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# Assessment of Knowledge, Attitudes, and Practices Regarding Surgical Instrument Processing and Packaging among Central Sterile Supply Department Staff in Multan, Pakistan

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**Declaration:**

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A.J.: Conceptualization, methodology, original draft, supervision, project administration. M.E.: Methodology, investigation, review and editing. H.K.: Investigation, data curation, validation, review and editing. F.A.: Formal analysis, visualization, original draft. S.M.M.: Investigation, resources, review and editing.

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## ABSTRACT

**Background:** The safe reprocessing of reusable surgical instruments relies on the ability to clean, inspect, package, sterilize, and handle the instruments in the Central Sterile Supply Department (CSSD). There is little local descriptive evidence from Multan. The aim of this study was to evaluate the knowledge, attitudes and self-reported practices of the CSSD staff about instrument processing and packaging.

**Methods:** The study was descriptive cross-sectional study with non-probability convenience sampling of 102 CSSD staff members in hospitals in Multan, Pakistan for four weeks. Knowledge (14 items), self-reported practice (10 items), and attitudes (9 items) were measured using a structured questionnaire adapted from published CSSD instruments. Face and content validity were assessed by three experts, and a pilot test was conducted with 15 staff.

**Results:** The mean agreement for the attitude items was 87.75%. The mean "always" responses for the practice items were 56.96% and the mean "very well informed" responses for the knowledge items were 51.39%. The lowest self-reported knowledge was for distinguishing rigid, semi-rigid and flexible scopes (40.2%) and spill-kit use (49.0%). The least common "always" practice answers were for instrument lubrication (45.1%) and routine equipment-validation testing (53.9%).

**Conclusion:** Attitudes were mostly positive and self-reported familiarity was wide, although there were inconsistencies in the technical tasks. These can be addressed through targeted competency-based training, supervision, and visual job aids. Findings are self-reported, convenience-based, and descriptive, and do not form statistically tested knowledge-practice associations or observed competence.

**Keywords:** *Sterilization; Surgical Instruments; Health Knowledge, Attitudes, Practice; Central Sterile Supply Department; Instrument Processing; Packaging*

## INTRODUCTION

Safe processing and packaging of reusable surgical instruments is an essential part of sterile-service delivery. Errors in any of the sequential activities of reprocessing can affect the safety of reusable devices, such as cleaning, inspection, preparation, packaging, sterilization, storage, and distribution. The World Health Organization stresses that these processes need to be supported by adequate infrastructure, equipment, standard procedures and quality control.[1] Packaging plays a crucial role in this cycle as it helps to keep processed instruments in good condition and allows the sterilizing agents to penetrate the device while keeping the contents safe during storage and transportation. Therefore, package integrity, proper preparation, and quality assurance are critical aspects of safe sterile processing.[1]

Evidence from Central Sterile Supply Department (CSSD) settings shows that packaging and processing errors continue to be measurable quality issues. These studies from China indicate that, in addition to equipment, staff knowledge, technical competence, and organizational processes are important factors in achieving reliable sterile processing.[2,3] Quality improvement methods have also been found to improve CSSD performance. The evidence from China also indicates that packaging errors can be identified systematically, and that a structured approach to monitoring can lead to improvements in CSSD monitoring indicators, while a quality improvement intervention using action research can lead to a reduction in packaging defects.[2,4,5] This evidence highlights the importance of identifying specific gaps in routine staff practices before introducing targeted corrective measures.

Because CSSD staff are involved in various phases of instrument reprocessing, they must be knowledgeable about infection prevention, equipment operation, packaging, indicators, and safe handling.[6] The findings of the two studies conducted in Saudi Ministry of Defence hospitals and Saudi Ministry of Health hospitals cannot be directly compared with the present descriptive percentages, as the instruments and scoring systems were different, but they show variation in KAP profiles across CSSD settings.[7,8] There is also evidence from Pakistan. While the population was larger than that of CSSD personnel and the instrument was different, the results of the 2024 study of healthcare professionals in Peshawar showed that 88% of the participants had positive attitudes toward infection prevention and 58% were compliant with practice measures,[9] highlighting the need to investigate whether positive attitudes are followed by consistent implementation of infection-prevention measures.

