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Improving Food Safety Practices Through Educational Interventions Among Anganwadi Staff: A Quasi-Experimental Study

Dr. Rajeev Aravindakshan, MBBS, MD[1], Dr. K. Rajeswari, MBBS[1*], Dr. Sathiyanarayanan S, MBBS, MD[3], Dr. Mohammed Shoyaib Khazi, MBBS, MD[4], Dr. Praveen Kumar S, MBBS[5]

[1]Professor and Head, Department of Community and Family Medicine, AIIMS Mangalagiri, Andhra Pradesh, India.

[2*]Junior Resident, Department of Community and Family Medicine, AIIMS Mangalagiri, Andhra Pradesh, India.

[3]Associate Professor, Department of Community and Family Medicine, AIIMS Mangalagiri, Andhra Pradesh, India.

[4]Senior Resident, Department of Community and Family Medicine, AIIMS Mangalagiri, Andhra Pradesh, India.

[5]Junior Resident, Department of Community and Family Medicine, AIIMS Mangalagiri, Andhra Pradesh, India.

*** Correspondence:** Dr. K. Rajeswari, MBBS

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ABSTRACT: Background: Foodborne illnesses, impacting an estimated 600 million individuals every year, are a large public health concern, especially for children under age 5, who carry about 40% of the burden. Anganwadi workers, central to India's Integrated Child Development Services (ICDS) workforce, are critical to ensuring food safety among young children and mothers. This study assesses the effect of educational interventions on food safety knowledge, attitudes, and practices (KAP) among Anganwadi personnel.

Methodology: A quasi-experimental study was carried out between November and December 2024 in 39 Anganwadi

centers of Mangalagiri, Andhra Pradesh. Participants were allocated to the Enhanced intervention group (flipchart + interaction) (n=18) and the Minimal intervention group (n=21). Baseline KAP was measured using a pretested, semi-structured questionnaire. The Enhanced intervention group received 30 minutes' one-on-one session by a public health professional (junior resident doctor) with enhanced intervention, discussion, and demonstrations aligned with WHO's "Five Keys to Safer Food", educational sessions focusing on hand hygiene, safe food handling, storage, and pathogen prevention. The pamphlet group was given standard pamphlet-based education. Post-intervention KAP was measured one month later. R software version 4.4 was used to analyze the data, with paired t-tests and Mann-Whitney U tests ($p<0.05$).

Findings: The Enhanced intervention group demonstrated significant KAP gains (knowledge [10 - 30]: +1.19, $p<0.001$; attitude [10 - 30]: +1.29, $p<0.001$; practice [10 - 50]: +2.55, $p<0.001$; total [30 - 110]: +5.03, $p<0.001$) compared to minimal intervention group changes. Participants belonging to lower socioeconomic strata had greater improvements.

Discussion: Educational interventions significantly enhance food safety practices among Anganwadi staff. Regular training and consideration of mandatory vaccinations are recommended to sustain improvements.

Keywords: *Educational interventions, Food handling practices, Food safety, Hand hygiene, Integrated Child Development Services (ICDS), Public health*

INTRODUCTION

The Integrated Child Development Services (ICDS) Scheme, introduced by the Government of India on October 2, 1975, is one of the world's largest and most impactful programs focused on early childhood care and development. It reflects the nation's dedication to improving the well-being of children and nursing mothers by addressing critical issues such as malnutrition, poor health, low learning capacity, and high mortality rates. The scheme plays a dual role by offering pre-school, non-formal education and promoting maternal and child health. It primarily targets

children aged 0-6 years, pregnant women, and lactating mothers, ensuring they receive essential care and support (1).

The Integrated Child Development Services (ICDS) provides vital support to enhance the health, nutrition, and overall well-being of young children and their mothers through a variety of services. These include healthcare, immunization, supplementary nutrition, preschool education, health and nutrition counselling, and referral services. These services are delivered through Anganwadi Centres(AWCs), community-based facilities located in both rural and urban areas. The term "Anganwadi" translates to a courtyard play centre within the community, primarily managed by an Anganwadi worker assisted by an Anganwadi helper. The Anganwadi worker is instrumental in promoting food safety and ensuring proper nutrition for beneficiaries. Due to their close connection with the community, they also serve as a primary source of information and guidance for mothers, educating them on food safety, hygiene, and childcare practices, which ultimately contributes to the health and development of children and their families (2). Improper food production, handling, and preparation techniques can significantly impact health. Foodborne diseases, which are typically infectious or toxic, arise from agents that enter the body through the consumption of contaminated food. Examples include typhoid fever, diarrhoea, food poisoning, staphylococcal infections, hepatitis A, amoebiasis, and dysentery, among others. An estimated 600 million – almost 1 in 10 people in the world – fall ill after eating contaminated food and 420,000 die every year, resulting in the loss of 33 million healthy life years (DALYs) (3).

