliative-care patients and nurses' central role in daily care, a setting-specific assessment is

relevant for service improvement. The objective of this study was to assess IPC knowledge/awareness, self-reported practices, and resource availability among nurses in a hospice in Almaty and to explore differences according to work experience.

Materials and Methods

Study design and setting

A cross-sectional study was conducted in a hospice in Almaty, Kazakhstan, providing continuous palliative and long-term nursing care. Data collection took place during 2024–2025. The study was designed as a single-center assessment of nurses involved in direct patient care.

Participants and selection criteria

A total of 32 nurses participated: ward nurses (n = 18), post nurses (n = 8), procedure nurses (n = 4), and nursing assistants performing basic care tasks (n = 2). Inclusion criteria were at least three months of employment in the hospice, active duty during the survey period, and voluntary participation. Nurses on leave and those who declined participation were excluded. All participants provided written informed consent.

Study size

No formal a priori sample-size calculation was reported in the source study. Accordingly, the analysis should be interpreted as an exploratory single-center assessment of the 32 participating nurses rather than as a population-representative estimate.

Study instrument and adaptation

A structured self-administered questionnaire was adapted from the instrument developed by Tafere et al. [13]. The adaptation process included: (1) translation into Russian, with partial Kazakh-language adaptation and forward–backward translation for linguistic equivalence; (2) limited rephrasing of selected items to reflect palliative/hospice care and prolonged patient contact without intentionally changing item meaning; (3) expansion of the resource section to capture hospice-specific infrastructure, including bedside access to antiseptics; and (4) a pilot test with five nurses to assess comprehension and feasibility. The original questionnaire structure and scoring approach were retained to support comparability with the source instrument.

The final questionnaire contained four sections: sociodemographic characteristics; an 18-item knowledge/IPC-awareness domain; a 15-item self-reported IPC practice domain; and resource availability. Several items in the 18-item domain reflect organizational awareness or previous training in addition to factual knowledge; the composite score is therefore described here as a knowledge/awareness score.

Outcomes and scoring

The primary outcomes were the total knowledge/awareness score (0–18) and the total self-reported practice score (0–15). Secondary outcomes were item-level response proportions, reported availability of IPC resources, and between-group differences according to work experience (≤10 years vs. >10 years). One point was assigned for each correct knowledge/awareness response. Practice items were scored dichotomously; the needle-stick injury item was reverse scored, and the chlorine-disinfection item was evaluated using the specified soaking time. Two classification approaches were retained from the source manuscript: an operational 50% threshold (≥9 points for knowledge/awareness and ≥8 points for practice) and comparison with the sample mean. Missing responses, if present, were recorded as “no data” and excluded from the relevant denominator.

Data collection, participant safety, and confidentiality

Questionnaires were completed individually and returned in sealed envelopes to reduce social-desirability pressure and protect confidentiality. Participation was voluntary and withdrawal was permitted at any time. The study involved questionnaire-based data collection and did not alter clinical care or expose participants to an interventional procedure.

Ethical considerations

Participants were informed about the purpose of the study, confidentiality principles, and their right to withdraw. Written informed consent was obtained from all participants. The study was approved by the local ethics

committee and conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 26. Quantitative variables were summarized using means and standard deviations or medians and interquartile ranges, with minimum–maximum values where available; categorical variables were summarized as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test and visual inspection of histograms and Q–Q plots. Depending on distributional assumptions, between-group comparisons of quantitative variables used either the independent-samples t test or the Mann–Whitney U test. Categorical variables were compared using Pearson's χ^2 test when expected cell counts were ≥5 and Fisher's exact test when expected counts were <5. All tests were two-sided, and $p < 0.05$ was considered statistically significant. Because numerous item-level comparisons were exploratory, no adjustment for multiple testing was applied; individual item p-values should therefore be interpreted cautiously.

Results

Participant characteristics

All 32 participants were female. Mean age was 34.8 ± 7.2 years (range 23–52). Seventeen nurses (53.1%) had ≤10 years of work experience and 15 (46.9%) had >10 years. Most participants were Kazakh (68.8%), followed by Russian (21.9%) and other nationalities (9.3%). All had college-level nursing education. Nineteen nurses (59.4%) reported completing IPC training within the previous 12 months.