Training and quality assurance are factors that can be changed in sterile-processing systems. A brief training programme was also found to improve sterile-processing knowledge and practices in hospitals in Ethiopia,[10] and a 360-degree assessment of CSSD staff in Iran showed differences in performance across the various domains,[11] suggesting that structured assessment can be used to identify areas for improvement. Although the performance of CSSD is important, there is limited locally relevant descriptive evidence of knowledge, attitudes and routine practices of CSSD staff in Multan. The creation of this baseline information could be useful for identifying areas for ongoing education and quality improvement and for context in future observational or interventional studies.

### Objectives

1. To evaluate the knowledge of the staff of CSSD about the standard surgical instrument processing, sterilization and packaging procedure in hospitals in Multan.
2. To report the attitudes and self-reported routine practices of CSSD staff towards infection prevention, safety measures, instrument handling, packaging and following sterilization related procedures.

## METHODS

### Study Design

The descriptive cross sectional study design was employed to get a description of knowledge, attitudes and self-reported practices of CSSD personnel at the same time. The design was chosen because the study purpose was to describe the current KAP profile at one time and not to test an intervention or to make causal inferences.


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**Study Settings**

The study was carried out with the staff of CSSD in different hospitals of Multan, Pakistan. Hospitals that participated were chosen based on accessibility and the availability of working CSSD departments that had staff members involved in surgical-instrument reprocessing. The data collection lasted for about 4 weeks.

**Data Sources**

A structured questionnaire was developed based on previously published KAP questionnaires for CSSD staff and was face and content validated by three subject-matter experts who have experience in sterile processing and infection control.[7,8] A pilot test was performed with 15 CSSD staff members from a non-participating hospital to evaluate clarity, comprehensibility and feasibility. The questionnaire was revised based on feedback from the pilot and the pilot responses were not included in the final analysis. The final instrument consisted of demographic/background questions and three KAP domains. The original study did not include formal internal-consistency reliability testing (e.g., Cronbach's alpha) and is therefore not inferred from the pilot exercise but rather reported as a methodological limitation.

**Study Population**

The study population consisted of CSSD staff (technicians, assistants, supervisors, and OT rotational staff) who participated in direct surgical-instrument reprocessing in the participating hospitals. All staff who were available and willing to participate in the data collection period were invited.

**Inclusion criteria:** CSSD staff directly involved in instrument reprocessing; willingness to give written informed consent.

**Exclusion criteria:** Staff on leave during the study period, administrative staff not involved in instrument processing, pilot study participants.

**Sample Size**

No formal a priori statistical sample size calculation was done as the study aimed to include all eligible CSSD staff who were available at the participating hospitals during the four-week data collection period. Therefore, the recruitment was census-like within the accessible participating workforce, and the number of participants (102) achieved is the number available and willing to participate in the study period. This method was suitable for the desired descriptive goal, but it does not offer the same level of statistical accuracy or representativeness of the population as a probability-based sample, and this is recognized.

**Sampling Technique**

The recruitment was limited to eligible CSSD staff who were available at the participating hospitals during the data collection period, which is why non-probability convenience sampling was used. All available eligible personnel were invited to participate. Convenience sampling reduces generalizability to the hospitals that participated in the study, and this is considered when interpreting the results.

**Data Collection Methods**

A structured questionnaire was administered face-to-face. Demographic and background variables were gender, age, weekly working hours, and years of experience. The 14 items used to assess knowledge had four response options: Yes, very well; Yes, well; Yes, to some extent; No. Self-reported practice was measured with 10 items, each having four frequency response options (Always; Most of the time; Sometimes; Rare). Attitudes towards infection-control and safety procedures were measured with nine items, each with four response options (Strongly agree; Agree; Neutral; Disagree).

The questionnaire was filled out by the primary investigator at the participating hospitals during working hours and took about 10-15 minutes to complete. Completed questionnaires were retrieved immediately and checked for completeness. Participants were told that their answers would be anonymous and confidential and that they were encouraged to answer honestly. Social-desirability and interviewer-related response effects were taken into account in interpretation due to the face-to-face administration.


