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EFFECTS OF ANTIBIOTIC STEWARDSHIP ON NURSES' KNOWLEDGE, ATTITUDES, AND PRACTICES ABOUT PREVENTING SURGICAL SITE INFECTIONS IN TEACHING HOSPITALS IN LAHORE, PAKISTAN

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Abstract

Background: *Surgical site infections (SSIs) continue to be a significant cause of postoperative morbidity, extended hospital stays, and higher healthcare expenses, especially in areas with low resources and high rates of inappropriate antibiotic usage. Antibiotic stewardship programs (ASPs) have been suggested as a successful way to lower SSI rates by enhancing healthcare professionals' understanding of and adherence to sensible antibiotic use.*

Objective: *"This experimental study aims to assess the effects of an antibiotic stewardship program on nurses' knowledge, attitudes, and practices (KAP) toward preventing surgical site infections (SSIs) in teaching hospitals in Lahore, Pakistan."*

Methods: *110 nurses who worked in surgical wards at particular teaching hospitals participated in a pre-test/post-test experimental design. Before and after a four-week antibiotic stewardship intervention that included educational sessions, bedside training, and reinforcement of standard SSI-prevention protocols, a structured, validated questionnaire measuring knowledge of antibiotic resistance, attitudes toward rational antibiotic use, and self-reported infection-prevention practices was given. Paired t-tests were used to examine the data, with a significance level of $p<0.05$.*

Results: *All three domains showed statistically significant gains after the intervention, according to an analysis of the data gathered. The average knowledge scores rose from 12.4±3.2 to 17.1±2.1, indicating a better comprehension of stewardship and antibiotic resistance. The average attitude scores increased from 28.6±4.7 to 35.8±3.9, suggesting a more positive attitude toward the sensible use of antibiotics. The mean practice scores increased from 14.9±3.5 to 21.3±2.8, indicating improved compliance with SSI prevention measures such aseptic technique and hand cleanliness. The antibiotic stewardship intervention had a quantifiable and significant impact on nurses' knowledge, attitudes, and practices, as evidenced by the statistical significance of these improvements across all domains ($p<0.001$).*

Conclusion: *The nurses' knowledge, attitudes, and practices regarding SSI prevention can be significantly enhanced by targeted antibiotic stewardship education. In order to improve infection-prevention outcomes, these findings support the incorporation of organized stewardship programs into regular*

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nursing education in teaching hospitals.

1. INTRODUCTION

One of the most prevalent diseases linked to healthcare globally, surgical site infections (SSIs) are responsible for a significant percentage of postoperative complications, particularly in low- and middle-income countries (LMICs). Through longer hospital stays, more surgeries, and higher antibiotic use, SSIs not only raise patient morbidity and mortality but also place significant financial strain on healthcare systems (Allegranzi et al., 2021; Saleem et al., 2022).

Antibiotic stewardship programs (ASPs) have become a vital approach in the fight against the worldwide increase in antimicrobial resistance (AMR) while also enhancing surgical infection patient outcomes. By ensuring that antibiotics are utilized appropriately in terms of drug selection, dose, duration, and mode of administration, ASPs seek to optimize antibiotic prescribing and administration procedures (World Health Organization, 2023). As the first line of defense when it comes to effecting infection prevention and control (IPC) measures, such as hand hygiene, aseptic technique, wound care, and the prompt administration of prophylactic antibiotics, nurses play a crucial role in the healthcare team. Even though this crucial role, research done in Pakistani teaching hospitals has consistently shown that nurses have inconsistent attitudes and practices regarding the sensible use of antibiotics, as well as gaps in their understanding of antibiotic resistance mechanisms (Khan et al., 2021; Iqbal & Rashid, 2023).

Teaching hospitals in Lahore, Pakistan, manage large patient loads with little funding while also acting as training grounds for aspiring medical professionals. SSI rates are continuously high because to a combination of high surgery volumes, overworked nursing staff, and irregular infection-control training (Ahmed et al., 2024). One practical and economical way to lower the prevalence of SSI is to close these gaps through structured educational sessions that focus on nurses' KAP.