Table 1 – Sociodemographic and professional characteristics by work experience

Indicator	≤10 years of experience (n = 17)	>10 years of experience (n = 15)	p-value
Age (years)			
Under 25	3 (17.6%)	0 (0%)	0.193
26–30	6 (35.3%)	3 (20.0%)	0.453
31–40	5 (29.4%)	6 (40.0%)	0.729
≥41	3 (17.6%)	6 (40.0%)	0.158
Nationality			
Kazakh	12 (70.6%)	10 (66.7%)	0.805
Russian	4 (23.5%)	3 (20.0%)	0.999 (Fisher)
Other	1 (5.9%)	2 (13.3%)	0.585
Education			
College	17	15	—
Bachelor	0	0	—
Master/PhD	0	0	—
Position			
Ward nurse	10 (58.8%)	8 (53.3%)	0.752
Post nurse	4 (23.5%)	4 (26.7%)	0.999
Procedure nurse	2 (11.8%)	2 (13.3%)	0.999
Nurse aide/assistant	1 (5.9%)	1 (6.7%)	0.999
Work shift			
Day	7 (41.2%)	4 (26.7%)	0.477

Indicator	≤10 years of experience (n = 17)	>10 years of experience (n = 15)	p-value
Night	4 (23.5%)	5 (33.3%)	0.704
Mixed	6 (35.3%)	6 (40.0%)	0.999
IPC training completed within the last 12 months			
Yes	10 (58.8%)	9 (60.0%)	0.999
No	7 (41.2%)	6 (40.0%)	—

Note. *Values are n (%) unless otherwise indicated. Fisher's exact test was used when expected cell counts were small. "—" indicates that a meaningful p-value was not calculated for a zero-variance or complementary category.*

IPC knowledge/awareness

The mean total knowledge/awareness score was 14.6 of 18, and all participants scored ≥9 points, meeting the study's operational definition of adequate knowledge/awareness. Median scores were 14 in the ≤10-year group and 15 in the >10-year group; no statistically significant difference in overall knowledge/awareness was reported. Across individual items, no between-group difference reached statistical significance. Numerically larger gaps were observed for awareness of TB/HIV protocols, hepatitis B vaccination requirements, accidental-exposure reporting, and the needle-stick injury response algorithm.

Table 2 – IPC knowledge and organizational-awareness items by work experience

Indicator	≤10 years (n = 17)	>10 years (n = 15)	p-value
B1. I know the standard precautions	15 (88.2%)	15 (100%)	0.487 (Fisher)
B2. The hospice has a designated person responsible for IPC	16 (94.1%)	15 (100%)	0.999
B3. Completed IPC training within the past 12 months	10 (58.8%)	9 (60.0%)	0.999
B4. Approved IPC SOPs are available	14 (82.4%)	14 (93.3%)	0.613
B5. PPE is always available	15 (88.2%)	14 (93.3%)	0.999
B6. Round-the-clock access to antiseptics/water	16 (94.1%)	15 (100%)	0.999
B7. Aware of HAI risks	16 (94.1%)	15 (100%)	0.999
B8. Disinfection reduces outbreak risk	17 (100%)	15 (100%)	—
B9. I know the rules of waste disposal	15 (88.2%)	15 (100%)	0.487
B10. I know pressure ulcer prevention measures within IPC	16 (94.1%)	15 (100%)	0.999
B11. I can process reusable care items correctly	15 (88.2%)	15 (100%)	0.487
B12. I know TB/HIV protocols	10 (58.8%)	12 (80.0%)	0.283
B13. Hepatitis B vaccination is mandatory	12 (70.6%)	14 (93.3%)	0.202
B14. There is a system for reporting accidental exposures	13 (76.5%)	14 (93.3%)	0.353
B15. I know the needle-stick injury response algorithm	12 (70.6%)	13 (86.7%)	0.434
B16. I know WHO's "5 Moments for Hand Hygiene"	15 (88.2%)	15 (100%)	0.487
B17. I know the rules for personal care items	16 (94.1%)	15 (100%)	0.999
B18. I know the patient isolation procedures	14 (82.4%)	15 (100%)	0.234