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The response scales were kept as in the study instrument. The knowledge and practice items were not validated continuous scales with clinical cut-offs, so item-level response proportions were reported instead of overall participants being assigned to arbitrary 'good', 'moderate' or 'poor' categories. The scale also did not include a strongly disagree response, which could have affected the distribution of agreement responses and is recognized as a limitation.

**Data Analysis Methods**

The data were analysed using SPSS version 27. Categorical variables were presented as frequencies and percentages. The distribution of responses for each KAP item was summarized as percentages. The reported mean percentages are descriptive summaries and are not psychometrically validated domain scores, as they are the arithmetic mean of the item-level response proportions within each domain (14 knowledge items, 10 practice items, and 9 attitude items). Since the study was descriptive in nature and the sample was convenience, no inferential statistical tests, correlation analysis, regression model or hypothesis testing was conducted. Therefore, apparent differences between knowledge and practice response patterns are described and not interpreted as statistically tested associations.

**Ethical Considerations**

The study was carried out in compliance with the ethical principles of the Declaration of Helsinki. The Institutional Ethical Review Board of Times University, Multan, Pakistan granted ethical approval. All participants gave written informed consent prior to data collection. Participants were told about the purpose of the study, that it was voluntary, that it would be confidential, anonymous, and that they could withdraw at any time without penalty. No personal information was gathered.

## RESULTS

**Demographic Characteristics**

There were 102 CSSD personnel involved. As shown in Table 1, 71 (69.6%) participants were male and 31 (30.4%) were female. Most participants were aged 20–30 years (66, 64.7%), followed by 31–40 years (22, 21.6%) and 41 years or older (14, 13.7%). The majority of participants (77, 75.5%) had 0-9 years of experience. Weekly working hours were less than 23 hours for 35 (34.3%), 23–47 hours for 41 (40.2%), and more than 47 hours for 26 (25.5%) participants.

**Table 1. Distribution of Study Population Characteristics (Frequency and Percentage) (N = 102)**

| Characteristic | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 71 | 69.6 |
| | Female | 31 | 30.4 |
| Age (years) | 20-30 | 66 | 64.7 |
| | 31-40 | 22 | 21.6 |
| | 41 and more | 14 | 13.7 |
| Weekly working hours | Less than 23 hours | 35 | 34.3 |
| | 23-47 hours | 41 | 40.2 |
| | More than 47 hours | 26 | 25.5 |
| Years of experience | 0-9 years | 77 | 75.5 |
| | 10 years and more | 25 | 24.5 |

**Knowledge of Sterilization and Packaging**

For the 14 knowledge items, no participant chose the 'No' answer, meaning that they reported being familiar with each of the items. The percentage choosing 'Yes, very well' was different for each item, however. The highest proportion was seen with correct hand hygiene technique (66.7%) and the lowest proportion was seen with distinguishing rigid, semi-rigid and flexible scopes (40.2%).


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**Table 2. Knowledge of the Study Population Toward Sterilization and Packaging Practice (N = 102)**

| Q# | Item | Yes, very well (%) | Yes, well (%) | Yes, to some extent (%) | No (%) |
|---|---|---|---|---|---|
| 1 | Correct method of hand hygiene | 66.7 | 25.5 | 7.8 | 0 |
| 2 | Proper donning and doffing technique of PPE | 52.0 | 33.3 | 14.7 | 0 |
| 3 | Safe handling of contaminated instruments | 55.9 | 28.4 | 15.7 | 0 |
| 4 | Correct method of operating the equipment/machines | 49.0 | 37.3 | 13.7 | 0 |
| 5 | Importance of pre-cleaning | 57.8 | 31.4 | 10.8 | 0 |
| 6 | Principle of manual cleaning | 52.9 | 28.4 | 18.6 | 0 |
| 7 | Usage of the spill kit and procedure to contain a hazard spill | 49.0 | 28.4 | 22.5 | 0 |
| 8 | Difference between rigid, semi-rigid, and flexible scopes | 40.2 | 40.2 | 19.6 | 0 |
| 9 | How to use tracking systems | 49.0 | 36.3 | 14.7 | 0 |
| 10 | Difference between thermal and chemical disinfection | 51.0 | 30.4 | 18.6 | 0 |
| 11 | Difference between packaging techniques | 53.9 | 32.4 | 13.7 | 0 |
| 12 | Spaulding classification | 46.1 | 38.2 | 15.7 | 0 |
| 13 | Difference between steam and low-temperature sterilization | 48.0 | 39.2 | 12.7 | 0 |
| 14 | Usage of chemical indicator/biological indicator | 52.0 | 35.3 | 12.7 | 0 |
| | **Mean (%)** | **51.39** | **33.07** | **15.21** | **0** |
| | **Minimum (%)** | **40.2** | **25.5** | **7.8** | **0** |
| | **Maximum (%)** | **66.7** | **40.2** | **22.5** | **0** |