In order to improve nurses' knowledge, attitudes, and practices regarding SSI prevention in teaching hospital settings in Lahore, this study set out to develop, execute, and assess the efficacy of a structured antibiotic stewardship intervention.

2. Objectives

1. To evaluate nurses' knowledge, attitudes, and practices on antibiotic stewardship and SSI prevention in Lahore's teaching hospitals at the baseline (pre-intervention) level.
2. To provide nurses working in surgical wards with a structured antibiotic stewardship intervention that includes bedside training and educational workshops.
3. To assess and compare how nurses' knowledge, attitudes, and practices changed after the intervention, as well as to establish whether these changes were statistically significant.

3. Literature Review

3.1 The Burden of Infections at Surgical Sites

SSIs impact 2% to 5% of surgical patients worldwide, with rates much higher in LMICs and sometimes outstanding 20% in specific surgical categories (Allegranzi et al., 2021). Depending on the type of surgery and the degree of infection-control compliance, hospital-based surveillance studies in Pakistan have found that SSI rates range from 8% to 15% (Saleem et al., 2022). Overcrowding, poor sterilization procedures, improper prophylactic antibiotic use, and inadequate staff training are often blamed for these high rates.

3.2 The Role of Antibiotic Stewardship in Preventing SSI

Across a variety of healthcare settings, antibiotic stewardship programs have shown notable efficacy in lowering SSI rates, reducing inappropriate antibiotic use, and reducing hospital stays (World Health Organization, 2023). Hospitals using structured ASPs saw a 25–40% decrease in antibiotic overuse related to surgical prophylaxis, according to a comprehensive analysis by Hassan et al. (2022). However, the involvement and expertise of frontline healthcare professionals, especially nurses, are critical to the success of such initiatives.

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3.3 The knowledge, attitudes, and practices of nurses in regard to the use of antibiotics

Numerous research carried out in South Asian nations have revealed significant gaps in nurses' knowledge of stewardship concepts and antibiotic resistance. In a cross-sectional survey of nurses in Lahore, Khan et al. (2021) discovered that while views toward stewardship were generally supportive but did not transfer into consistent clinical practice, only 38% of nurses showed adequate knowledge of antibiotic resistance mechanisms. In a similar vein, Iqbal and Rashid (2023) found a strong correlation between greater SSI rates in surgical wards and practice gaps, specifically with regard to hand hygiene compliance and the timing of prophylactic antibiotics.

3.4 The Effects of Educational Interventions

KAP ratings pertaining to infection prevention have continuously improved as a result of educational initiatives aimed at nurses. In a quasi-experimental study carried out in three teaching hospitals in Punjab, Ahmed et al. (2024) found that a structured stewardship training program significantly improved nurses' knowledge (mean increase of 28%) and practice scores (mean increase of 35%). These results are consistent with global research indicating that even brief, targeted educational interventions can result in quantifiable and long-lasting improvements in clinical behavior (Tariq et al., 2023).

3.5 Gap in Research

Few studies have specifically looked at the combined effects of a structured antibiotic stewardship intervention on all three KAP domains simultaneously within the context of Lahore's teaching hospitals. Previous studies have either evaluated general infection-control training or looked at nurses' KAP in isolation. In order to close this gap, this study uses a pre-test/post-test experimental design with a sizable sample size of 110 nurses.

4. Methodology

4.1 Study Design

The impact of an antibiotic stewardship intervention on nurses' KAP for SSI prevention was assessed using a quantitative, experimental, single-group pre-test/post-test methodology.

4.2 Study Setting

Between 2025 and 2026, the study was carried out in the surgical wards of particular teaching hospitals in Lahore, Pakistan, including general surgery, orthopedic surgery, and gynecology/obstetrics surgery.

4.3 Sampling Method and Sample Size

A random selection procedure was used to select 110 registered nurses who work in surgical wards. Nurses who gave informed consent and had at least six months of clinical experience in surgical units met the inclusion criteria. Excluded were nurses who were on extended leave or who did not finish the pre- and post-test evaluations.