Note. *The original 18-item domain includes factual knowledge as well as awareness of organizational resources/training. Item-level p-values are exploratory and were not adjusted for multiple comparisons.*

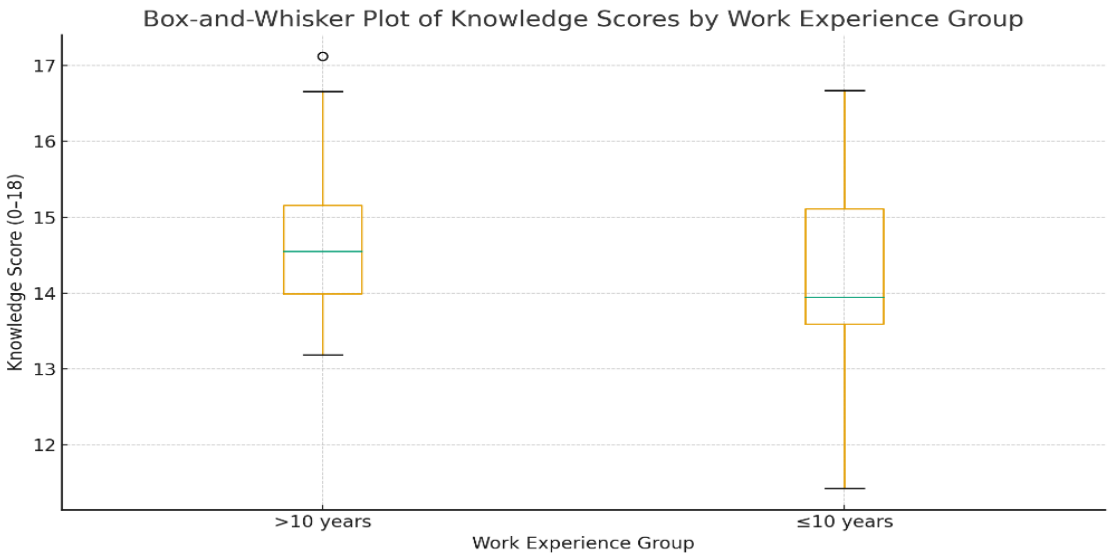


Figure 1 - Box-and-whisker plot of total IPC knowledge scores among hospice nurses by work experience

Self-reported IPC practices

Most individual practice items showed high reported adherence, particularly safe disposal of sharps, waste segregation, chlorine-based equipment disinfection, and appropriate soaking time. However, lower adherence was reported among nurses with ≤10 years of experience for hand hygiene before and after patient care, not recapping needles, use of masks and aprons, covering personal cuts or wounds, and hepatitis B vaccination. None of the individual item-level differences reached statistical significance.

The total practice score showed a clear between-group difference. Nurses with ≤10 years of experience had a median score of 11 (IQR 10–12), compared with 14 (IQR 13–15) among nurses with >10 years of experience. The Mann–Whitney U test indicated a statistically significant difference ($p < 0.001$), showing higher self-reported overall adherence in the more experienced group.

Table 3 – Self-reported IPC practices among hospice nurses (n = 32)

Indicator	≤10 years (n = 17)	>10 years (n = 15)	p-value
C1. I wash my hands before and after caring for each patient	12 (70.6%)	14 (93.3%)	0.118
C2. I wash my hands immediately after contact with blood/body fluids	14 (82.4%)	15 (100%)	0.228
C3. I dispose of needles in a sharps container	17 (100%)	15 (100%)	—
C4. I never recap a used needle	10 (58.8%)	12 (80.0%)	0.283
C5. I use gloves when changing dressings/pressure ulcers	14 (82.4%)	15 (100%)	0.228
C6. I wear a mask when there is a risk of aerosol transmission	13 (76.5%)	14 (93.3%)	0.353
C7. I change my gown promptly when contaminated	15 (88.2%)	15 (100%)	0.487
C8. I use an apron when caring for wounds/stomas	11 (64.7%)	13 (86.7%)	0.184
C9. I cover my own cuts/wounds before duty	12 (70.6%)	14 (93.3%)	0.118
C10. I am vaccinated against hepatitis B	10 (58.8%)	12 (80.0%)	0.283
C11. I do not eat or drink in the working area	16 (94.1%)	15 (100%)	0.999
C12. Sustained a needle-stick injury in the past year	3 (17.6%) "Yes"	2 (13.3%) "Yes"	0.999