The mean proportion of respondents who reported being ‘very well’ informed was 51.39% across the 14 knowledge items, with 33.07% reporting being ‘well’ informed and 15.21% reporting being informed ‘to some extent’. The lowest proportions of ‘very well’ responses were for scope classification (40.2%), Spaulding classification (46.1%), steam versus low-temperature sterilization (48.0%), equipment operation (49.0%), spill-kit use/hazard-spill containment (49.0%), and tracking systems (49.0%).


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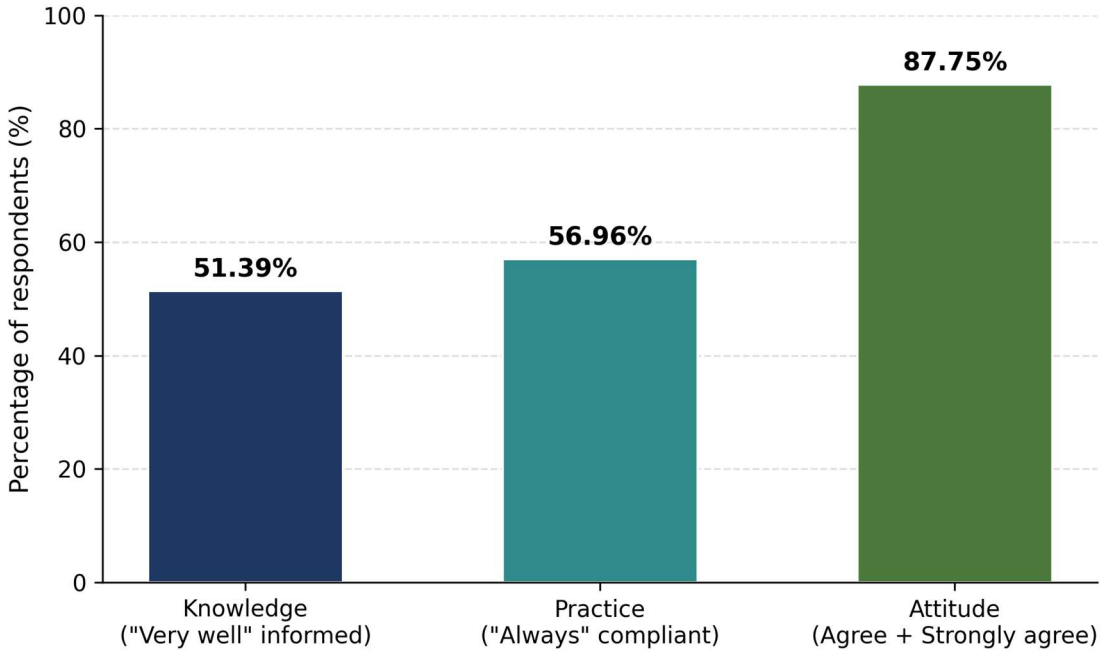


Figure 1. Mean percentage of respondents selecting the highest response category within each KAP domain: 'very well' informed for knowledge, 'always' for practice, and combined 'agree/strongly agree' for attitudes. These are descriptive item-level averages, not validated overall KAP scores.