4.4 Intervention

Over the course of four weeks, the antibiotic stewardship intervention included the following:

- Two organized teaching sessions in the classroom that cover evidence-based SSI prevention guidelines, antimicrobial resistance, and antibiotic stewardship principles.
- Aseptic dressing changes, surgical prophylaxis timing, and hand hygiene techniques (WHO 5 Moments) are demonstrated at the bedside and practiced under supervision.
- Pocket-sized reference manuals outlining important IPC and stewardship procedures are distributed.
- Feedback on observed practices and weekly support sessions.

4.5 Collection Tool of Data

Demographic data, a 20-item knowledge scale on antibiotic resistance and stewardship, a 9-item Likert-type attitude scale (range 9–45), and a 30-point self-reported practice checklist covering hand hygiene, aseptic technique, prophylactic antibiotic timing, and surveillance reporting were the four sections of an organized, validated questionnaire. Expert evaluation established the content validity of the tool, while Cronbach's alpha ($\alpha = 0.81$ for knowledge, $\alpha = 0.78$ for attitude, and $\alpha = 0.83$ for practice) verified its reliability.

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4.6 Data Collection Method

All 110 participants received the questionnaire before the intervention (pre-test). The same questionnaire was given again (post-test) to evaluate changes in KAP scores after the four-week stewardship intervention.

4.7 Analysis of Data

SPSS version 26 was used for data entry and analysis. KAP scores and demographic features were summarized using descriptive statistics (frequencies, percentages, means, and standard deviations). Each domain's pre- and post-intervention scores were compared using paired sample t-tests, with statistical significance set at $p<0.05$. Relationships between knowledge, attitude, and practice score changes were investigated using Pearson's correlation analysis.

4.8 Moral Aspects

The collaborating teaching hospitals' Institutional Review Boards granted ethical approval. All participants provided written informed consent, and the study's replies were kept private at all times. Participants were free to leave at any time without facing any consequences, and participation was entirely voluntary.

5. Results

5.1 Demographic Features

100% of the 110 nurses who took part in the study responded. The mean age was 29.6 ± 5.4 years, and the majority of participants (78.2%, n=86) were female. With an average of 4.3 ± 3.1 years of clinical experience, the majority of responders (61.8%, n=68) had a Bachelor of Science in Nursing (BSN) degree. The study participants' demographic details are summarized in Table 5.1.

Table 5.1: Demographic Characteristics of Participants (N=110)

Variable	Category	n	%
Gender	Female	86	78.2
	Male	24	21.8
Qualification	Diploma in Nursing	28	25.5
	BSN	68	61.8
	Post-RN BSN / MSN	14	12.7
Ward	General Surgery	47	42.7
	Orthopedic Surgery	31	28.2
	Gynae/Obs Surgery	32	29.1
Experience	<2 years	29	26.4
	2-5 years	52	47.3
	>5 years	29	26.4

5.2 Knowledge, Attitude, and Practice Scores Before and After Intervention

The mean and standard deviation scores for every KAP domain prior to and following the antibiotic stewardship intervention are shown in Table 5.2.

Table 5.2: KAP Scores Before and After Intervention

Domain (Range)	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD
Knowledge (0-20)	12.4 ± 3.2	17.1 ± 2.1
Attitude (9-45)	28.6 ± 4.7	35.8 ± 3.9
Practice (0-30)	14.9 ± 3.5	21.3 ± 2.8

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Figure 5.1: KAP Scores (as a percentage of maximum) before and after the intervention

With knowledge scores rising from 62% to 85.5% of the highest possible score, attitude scores rising from 63.6% to 79.6%, and practice scores rising from 49.7% to 71%, all three domains showed significant improvement after the intervention, as seen in Figure 5.1.