Indicator	≤10 years (n = 17)	>10 years (n = 15)	p-value
C13. I disinfect equipment with 0.5% chlorine solution	17 (100%)	15 (100%)	—
C14. Soaking time = 10 minutes	15 (88.2%)	15 (100%)	0.487
C15. I sort waste by category	17 (100%)	15 (100%)	—

Note. *For C12, the table presents the proportion answering "Yes" to a needle-stick injury in the previous year; the score was reverse coded, with "No" treated as the correct/safe response. Item-level p-values are exploratory and unadjusted.*



Figure 2 - Box-and-whisker plots of total IPC practice scores among hospice nurses by work experience group

Resource availability

All participants reported availability of alcohol-based hand-rub dispensers at ward entrances, sharps containers in procedure areas, and color-coded waste bags. Regular IPC training was reported as being provided for staff by 15/17 (88.2%) nurses in the ≤10-year group and 13/15 (86.7%) in the >10-year group (p = 0.999). This organizational availability measure should be distinguished from actual training attendance: only 19/32 participants (59.4%) reported having completed IPC training within the preceding 12 months.

Table 4 - Reported resource availability for IPC in the hospice (n = 32)

Indicator	≤10 years of experience (n = 17)	>10 years of experience (n = 15)	p-value
D1. Alcohol-based hand-rub dispensers installed at ward entrances	17 (100%)	15 (100%)	—
D2. Sharps containers available in all procedure areas	17 (100%)	15 (100%)	—
D3. Color-coded waste bags consistently available	17 (100%)	15 (100%)	—
D4. Regular IPC training provided for staff	15 (88.2%)	13 (86.7%)	0.999

Note. *D4 refers to perceived provision/availability of regular staff training, not to individual completion of IPC training within the previous 12 months.*

Discussion

This study assessed IPC knowledge/awareness, self-reported practices, and structural resource availability among hospice nurses in Almaty. The overall knowledge/awareness score was high (mean 14.6/18), and all participants met the study's operational ≥50% threshold. No statistically significant overall difference in knowledge/awareness was reported between nurses with ≤10 and >10 years of experience. The remaining gaps were concentrated in more specialized areas, including TB/HIV protocols, isolation procedures, and post-exposure management.

Self-reported practice showed greater variability. Regulated procedures such as sharps disposal, waste segregation, chlorine-based disinfection, and the specified soaking time were reported with very high adherence. In contrast, personal-protection behaviors—especially hand hygiene, mask and apron use, and covering skin breaks—were less consistent among nurses with ≤10 years of experience. The total practice score was significantly higher in the >10-year group (median 14 vs. 11; $p < 0.001$). Because this was a cross-sectional, unadjusted group comparison, the result indicates an association with work experience rather than proof that experience itself caused better adherence.

Structural support for IPC was strong for the three physical-resource indicators: all nurses reported access to hand-rub dispensers, sharps containers, and color-coded waste bags. Training indicators require more careful interpretation. Although 87.5% of participants reported that regular IPC training was provided within the institution, only 59.4% reported that they had personally completed IPC training in the preceding 12 months. The difference may reflect scheduling, participation, or wording of the questionnaire and should not be interpreted as complete training coverage.

The findings are broadly consistent with international evidence showing that knowledge does not automatically translate into practice. In the Ethiopian CAUTI-prevention study, good knowledge and practice were 37.7% and 51.8%, and work experience and training were associated with better outcomes [11]. The Philippine study found good knowledge but suboptimal practice, with workload and PPE-related barriers [12]. Debre Tabor data similarly identified training and work experience as relevant to both knowledge and practice [13]. In Georgia, sufficient knowledge coexisted with incomplete adherence to infection-reduction recommendations, particularly under workload pressure [14]. Research from Yemen and Saudi Arabia, together with evidence from Türkiye, likewise supports continued education, structured assessment, and reinforcement of standard precautions [15–18]. Simulation-based IPC education has also been shown to improve knowledge, self-efficacy, and adherence to standard precautions, supporting the practical training approach proposed here [19].