Children under five years of age carry 40% of the foodborne disease burden with 1,25,000 deaths every year (3). *Salmonella, Campylobacter* and enterohaemorrhagic *Escherichia coli* are some of the most common foodborne pathogens that affect millions of people annually, sometimes with severe and fatal outcomes (4). This high incidence is often linked to substandard food hygiene practices. One of the key contributors to food contamination is poor personal hygiene, particularly inadequate handwashing, which significantly increases the risk of foodborne illnesses (5). Hand hygiene is a simple yet essential aspect of safe food handling and has long been recognized as a vital preventive measure in both healthcare settings (6) and food

preparation areas, as it helps prevent the transmission of infectious diseases through direct contact with either individuals or food. Therefore, maintaining proper hand hygiene is often seen as an indicator of adherence to safe food handling practices among food handlers. Training and educational interventions in food safety are crucial for improving the practices of food handlers, with the ultimate goal of reducing the incidence of foodborne illnesses in various settings (7). Many studies have been conducted to assess the impact of different training and educational programs on the knowledge, attitudes, and behaviours of food handlers in retail and food service environments (8). There is a need for understanding the extent of knowledge and level of practices followed by food handlers at household level during storage of raw food, food preparation, and consumption as it plays an important role in the prevention of foodborne illnesses (9). To strengthen food safety systems in all countries, the WHO stated the theme for "World Health Day" for the year 2015 as "from farm to plate, make food safe." The WHO "Five keys for safer food" were also used for promotion of the WHO theme.

The core messages of the "Five Keys to Safer Food" are:

1. Keep clean; 2. Separate raw and cooked; 3. Cook thoroughly; 4. Keep food at safe temperatures and 5. Use safe water and raw material (9)

OBJECTIVES

1. To estimate the knowledge, attitude, and practices of food handling and food safety among food handlers in Anganwadi centers
2. To determine the effectiveness of educational intervention on the food handling and food safety among food handlers in Anganwadi centers

METHODOLOGY

Participants from 39 Anganwadi centers located in the Mangalagiri block were assigned to either an Enhanced intervention group or Minimal intervention group based on area, so that there was no cross flow of information from the Enhanced intervention group to the group. A pretested, semi-structured, and face-validated questionnaire was used to collect baseline data regarding their knowledge and

practices related to food handling before and after the intervention (9,10). The questionnaire comprised three sections to assess participants' knowledge, attitudes, and practices regarding food handling. The knowledge and attitude section consisted of 10 questions, three-point Likert scale scoring was awarded. Thus, scores ranged from 10 to 30 points. While, the practices section consisted of 10 questions, five-point Likert scale scoring was awarded for each question, and score ranged from 10 to 50 points.

After listing out all Anganwadi each of them was approached by the investigator. If a participant was unavailable on the day of education, follow-up visits were made on the next two consecutive days. However, if the participants remained absent after three attempts, they were excluded. The purpose of the study was explained to the participants, and written informed consent was obtained from each of them. Interview was conducted by the investigator; the investigator read the questions aloud without providing any additional explanations to avoid influencing the responses. Following the completion of the baseline interview, all participants received pamphlets regarding guidance on food safety and hygiene, allocated participants based on the area, received 30 minutes one on one sessions by the public health professional (junior resident doctors), it included Enhanced intervention (flipchart + interaction), discussions, and demonstrations aligned with WHO's "Five Keys to Safer Food", educational sessions focused on handling hand hygiene, safe food handling, storage, and pathogen prevention.

A post-education assessment was conducted one month after the date of the education. The same questionnaire was administered again to the participants; order of question was changed to minimize memory bias. The data collected was then analyzed to evaluate the effectiveness of the intervention in enhancing knowledge and improving food safety practices among the participants.