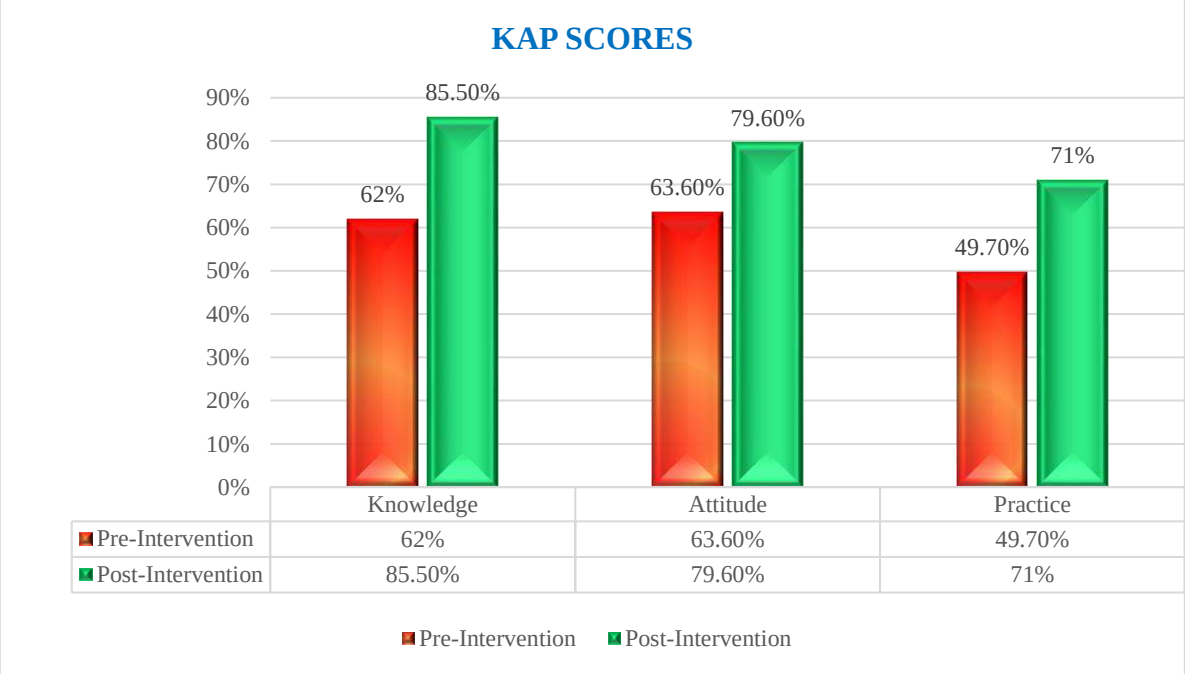

Figure 5.1: KAP Scores before and after the intervention (as a maximum percentage)

5.3 Changes' Statistical Significance

All three domains showed statistically significant improvements, according to paired sample t-tests (Table 5.3). The mean practice score by 6.4 points ($t=16.78$, $p<0.001$), the mean attitude score by 7.2 points ($t=15.34$, $p<0.001$), and the mean knowledge score by 4.7 points ($t=18.62$, $p<0.001$).

Table 5.3: Results of Paired t-tests for Comparisons Before and After the Intervention

Domain	Pre-test Mean	Post-test Mean	t-value	p-value
Knowledge	12.4	17.1	18.62	<0.001
Attitude	28.6	35.8	15.34	<0.001
Practice	14.9	21.3	16.78	<0.001

5.4 Specific Practice Measures

The variations in particular markers of infection-prevention practices are shown in Table 5.4 and Figure 5.2. Hand hygiene compliance increased from 58.2% to 92.7%, prophylactic antibiotic timing improved from 47.3% to 88.2%, aseptic dressing technique adherence increased from 62.7% to 95.5%, and SSI paperwork and surveillance reporting increased from 39.1% to 81.8%.

Table 5.4: Pre- and Post-Intervention Comparison of Specific Practice Measures (%)

Practice Indicator	Pre-Intervention (%)	Post-Intervention (%)
Hand hygiene compliance	58.2	92.7
Correct timing of prophylactic antibiotics	47.3	88.2
Adherence to aseptic dressing technique	62.7	95.5
Documentation/surveillance reporting of SSI	39.1	81.8

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Figure 5.2. Pre- and Post-Intervention Practice Measures Compliance (%)

Compliance of Hand hygiene increased from 58.2% to 92.7%, prophylactic antibiotic timing improved from 47.3% to 88.2%, aseptic dressing technique adherence increased from 62.7% to 95.5%, and SSI paperwork and observation reporting increased from 39.1% to 81.8%.