Scientific novelty and practical implications

The study's contribution is primarily contextual and service-level rather than methodological. It provides an integrated assessment of IPC knowledge/awareness, self-reported practice, and resource availability in a hospice setting in Kazakhstan, an environment underrepresented in the published nursing IPC literature. The observed gap between high knowledge/awareness scores and lower self-reported personal-protection practices among less experienced staff identifies a practical target for local quality-improvement work. Recurrent training should therefore emphasize behavior-based components - hand hygiene, correct PPE use, prevention and management of occupational exposure, and scenario-based simulation - alongside routine audit and feedback.

Strengths and limitations

The study has several strengths: it addresses a clinically vulnerable palliative-care setting, combines individual and organizational IPC domains, uses a previously published questionnaire as the basis for measurement, and reports both total scores and item-level patterns. However, the findings must be interpreted in light of important limitations.

The sample was small (n = 32), single-center, and entirely female, limiting generalizability. The cross-sectional design does not establish causality. Practice was self-reported rather than directly observed and is therefore vulnerable to recall and social-desirability bias despite use of sealed envelopes. The locally adapted instrument underwent only a small feasibility pilot, and psychometric validation in the Kazakhstan hospice context was not reported. The 50% threshold for "adequate" knowledge/practice is permissive and should be regarded as an operational study definition rather than an external clinical standard. The knowledge/awareness domain also includes several organizational or training items, which limits construct purity. Multiple item-level comparisons were conducted without multiplicity correction, and effect sizes and confidence intervals for the main group comparison were not reported. Finally, no patient-level infection outcomes were measured, so the clinical effect of the reported practices cannot be inferred.

Conclusion

Hospice nurses demonstrated high IPC knowledge/awareness and strong reported availability of essential IPC supplies, but self-reported personal-protection practices were less consistent among nurses with ≤10 years of experience. The significant difference in total practice scores supports targeted, recurrent, behavior-focused education for less experienced staff. Simulation-based training, reinforcement of PPE and hand-hygiene protocols, and routine audit and feedback may help narrow the knowledge–practice gap and strengthen occupational and patient safety.

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Declarations

Ethics approval and consent to participate

The study was approved by the local ethics committee. All participants were informed about the aims and procedures of the study and provided written informed consent before participation. Participation was voluntary, confidentiality was ensured, and participants had the right to withdraw from the study at any time without any consequences. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Participant safety and confidentiality

The study involved completion of a self-administered questionnaire and did not include any intervention or alteration of routine clinical care. Completed questionnaires were returned individually in sealed envelopes to protect confidentiality and reduce the risk of social desirability bias. No directly identifying personal information was used in the analysis.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available because no public repository or formal data-sharing mechanism was established for this study. De-identified data may be made available upon reasonable request, subject to approval by the authors, the institution, and the responsible ethics committee.

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The authors declare that they have no conflicts of interest related to this study.

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Kataeva A.K.: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draft. **Baymuratova M.A.:** Conceptualization, Methodology, Supervision, Project administration, Writing – review and editing. **Alibayeva G.A.:** Methodology, Validation, Writing – review and editing. **Omarova A.A.:** Investigation, Resources, Project administration. **Saussanova D.Zh.:** Formal analysis, Visualization, Writing – review and editing. **Abdukalikova D.B.:** Methodology, Validation, Supervision, Writing – review and editing. **Toigombaeva V.S.:** Validation, Supervision, Writing – review and editing. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for their respective contributions.

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Декларации
Одобрение этического комитета и информированное согласие на участие
Исследование было одобрено локальным этическим комитетом. Все участники были проинформированы о целях и процедурах исследования и до включения в исследование

предоставили письменное информированное согласие. Участие было добровольным, конфиденциальность обеспечивалась, участники имели право отказаться от дальнейшего участия в любое время без каких-либо последствий. Исследование проводилось в соответствии с принципами Хельсинкской декларации.