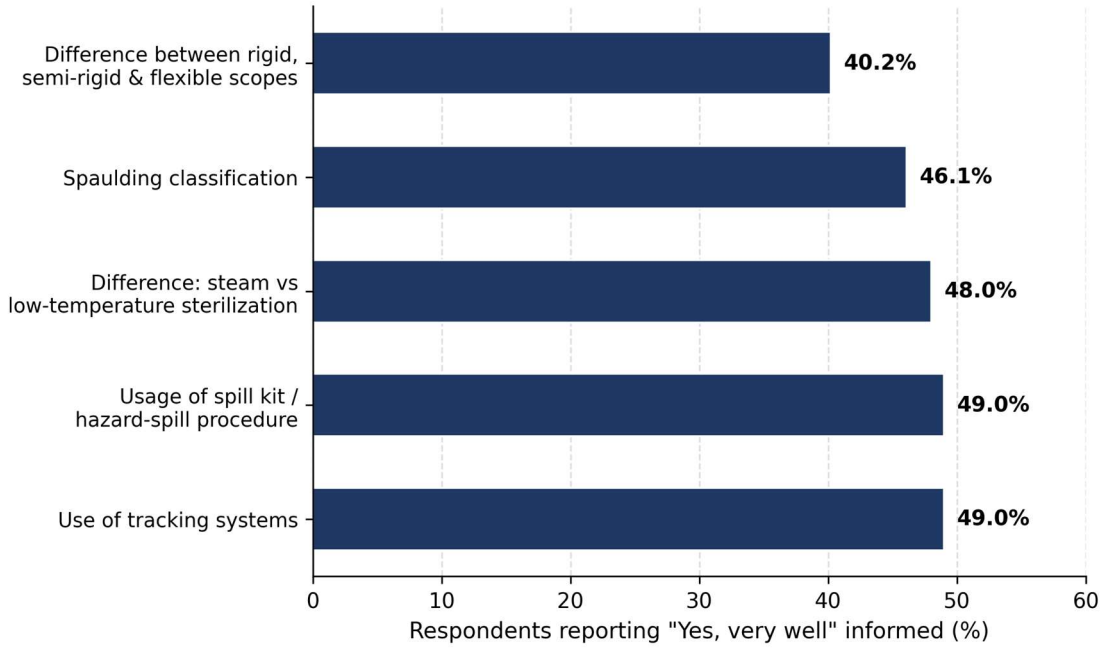


**Figure 2. Knowledge items with the lowest proportions of 'very well informed' responses.**

**Practice of Sterilization and Packaging**

Self-reported practice was different for the 10 activities assessed (Table 3). The highest percentages of 'always' were seen for implementing manufacturer instructions (60.8%), placing biohazard signage during contaminated transport (60.8%) and using complete PPE in contaminated areas (60.8%). The smallest percentage of respondents reporting 'always' was for lubricating moving parts of surgical instruments (45.1%) and routine equipment-validation testing


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(53.9%). The mean proportion reporting 'always' was 56.96% across the 10 practice items, 24.22% 'most of the time', 13.53% 'sometimes' and 5.29% 'rare'.

**Table 3. Practice of the Study Population Toward Sterilization and Packaging (N = 102)**

| Q# | Item | Always (%) | Most of the time (%) | Sometimes (%) | Rare (%) |
|---|---|---|---|---|---|
| 1 | Implement manufacturer instructions (IFU) for device processing | 60.8 | 23.5 | 8.8 | 6.9 |
| 2 | Place biohazard signage during contaminated transport | 60.8 | 22.5 | 9.8 | 6.9 |
| 3 | Lubricate moving parts of surgical instruments | 45.1 | 27.5 | 20.6 | 6.9 |
| 4 | Manual pre-cleaning prior to washer-disinfector loading | 52.0 | 25.5 | 17.6 | 4.9 |
| 5 | Conduct routine validation tests of equipment | 53.9 | 24.5 | 14.7 | 6.9 |
| 6 | Inspect devices post-processing for damage/cleanliness | 58.8 | 19.6 | 16.7 | 4.9 |
| 7 | Verify sterilizer parameters for each cycle | 59.8 | 21.6 | 14.7 | 3.9 |
| 8 | Allow adequate instrument cooling post-sterilization | 59.8 | 27.5 | 9.8 | 2.9 |
| 9 | Utilize complete PPE in contaminated areas | 60.8 | 23.5 | 11.8 | 3.9 |
| 10 | Perform regular sterilizer testing protocols | 57.8 | 26.5 | 10.8 | 4.9 |
| | **Mean (%)** | **56.96** | **24.22** | **13.53** | **5.29** |
| | **Minimum (%)** | **45.1** | **19.6** | **8.8** | **2.9** |
| | **Maximum (%)** | **60.8** | **27.5** | **20.6** | **6.9** |