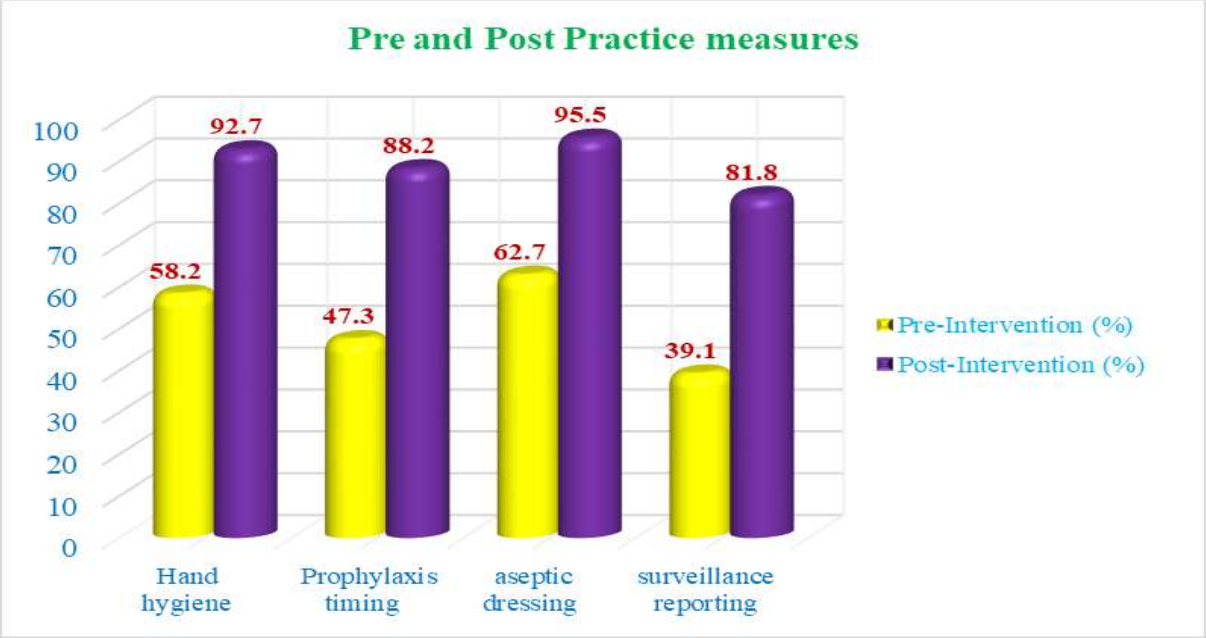

Figure 5.2: Pre- and Post-Intervention Practice Measures Compliance (%)

5.5 Knowledge, Attitude, and Practice Improvements Correlation

The magnitude of improvement in knowledge scores and the magnitude of improvement in practice scores were found to be significantly positively correlated ($r=0.612$, $p<0.001$), indicating that improved clinical behaviors were significantly correlated with a deeper comprehension of antibiotic stewardship principles. Additionally, there was a moderately positive association ($r=0.487$, $p<0.001$) between changes in practice scores and attitude.

6. Discussion

The findings of this study show that nurses' knowledge, attitudes, and practices regarding the prevention of surgical site infections in teaching hospitals in Lahore improved statistically significantly after a planned, four-week antibiotic stewardship intervention. These findings are in line with earlier studies carried out in comparable environments, which have repeatedly demonstrated that focused educational interventions can significantly improve healthcare workers' comprehension of antimicrobial resistance and stewardship concepts (Ahmed et al., 2024; Tariq et al., 2023).

The significant increase in knowledge scores from a mean of 12.4 to 17.1 out of 20 indicates that many nurses had significant gaps in their knowledge of stewardship guidelines and antibiotic resistance mechanisms before they started the trial. This result is consistent with that of Khan et al. (2021), who found that nurses in Lahore had poor baseline knowledge levels. Even relatively short, targeted instructional sessions can successfully address these knowledge shortcomings, as evidenced by the notable improvement that occurred after the intervention.