Безопасность участников и конфиденциальность

Исследование предусматривало заполнение самостоятельно администрируемой анкеты и не включало каких-либо вмешательств или изменений стандартной клинической помощи. Заполненные анкеты возвращались индивидуально в запечатанных конвертах для обеспечения конфиденциальности и снижения риска систематической ошибки социальной желательности. Персональные данные, позволяющие непосредственно идентифицировать участников, при анализе не использовались.

Доступность данных

Наборы данных, полученные и/или проанализированные в рамках настоящего исследования, не размещены в открытом доступе, поскольку для данного исследования не был создан публичный репозиторий или формальный механизм обмена данными. Обезличенные данные могут быть предоставлены по обоснованному запросу при условии одобрения авторами, учреждением и ответственным этическим комитетом.

Финансирование

Исследование не получало внешней финансовой поддержки.

Конфликт интересов

Авторы заявляют об отсутствии конфликта интересов, связанного с настоящим исследованием.

Вклад авторов:

Катаева А.К.: концептуализация, методология, проведение исследования, курирование данных, формальный анализ, визуализация, написание первоначального варианта рукописи. **Баймуратова М.А.:** концептуализация, методология, научное руководство, администрирование проекта, рецензирование и редактирование рукописи. **Алибаева Г.А.:** методология, валидация, рецензирование и редактирование рукописи. **Омарова А.А.:** проведение исследования, обеспечение ресурсами, администрирование проекта. **Саусанова Д.Ж.:** формальный анализ, визуализация, рецензирование и редактирование рукописи. **Абдукаликова Д.Б.:** методология, валидация, научное руководство, рецензирование и редактирование рукописи. **Тойгомбаева В.С.:** валидация, научное руководство, рецензирование и редактирование рукописи. Все авторы ознакомились с окончательной версией рукописи, одобрили её и согласились нести ответственность за соответствующий вклад в работу.

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Мәлімдемелер

Этикалық мақұлдау және зерттеуге қатысуға ақпараттандырылған келісім
Зерттеу жергілікті этикалық комитетпен мақұлданды. Барлық қатысушыларға зерттеудің мақсаттары мен рәсімдері туралы ақпарат берілді және зерттеуге қатысар алдында олар жазбаша ақпараттандырылған келісім берді. Қатысу ерікті болды, құпиялылық қамтамасыз етілді және қатысушылар кез келген уақытта ешқандай салдарсыз зерттеуге одан әрі қатысудан бас тартуға құқылы болды. Зерттеу Хельсинки декларациясының қағидаттарына сәйкес жүргізілді.

Қатысушылардың қауіпсіздігі және құпиялылық
Зерттеу өздігінен толтырылатын сауалнаманы пайдалануды көздеді және стандартты клиникалық көмекке қандай да бір араласуды немесе өзгеріс енгізуді қамтымады. Құпиялылықты қамтамасыз ету және әлеуметтік тұрғыдан қолайлы жауап беру жүйелік қатесінің ықтималдығын азайту мақсатында толтырылған сауалнамалар жеке-жеке жабық конверттерде қайтарылды. Талдау барысында қатысушыларды тікелей сәйкестендіруге мүмкіндік беретін дербес мәліметтер пайдаланылған жоқ.

Деректердің қолжетімділігі
Осы зерттеу барысында алынған және/немесе талданған деректер жиынтығы ашық қолжетімділікте орналастырылмаған, себебі зерттеу үшін қоғамдық репозиторий немесе деректермен алмасудың ресми тетігі құрылмаған. Иесіздендірілген деректер негізделген сұрау бойынша авторлардың, мекеменің және жауапты этикалық комитеттің мақұлдауымен ұсынылуы мүмкін.

Қаржыландыру
Зерттеу сыртқы қаржылық қолдау алған жоқ.

Мүдделер қақтығысы
Авторлар осы зерттеуге байланысты мүдделер қақтығысының жоқ екенін мәлімдейді.

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қолжазбаның соңғы нұсқасымен танысып, оны мақұлдады және зерттеуге қосқан тиісті үлесі үшін жауапкершілік алуға келісті.

Алғыс

Авторлар зерттеуге қатысқан барлық мейіргерлерге уақыт бөліп, ашықтық танытып, зерттеуге құнды үлес қосқаны үшін шынайы алғыс білдіреді.

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