

SUPPLEMENTARY MATERIAL

Knowledge, attitudes, and practices of food handlers regarding food safety in urban areas of Southeast Asia: a narrative review

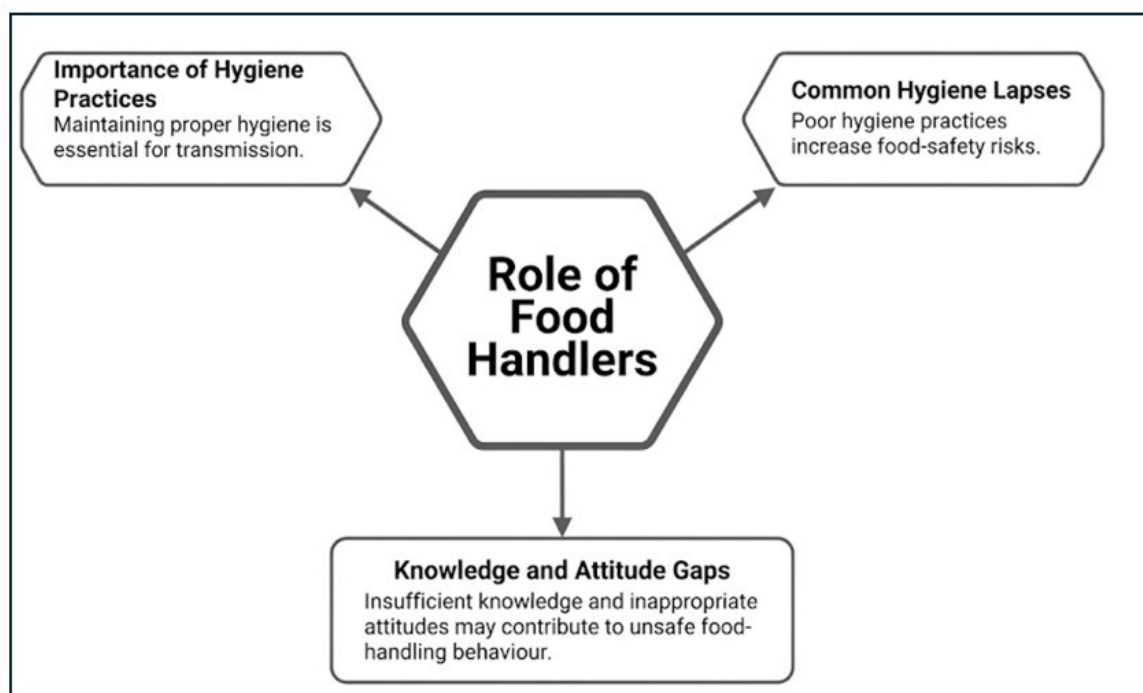
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Supplementary Figure 1. Unveiling the multifaceted role of food handlers.

Supplementary Table 1. Knowledge and compliance rates among food handlers (2022-2023).

Country	Group	Knowledge (%)	Compliance (%)	Barriers Identified
Malaysia	Locals	85	75	None
	Migrants	65	40	Language barriers, lack of training.
Thailand	Locals	90	80	None
	Migrants	75	65	Limited financial access to training.

Developed by the authors based on findings reported in Abdullah *et al.* (2020), Srichampa *et al.* (2018), and other studies included in this review.

Supplementary Table 2. Barriers faced by migrant food handlers in urbanized nations.

Country	Barrier	Specific examples
Malaysia	Linguistic inaccessibility	Training conducted in Malay/English, excluding non-native speakers.
UAE	High training costs	Financial burden on low-income migrants.
Singapore	Policy restrictions	Exclusion of undocumented workers from mandatory programs.

Developed by the authors based on evidence reported in Srichampa *et al.* (2018), Osaili *et al.* (2022), Hengst *et al.* (2023), and other studies included in this review.

Supplementary Table 3. Knowledge and skill levels among food handlers (2020-2024).

Group	Knowledge level (%)	Skill Proficiency (%)	Common gaps identified
Trained local workers	85	80	Rare non-compliance with hygiene protocols
Untrained local workers	55	50	Inconsistent handwashing and storage
Migrant workers	40	35	Cross-contamination and hygiene practices
Educated (degree level)	90	85	Minor lapses in advanced protocols

Developed by the authors based on evidence reported in Rahman *et al.* (2023) and other reviewed studies.

Supplementary Table 4. Cultural beliefs and food safety practices in Southeast Asia.

Country	Cultural belief	Implication for food safety
Malaysia	“Fresh foods don’t need refrigeration”	Improper storage of perishable items
Thailand	Preference for raw seafood dishes	Higher risk of foodborne illnesses
Indonesia	Use of traditional wooden utensils	Potential for microbial contamination

Authors’ synthesis of findings from reviewed literature, including Harmayani *et al.* (2019).

Supplementary Table 5. Influence of workplace conditions on food safety compliance.

Workplace factor	Positive impact on compliance	Negative impact on compliance
High managerial oversight	Promotes adherence to protocols	Reduced violations and better outcomes.
Extended working hours	Fatigue and negligence	Increased hygiene violations.
Low wages	Lack of motivation	Poor compliance and high turnover.

Authors’ synthesis of findings from reviewed literature, including Appling *et al.* (2018).

Supplementary Table 6. Policy gaps and enforcement challenges in urban Malaysia.

Challenge	Description	Examples
Limited inspections	Insufficient staff for urban coverage	Low inspection rates in hawker stalls
Resource constraints	Inadequate funding for training programs	Lack of multilingual training options
Regulatory disparities	Unequal enforcement between large and small businesses	Informal eateries often neglected

Developed by the authors based on evidence reported in Aziz *et al.* (2023), Nawawi *et al.* (2022), and related literature.

Supplementary Table 7. Effectiveness of training programs for food handlers.

Location	Training type	Compliance improvement (%)	Key outcomes
Kuala Lumpur	Behavior-based intervention	45	Reduced violations, improved hygiene.
Selangor	Biannual refresher courses	25	Increased retention of food safety skills.
Singapore	Linguistic-cultural training	30	Higher engagement and knowledge retention.

Authors’ synthesis of findings from reviewed literature, including Johnson *et al.* (2023) and Alkhalidi *et al.* (2025).

Supplementary Table 8. Comparison of training methods for food handlers.

Training method	Knowledge retention (%)	Application improvement (%)	Key benefits
Traditional lecture-based	65	50	Basic understanding of principles
Visual/video-based learning	85	70	Simplified learning, multilingual reach

Authors’ synthesis based on findings reported by Insfrán-Rivarola *et al.* (2020).

Supplementary Table 9. Impact of monitoring and supportive management on food safety.

Intervention type	Compliance improvement (%)	Key findings
Quarterly inspections	35	Higher adherence to safety standards
Managerial support	20	Improved morale and protocol adoption
Reward-based incentives	20	Encouraged consistent compliance

Authors’ synthesis based on findings reported by Hamilton Public Health Services (2020).