Furthermore, attitude scores markedly improved, indicating a change toward more positive views of responsible stewardship and sensible antibiotic usage. Positive attitudes have been found to be a major predictor of long-lasting behavioral change in clinical practice, making this a significant finding (Iqbal & Rashid, 2023). However, the comparatively lesser proportional improvement in attitude scores when compared to knowledge scores indicates that repeated, longer-term

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reinforcement may be necessary for attitudinal transformation instead of just one training cycle.

The improvements in practice ratings, specifically hand hygiene compliance (58.2% to 92.7%) and appropriate timing of preventive antibiotics (47.3% to 88.2%), are the most clinically significant outcomes. The surgical literature shows a direct correlation between the occurrence of SSI and both of these techniques (Allegranzi et al., 2021). The hypothesis that better comprehension of stewardship principles directly facilitates better clinical behavior is supported by the strong positive correlation (r=0.612) between knowledge gains and practice gains. This relationship was also noted by Hassan et al. (2022) in their systematic review of ASP interventions.

Although these encouraging results, the comparatively small improvement in surveillance reporting practices (39.1% to 81.8%, still leaving nearly one-fifth of nurses non-compliant) points to a problem that needs more institutional attention, perhaps by integrating electronic reporting systems or hiring specialized infection-control liaison nurses.

Overall, these results support the importance of include organized antibiotic stewardship education in teaching hospitals' pre-service nursing curricula and continuing in-service training programs, especially in settings with limited resources where AMR is becoming a greater problem.

7. Limitations of the Study

Because there is lack of control group in the single-group pre-test/post-test approach, it is challenging to rule out the impact of outside variables (such as simultaneous hospital policy changes) on the improvements that are seen.

- The practice data were self-reported, which could overestimate true levels of compliance due to social attractiveness bias.
- The very brief follow-up period (just after the intervention) makes it impossible to evaluate the feasibility of the noted changes over the long run.
- The study was limited to teaching hospitals, which may have different staffing and resource levels than district or rural medical facilities.

8. The Study's Significant

This study adds to the limited local data on the efficacy of antibiotic stewardship programs designed especially for nursing staff at teaching hospitals in Pakistan. Using a comparatively large sample size of 110 participants, the study shows statistically significant gains in all three KAP categories, offering hospital management and nurse education departments useful information. The results can guide the creation of standardized stewardship training modules that could be incorporated into infection-control policy frameworks, hospital orientation programs, and continuing education courses, ultimately lowering SSI rates and advancing the larger fight against antibiotic resistance.

9. Implications and Recommendations

9.1 Recommendations

4. Hospital administrators must to make antibiotic stewardship instruction a required part of yearly continuing education courses and nursing orientation.
5. To evaluate the sustainability of KAP gains, next future research also use quasi-experimental / randomized controlled designs with control groups and extended follow-up times.
6. To validate practice improvements, especially in hand hygiene and surveillance reporting, direct observational audits should be used instead of self-reported metrics.
7. Dedicated infection-control champions on each ward and digital documentation tools should improve the observation and reporting procedures for SSIs.
8. To ensure a multidisciplinary approach to SSI prevention, stewardship interventions should be extended to other cadres of healthcare workers, such as doctors and pharmacists.

9.2 Implications for Policy and Practice

The findings of this study directly affect national antibiotic resistance efforts, hospital infection control policies, and nursing education. At a comparatively cheap cost, incorporating stewardship content into regular training at the institutional level can increase adherence to evidence-based SSI-prevention procedures. The results support the inclusion of nurse-focused stewardship modules in

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Pakistan's National Action Plan for Antimicrobial Resistance at the policy level, acknowledging nurses as crucial participants in the integration effort to prevent AMR and reduce the burden of infections related to healthcare.

10. Conclusion

This study showed that nurses' knowledge, attitudes, and practices toward preventing surgical site infections in teaching hospitals in Lahore, Pakistan, were greatly enhanced by a planned, four-week antibiotic stewardship intervention. All examined domains showed statistically significant increases, with the largest link between knowledge gains and clinical practice. These results highlight the need of funding focused, continuous education programs for nursing staff as a workable and successful tactic for lowering the incidence of SSI and preventing antibiotic resistance in healthcare settings with limited resources.

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