Statistical analysis: The collected data was entered into entered MS Excel and subsequently analyzed using R version 4.4 software. The baseline characteristics of the participants were evaluated using descriptive statistics. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation. To compare the baseline characteristics

between the Enhanced intervention (flipchart + interaction) group and pamphlet groups, independent t-tests were applied for continuous variables, whereas chi-square tests or Fisher's exact tests were used for categorical variables. For within-group comparisons before and after the intervention, Paired t-tests were employed for normally distributed data, whereas Wilcoxon signed-rank tests were utilized for non-normally distributed data. To assess the mean difference in food safety scores between the two groups, independent t-tests were used for normally distributed data, while the Mann-Whitney U test was applied if the data did not follow a normal distribution. A p-value of less than 0.05 was considered statistically significant.

RESULTS

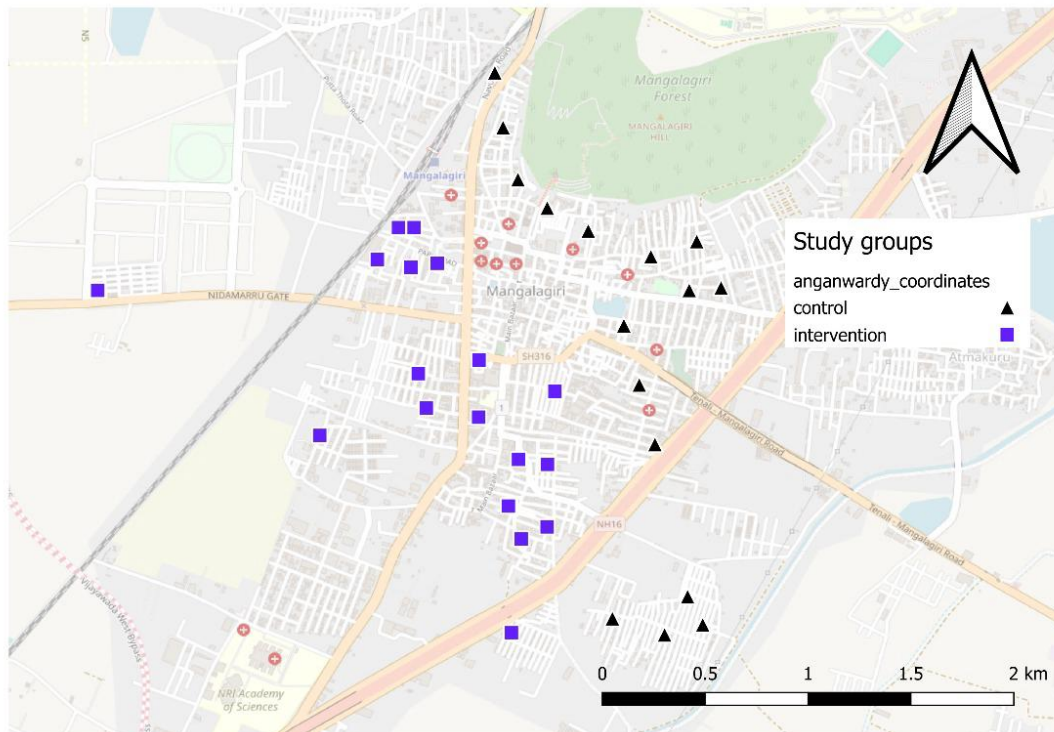
Table 1: Baseline Characteristics of Participants in the Enhanced intervention and Minimal intervention Groups

Variable	Enhanced intervention [1]	Minimal intervention[1]	P-lue[2]
Age	41 ± 7	43 ± 6	0.4
Designation			0.6
Anganwadi helper	12 (48%)	14 (45%)	
Anganwadi teacher	13 (52%)	17 (55%)	
Education			0.2
Graduate	9 (36%)	7 (22.6%)	
High	11(44%)	9 (29%)	
Intermediate	0 (0%)	8(25.8%)	
Middle	4 (16%)	5 (16.1%)	

Post graduate	1 (4.0%)	2 (6.5%)	
Socioeconomic Scale			0.9
Lower Middle	11 (44%)	14 (45%)	
Upper Lower	14 (56%)	17 (55%)	
[1]Mean ± SD; n (%)			
[2]Wilcoxon rank sum test; Fisher's exact test; Pearson's Chi-squared test			