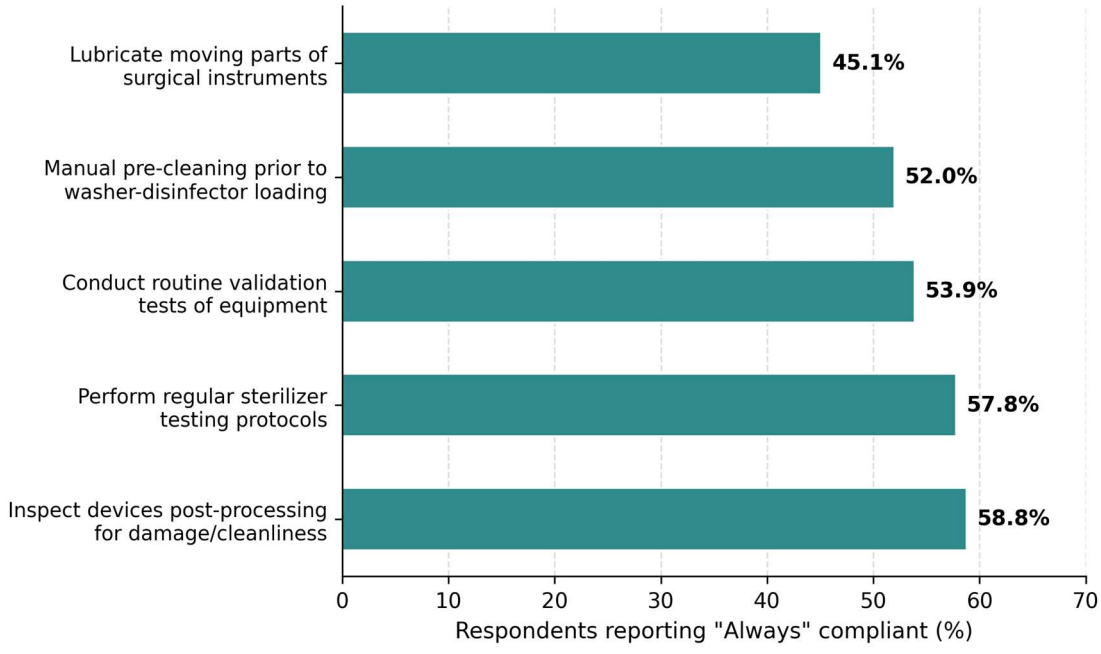



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**Figure 3. Practice items with the lowest proportions of respondents reporting 'always' compliance.**

**Attitude Toward Sterilization Practices**

The majority of the nine statements measured had positive attitude responses (Table 4). The highest combined agreement was for receiving training in spill-kit use (95.1%), followed by testing sterilizers before operation (93.1%) and orderly arrangement of devices to ensure surface exposure (88.3%). The lowest combined agreement (77.4%) and highest disagreement (8.8%) and neutral response (13.7%) was for the statement on minimum PPE in clean areas. The average percentage of responses that agreed (agree or strongly agree) was 87.75% for all nine items.