The mean age of participants in the Enhanced intervention group was 41 ± 7 years, and in the minimal intervention group it was 43 ± 6 years. There was no statistically significant difference in age between the two groups (p = 0.40). In the Enhanced intervention group, 48% were helpers and 52% were teachers and in the minimal intervention group, 45% were helpers and 55% were teachers. The differences in designation between groups were not statistically significant (p = 0.60). Educational qualifications varied slightly between the groups. In the Enhanced intervention group, 36% were graduates, 44% had completed high school, and smaller proportions had completed middle school (16%) or postgraduate studies (4%). None had studied at the intermediate level. In contrast, the minimal intervention group had a more even distribution, with 22.6% graduates, 29% high school, 25.8% intermediate, 16.1% middle school, and 6.5% postgraduates. The difference in educational status between the two groups was, however, not statistically significant (p = 0.20). Majority in both groups belonged to the upper lower class (56% in Enhanced intervention group and 55% in minimal intervention group), followed by the lower middle class (44% and 45%, respectively). No significant difference was found between the groups in socioeconomic scale (p = 0.9).

Figure 1: Geographical Distribution of Enhanced intervention and Minimal intervention Group Anganwadi Centres in Mangalagiri (Legend: Blue squares represent Enhanced intervention group centres, and black triangles represent minimal intervention group centres. Scale: 1 cm = 1 km.)



The spatial distribution of Anganwadi centres included in the study is depicted in the figure 1, with blue squares representing the Enhanced intervention group and black triangles indicating the minimal intervention group. The centres in the Enhanced intervention group are spread across various parts of Mangalagiri, with a noticeable concentration in the western and central regions and a few scattered in the southern area. In contrast, the minimal intervention group centres are predominantly located in the eastern and southeastern parts of the city, with fewer in the central zone. This geographic arrangement enabled a purposeful separation between the two groups, which was, strategically considered during the planning phase to reduce the likelihood of contamination or cross-interaction between the Enhanced intervention and minimal intervention groups during the course of the study.

Table 2: Comparison of Pre- and Post-Intervention Knowledge, Attitude, and Practice (KAP) Scores for Food Handling and Food Safety between Enhanced intervention and Minimal intervention Groups

Variable	Minimal intervention (Pre)[1]	Enhanced intervention (Pre)[1]	P-value (Pre)[2]	Minimal interventio n (Post)[1]	Enhanced intervention (Post)[1]	P-value (Post)[2]
Knowledge	18.6 ± 3.6	21.3 ± 4.3	0.013	18.8 ± 3.6	22.5 ± 3.8	<0.001
Attitude	19.3 ± 3.5	21.6 ± 4.4	0.033	19.5 ± 3.4	22.9 ± 4.0	0.001
Practice	28.4 ± 4.1	28.8 ± 5.0	0.7	28.6 ± 4.2	31.4 ± 3.9	0.013
Total	66 ± 9	72 ± 12	0.064	67 ± 9	77 ± 10	<0.001
[1]Mean ± SD						
[2]Unpaired t-test						

At the baseline, before the intervention was implemented, the minimal intervention group exhibited slightly higher mean scores in all three domains compared to the Enhanced intervention group. Knowledge among the intervention group had a mean knowledge score of 21.3 ± 4.3, while the minimal intervention group scored only 18.6 ± 3.6. This difference was statistically significant with ($p = 0.013$). Attitude among the Enhanced intervention group had a mean attitude score was 21.6 ± 4.4, and of the minimal intervention group was 19.3 ± 3.5. This difference was also statistically significant with ($p = 0.033$). The mean practice scores were similar for both groups, with the minimal intervention group at 28.4 ± 4.1 and the Enhanced intervention group at 28.8 ± 5.0. This difference was not statistically significant ($p = 0.7$). The overall mean KAP score was 72 ± 12 for the Enhanced intervention group and 66 ± 9 for the minimal intervention group. This difference approached statistical significance ($p = 0.064$).

In post-intervention assessment the mean knowledge score in the minimal intervention increased to 18.8 ± 3.6, while the Enhanced intervention group's mean score increased to 22.5 ± 3.8. The difference between the groups remained statistically significant ($p < 0.001$).

Attitude among the minimal intervention group showed a slight increase in mean attitude score to 19.5±3.4, whereas the Enhanced intervention group's mean score increased to 22.9 ± 4.0. The difference between the groups remained statistically significant (p = 0.001). The minimal intervention group's mean practice score slightly improved to 28.6 ± 4.2, while the Enhanced intervention group demonstrated a more notable increase to 31.4 ± 3.9. The difference between the groups in the post-intervention practice scores became statistically significant (Table2).

Table 3A: Impact of the Intervention on Knowledge, Attitude, and Practice Scores Within Enhanced intervention and Minimal intervention Groups

Variable	Enhanced intervention				Minimal intervention			
	Pre[1]	Post[1]	Mean_Diff	P_value[2]	Pre[1]	Post[1]	Mean_Diff	P_value[2]
Knowledge	21.29 ± 4.33	22.48 ± 3.78	1.19	< 0.001	18.56 ± 3.64	18.84 ± 3.60	0.28	0.005
Attitude	21.61 ± 4.42	22.90 ± 4.03	1.29	< 0.001	19.28 ± 3.53	19.48 ± 3.43	0.2	0.021
Practice	28.81 ± 4.97	31.35 ± 3.86	2.55	< 0.001	28.40 ± 4.09	28.56 ± 4.19	0.16	0.042
Total	71.71 ± 12.23	76.74 ± 9.86	5.03	< 0.001	66.24 ± 9.44	66.88 ± 9.40	0.64	< 0.001
[1]Mean ± SD								
[2] paired student t-tests								

After the educational intervention, there was a significant improvement in knowledge, attitude, and practice (KAP) scores among participants in the Enhanced intervention group. The mean knowledge score increased from 21.29± 4.33 before the intervention to 22.48 ± 3.78 afterward, with a statistically significant mean difference of 1.19 ($p < 0.001$), indicating that the Enhanced intervention effectively

enhanced participants' understanding of food safety and handling. Attitude scores also showed a significant rise from 21.61 ± 4.42 to 22.90 ± 4.03 ($p < 0.001$), suggesting that the program positively influenced the participants' attitudes towards food handling practices. The most notable improvement was observed in practice scores, which increased from 28.81 ± 4.97 to 31.35 ± 3.86 ($p < 0.001$), highlighting the strong impact of the educational intervention on the actual food handling behaviours of the participants. In contrast, the minimal intervention group, which did not receive the intervention, exhibited only minor yet statistically significant improvements over time. Knowledge scores slightly increased from 18.56 ± 3.64 to 18.84 ± 3.60 ($p = 0.005$), attitude scores from 19.28 ± 3.53 to 19.48 ± 3.43 ($p = 0.020$), and practice scores from 28.40 ± 4.09 to 28.56 ± 4.19 ($p = 0.043$). These minimal changes in the minimal intervention group may be attributed to external factors or routine exposure to general food safety information. However, the substantial improvements observed in the Enhanced intervention group, especially in practice, underscore the effectiveness of the educational program in promoting safer food handling knowledge, attitudes, and practices. (Table 3A)

Table 3B: Impact of the enhanced intervention relative to the minimal intervention group on Changes in Knowledge, Attitude, and Practice Scores

Variable	Coefficient	95% CI (CI Lower, CI Upper)	p value
Knowledge change			
minimal intervention	-		
enhanced intervention	0.914	(0.487,1.340)	< 0.001
Attitude change			
minimal intervention	-		
enhanced intervention	1.090	(0.299,1.882)	0.007
Practice change			

minimal intervention	-		
enhanced intervention	2.388	(1.475, 3.302)	< 0.001
KAP total change			
minimal intervention	-		
enhanced intervention	4.392	(3.039, 5.746)	< 0.001

Linear Regression analysis demonstrated that the educational Enhanced intervention had a statistically significant impact on improving knowledge, attitude, and practice (KAP) scores among food handlers in Anganwadi centres. The Enhanced intervention group showed a significant increase in knowledge (ß = 0.91(0.487,1.340), $p < 0.001$), attitude (ß = 1.09(0.299,1.882), $p = 0.008$), and practice scores (p = 2.39 (1.475, 3.302), $p < 0.001$). The total KAP score also improved significantly (P = 4.39(3.039, 5.746), $p < 0.001$), confirming the effectiveness of the Enhanced intervention in enhancing food safety-related behaviors. (Table 3B)

DISCUSSION

This study evaluated the impact of an educational intervention on the knowledge, attitude, and practices (KAP) of food handling and food safety among Anganwadi staff. The findings reveal a positive influence of the intervention on the Enhanced intervention group, as evidenced by significant improvements in their knowledge, attitude, and reported practices related to food safety from the pre- to post-intervention assessments (Table 3). These improvements suggest that targeted education can be an effective strategy for enhancing food safety behaviours among Anganwadi workers and helpers, who play a crucial role in providing nutrition and care to young children.