**Table 4. Attitude of the Study Population Toward Sterilization Practices (N = 102)**

| Q# | Item | Strongly agree (%) | Agree (%) | Neutral (%) | Disagree (%) |
|---|---|---|---|---|---|
| 1 | CSSD staff should wear minimum PPE (gloves, mask) in a clean area | 48.0 | 29.4 | 13.7 | 8.8 |
| 2 | CSSD staff should perform hand hygiene before/after entering the work area | 53.9 | 35.3 | 6.9 | 3.9 |
| 3 | CSSD staff should arrange devices orderly to ensure full surface exposure | 61.8 | 26.5 | 7.8 | 3.9 |
| 4 | CSSD staff should know how to handle sharp disposable items received in error | 64.7 | 24.5 | 7.8 | 2.9 |
| 5 | CSSD staff should receive proper spill-kit usage training | 67.6 | 27.5 | 0 | 4.9 |
| 6 | CSSD staff should correctly open/disassemble devices during manual cleaning | 53.9 | 28.4 | 10.8 | 6.9 |
| 7 | CSSD staff should dry instruments after manual cleaning | 57.8 | 28.4 | 9.8 | 3.9 |
| 8 | CSSD staff should follow correct donning/doffing sequences for PPE | 55.9 | 32.4 | 7.8 | 3.9 |
| 9 | CSSD staff should test the sterilizer before operation (leak, Bowie-Dick, BI tests) | 59.8 | 33.3 | 2.0 | 4.9 |
| | **Mean (%)** | **58.17** | **29.58** | **7.44** | **4.89** |
| | **Minimum (%)** | **48.0** | **24.5** | **0** | **2.9** |
| | **Maximum (%)** | **67.6** | **35.3** | **13.7** | **8.8** |

The present study gives descriptive baseline data about the staff of CSSD in Multan. Continuing competency development may be especially important in this workforce, as most participants had less than 10 years of experience (75.5%). The cross-sectional design and the absence of direct observation, however, preclude the interpretation of experience as a determinant of performance.

The knowledge findings reveal a high level of self-reported knowledge and confidence in general, but not in all technical topics. Only 40.2% said they were 'very well' informed about the difference between rigid, semi-rigid and flexible scopes, and 49.0% said they were 'very well' informed about the use of spill-kits. A recent CSSD KAP study conducted in Saudi Arabia also discussed these areas, in which knowledge gaps included spill-kit use and scope distinctions.7 The similarity is significant as it indicates that there may be technically specific tasks that should be addressed in various CSSD settings, but the instruments and scoring methods were different and direct numerical comparison is not appropriate.

The practice findings also reveal that compliance with the routine was not consistent. The lowest 'always' response was for instrument lubrication (45.1%), and routine equipment-validation testing was reported by 53.9% as 'always'


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performed. These results are in line with the general evidence that the quality of sterile processing is dependent on the reliability of the performance at several sequential steps and not on a single endpoint. WHO guidance focuses on quality assurance and validation throughout the reprocessing cycle,[1] and studies of packaging, CSSD management, adverse events and staff-reported instrument errors have identified process-specific deficiencies and opportunities for quality improvement.[3,12–14]

## DISCUSSION

The attitude profile was more consistently positive than the item-level knowledge and practice profiles, with a mean 87.75% combined agreement across the nine statements. The pattern should be interpreted with caution as the attitude instrument was not a strongly disagree/agree scale, and the study did not compute a validated attitude score. However, the overall agreement is consistent with the results of other studies conducted in CSSD settings in Pakistan and other settings that reported positive attitudes towards infection prevention or sterilization.[7–9] Differences in populations, questionnaires, and scoring systems between studies make it difficult to rank the levels of attitudes.

The observed pattern is also applicable to the difference between knowledge and implementation. The present study did not statistically test a knowledge-practice association and thus cannot infer a 'knowledge-practice gap' in the inferential sense. However, descriptively, the mean proportion of 'very well informed' knowledge responses (51.39%) was lower than the mean proportion of 'always' practice responses (56.96%) and individual technical items had variable confidence and compliance. The results should be interpreted as item-level response patterns and not as evidence of the causal or predictive relationship between knowledge and practice.

Future evaluation of training and structured quality-improvement systems may be reasonable. Fast et al. Reported improvements in sterile-processing knowledge and practices following a short-term training programme in 12 Ethiopian hospitals,[10] while Pan et al. reported reductions in packaging defects after an action-research quality-improvement intervention.[5] The present study does not evaluate an intervention, so these findings should be used to support future testing rather than as evidence that training would necessarily improve the current participants' performance.