At baseline, while no significant differences were observed in the sociodemographic characteristics of the Enhanced intervention and minimal intervention groups (Table 1), the minimal intervention group exhibited statistically higher scores in knowledge and attitude compared to the Enhanced intervention group (Table3). This initial

difference highlights the potential variability in baseline food safety awareness among Anganwadi staff. However, the subsequent analysis of change scores (Table 3b) provides a more robust assessment of the intervention's effect, demonstrating that the Enhanced intervention group experienced significantly greater positive changes in all KAP domains compared to the minimal intervention group. This indicates that the educational program was successful in improving knowledge and fostering a more positive attitude towards food safety, ultimately leading to better reported practices within the Enhanced intervention group.

The significant improvements observed in the Enhanced intervention group align with findings from other studies that have demonstrated the effectiveness of educational interventions in enhancing food safety knowledge and practices among food handlers (Nyawo et al.2021) (21). Importance of hand hygiene through educational intervention and it's improved in practice study with Ehuwa et al. (2021) similar to our post intervention practices (4). The study (Soares et al. (2012), similar to our study finding that periodical training promotes positive food safety culture. The knowledge and food safety practices of food handlers showed a significant improvement following their intervention. Notably, there was a marked increase in the number of food handlers who began using soap for handwashing. These findings are consistent with those of Deshpande et al., and Young et al. (2019) who also reported enhancements in both knowledge and food handling practices after implementing an educational intervention (6, 22).

The minor gains of the minimal intervention group (knowledge: +0.28, p=0.005; attitude: +0.2, p=0.020; practice: +0.16, p=0.043) can be due to contamination (e.g., sharing of information between groups due to proximity of communities), passive diffusion of food safety information through local campaigns, or seasonal reasons such as heightened awareness during festivals. Future studies should thus apply cluster randomization, have physical distancing between groups, or use blinded assessors to limit cross-group interactions to prevent this. The Anganwadi setting presents a unique context where ensuring food safety is paramount due to the vulnerability of the target beneficiaries' young children. Improved food handling practices by Anganwadi staff can directly contribute to reducing the risk of

foodborne illnesses and promoting better health outcomes within the community, aligning with the broader goals of the ICDS scheme (1)

LIMITATION

The quasi-experimental design, while suitable for real-world implementation, lacks randomization and may introduce selection bias. Additionally, reliance on self-reported data may lead to overestimation of actual behaviour changes. Future studies should consider incorporating direct observational methods to validate reported practices. The short duration of follow-up also limits the assessment of long-term sustainability of the intervention's impact. Further research should explore whether the observed improvements are maintained over time. Identifying which components of the educational intervention were most effective could also help in designing more focused and resource-efficient training modules. Moreover, future investigations could examine organizational and contextual factors such as workload, infrastructure, and support systems that influence the adoption of safe food practices. Qualitative research may provide deeper insights into barriers and facilitators that affect the daily implementation of food safety knowledge. Expanding and evaluating similar interventions across diverse geographical and programmatic contexts within the ICDS framework would strengthen generalizability of the findings (1).

CONCLUSION

It is essential to implement a regular and structured education and training program for food handlers at Anganwadi centres to ensure the consistent application of food safety knowledge and practices. Periodic refresher courses should be made mandatory to reinforce their understanding and ensure the continuous adoption of safe food handling procedures. The training should comprehensively cover critical aspects such as maintaining proper hand hygiene, safe food handling techniques, appropriate food storage methods. Among all food handlers at Anganwadi centres should be considered a key preventive measure to reduce the risk of foodborne disease transmission. Furthermore, there is a need to establish a well-structured framework to assess and monitor food safety practices, and hygiene standards among food handlers. This framework would facilitate regular evaluations, ensuring that

high standards of food hygiene and safety are consistently maintained in Anganwadi centres ultimately protecting the health and well-being of children and mothers. Ensuring that all employees are vaccinated against major foodborne illnesses, including Typhoid, Hepatitis A, and Hepatitis B, would significantly contribute to minimizing health hazards. Incorporate a formal system to track food safety procedures and vaccination status.

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