In general, the results indicate that specific educational focus is needed for the areas that are not responding as well, such as scope classification, spill management, instrument lubrication, and equipment validation. These recommendations should be used in conjunction with local protocols, manufacturer instructions, competency assessment and quality-assurance systems. Future research should rely on direct observation and, if possible, probability-based multicentre sampling to assess if the patterns of self-reported sterile processing observed here reflect actual sterile processing performance.

The present descriptive cross-sectional study revealed that the attitude responses were generally positive and the self-reported knowledge of the CSSD personnel (102) about the topics of sterile processing was broad in Multan. The mean proportion of 'very well informed' responses for the knowledge items was 51.39%, the mean proportion of 'always' for the practice items was 56.96%, and the mean proportion of combined agreement for the attitude items was 87.75%. The lowest knowledge response proportions were for technically specific topics (scope classification and spill-kit use) and the lowest 'always' practice responses were for instrument lubrication and equipment validation. The results of these findings indicate specific domains for competency-based quality improvement, but do not provide causal or statistically tested relationships between KAP domains.

The results provide support for targeted continuing education, competency reinforcement in practice, and quality assurance of supervision in the specific areas identified by the results of the items. Recommendations should be consistent with institutional policies, manufacturer instructions, and applicable sterile-processing standards. Since practices were self-reported, future research should involve direct observation or objective competency assessment to determine if reported gaps are actual procedural deficiencies.


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## IMPLICATIONS

Competency-based refresher training and visual job aids for scope classification, spill management, instrument lubrication, and equipment-validation procedures may be considered for hospitals. Periodic competency assessment and documentation of quality-control activities may complement training. These findings could be replicated and generalized in future multicentre studies based on direct observation and probability sampling. Interventional studies could then assess whether specific training or quality improvement efforts result in better objective packaging and reprocessing performance.

## STRENGTHS

This study aims to fill a locally relevant gap in the evidence by providing a description of KAP-related responses of the CSSD personnel in Multan. The questionnaire was modified from previously published CSSD KAP questionnaires, pre-tested and reviewed by three subject-matter experts. Overall KAP cut-offs are not validated and reporting at the item level can highlight specific areas for potential quality improvement.

## LIMITATIONS

There are a number of restrictions to be taken into account. First, the convenience recruitment from easily accessible hospitals restricts the generalizability of the results beyond the participating hospitals. Second, the sample size of 102 was not calculated using a formal probability-based or power-based sample size calculation. Third, all practice data were self-reported and could have been influenced by recall and social-desirability bias, which may have been exacerbated by the face-to-face administration. Fourth, the adapted questionnaire was not tested for formal internal-consistency reliability. Fifth, the attitude response scale lacked a strongly disagree response, which could have influenced response distributions. Sixth, the study employed descriptive statistics only and no inferential tests were conducted, therefore apparent differences in the pattern of KAP responses should not be interpreted as statistically significant associations. Lastly, staffing, workload, resource availability, supervisory practices, and facility-level quality systems were not directly measured. The cross-sectional design also does not allow for causal inferences.

## DECLARATIONS

**Ethics approval and consent to participate:** The study was approved by the Institutional Ethical Review Board of Times University, Multan, Pakistan and participants gave informed consent. The study was carried out in compliance with the ethical principles for research on human subjects, such as the Declaration of Helsinki. All participants gave written informed consent before data collection. There was no coercion to participate, and anonymity and confidentiality were maintained by not collecting any personally identifiable information. Participants were informed of their right to withdraw from the study at any time without repercussions.

**Consent for publication:** Not applicable.

**Availability of data and materials:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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**Authors's Contributions:**

Anas Jahangir: Conceptualization, Methodology, Writing - original draft, Supervision, Project administration.
Mubashir Ejaz: Methodology, Investigation, Writing - review & editing.
Hira Khan: Investigation, Data curation, Validation, Writing - review & editing.
Fatima Ashraf: Formal analysis, Visualization, Writing - original draft.
Syed Muhammad Muzammil: Investigation, Resources, Writing – review & editing.

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