Application of a healthy food markets guide to two Indonesian markets to reduce transmission of "avian flu"

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Problem The World Health Organization (WHO) developed a guideline with 10 control measures to reduce transmission of A(H5N1) avian influenza virus in markets in low-resource settings. The practical aspects of guide implementation have never been described.
Approach WHO's guideline was implemented in two Indonesian markets in the city of Makassar to try to reduce transmission of the A(H5N1) virus. The guideline was operationalized using a participatory approach to introduce a combination of infrastructural and behavioural changes.
Local setting Avian influenza is endemic in birds in Makassar. Two of the city's 22 dilapidated, poorly-run bird markets were chosen for the study. Before the intervention, neither market was following any of WHO's 10 recommended control measures except for batch processing.
Relevant changes Market stakeholders' knowledge about the avian influenza A(H5N1) virus improved after the interventions. WHO guideline recommendations for visual inspection, cleaning and poultry-holding practices, as well as infrastructural requirements for zoning and for water supply and utilities, began to conform to the WHO guideline. Low-maintenance solutions such as installation of wastewater treatment systems and economic incentives such as composting were well received and appropriate for the low-resource setting.
Lessons learnt Combining infrastructural changes with behaviour change interventions was critical to guideline implementation. Despite initial resistance to behaviour change, the participatory approach involving monthly consultations and educational sessions facilitated the adoption of safe food-handling practices and sanitation. Market authorities assumed important leadership roles during the interventions and this helped shift attitudes towards regulation and market maintenance needs. This shift may enhance the sustainability of the interventions.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Live bird markets have been implicated in the circulation of avian influenza A(H5N1) virus[1] and are a potential source of viral transmission among humans and animals.[2,3] In 2006 the World Health Organization (WHO) developed a guideline – *A guide to healthy food markets* – to reduce contamination with and transmission of A(H5N1) virus in live bird markets.[4] The guideline lists 10 control measures for the poultry area of markets, the main aims of which are to improve the environment and ensure safe food-handling practices. The 10 control measures involve education and awareness of how avian influenza is transmitted; monitoring of conditions and food-handling practices; visual inspection of fowl to look for signs of infection; use of personal protective equipment (masks, gloves, disposable aprons, rubber boots, etc.); market zoning to prevent public access to potentially contaminated areas; use of potable water for cleaning and hand-washing; appropriate cage design and holding practices; appropriate cleaning practices; properly designed utilities, such as drainage systems, and batch processing. This study reports on the lessons learnt from implementing the guideline in two live bird markets in Indonesia, a low-resource country with areas where avian influenza A(H5N1) virus infection is endemic in fowl.

Problem and local setting

The site of the study was the city of Makassar (population 1.6 million), where 80 000 birds are slaughtered daily and where avian influenza A(H5N1) virus infection is endemic in birds.[5] Makassar has 22 live bird markets under the purview of the municipal market authority. All of them have dilapidated infrastructure, no health services and an inadequate operational environment. Two markets were selected for this study based on the management teams' readiness to undergo the interventions. Market A had 186 kiosks, 17 management and sanitation staff, and 5 poultry kiosks that received and slaughtered a daily total of 500 birds; Market B had 247 kiosks, 17 management and sanitation staff, and 13 poultry kiosks that received and slaughtered a daily total of 2700 birds.

Before the intervention, an assessment was conducted to determine the extent to which WHO's 10 control measures were being practised.[6] The assessment showed that only one of the measures – batch processing – was being followed as recommended in the WHO guideline, which calls for separating poultry batches, cleaning between batches and at the end of the trading day, and having the capacity to trace back poultry through the use of regular suppliers. The other nine control measures were not met. For example, each poultry kiosk held, slaughtered and sold birds without separate zoning for these different processes; drainage, bins, electricity and water supplies were limited; work surfaces, cages and floors were hard to clean; and no regulated inspection or sanitation programmes were in place.

Approach

A municipal-level taskforce was established. It was composed of the finance and operations staff of the municipal market authority, general managers and sanitation teams of the live bird market, and members of the nongovernmental organization (NGO), CHF International, that was funded to implement the

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Table 1. **Comparison of poultry vendor knowledge, attitudes and practices before and after intervention to reduce transmission of A(H5N1) influenza virus in two poultry markets, Makassar, Indonesia, 2008–2009**

Control measure[4] and related knowledge, attitude or practice	Before ($n = 34$) No. (%)	After ($n = 29$) No. (%)	*P*
Education and awareness			
Aware that people can get sick from working with poultry	8 (24)	18 (62)	0.002
Practising slaughter of sick birds and sale of sick or dead birds	5 (15)	6 (21)	0.533
Education and awareness, monitoring, visual inspection			
Able to identify three symptoms of avian influenza infection in chickens	26 (76)	27 (93)	0.092
Personal protective equipment			
Wearing rubber boots[a]	22 (65)	16 (55)	0.441
Wearing plastic aprons[a]	5 (15)	16 (55)	0.001
Cages and holding practices, cleaning			
Cleaning cages daily	28 (82)	29 (100)	0.027
Cleaning			
Using soap when cleaning chopping boards, knives and defeathering machines	13 (38)	18 (62)	0.059

[a] Based on observation of poultry vendors.

project to improve the two markets according to the WHO guideline. The taskforce oversaw the change process and monitored the interventions monthly.

Interventions promoting infrastructural and behavioural changes were introduced over an 18-month period (January 2008–June 2009). The interventions were specifically aimed at achieving compliance with the nine recommended measures not being practised at the markets (batch processing was excluded since it was already being practised). A participatory approach involving market managers, sanitation teams and poultry vendors was applied to put the measures into operation. Under this approach, problems were posed and potential solutions discussed at monthly consultation meetings held at the markets until acceptable options emerged.[7]

Interventions that required construction or introduction of new goods were designed to ensure sustainability, low ongoing costs and easy maintenance. Education sessions lasting two hours were held monthly to improve market managers', sanitation teams' and poultry vendors' knowledge and practices in the area of sanitation and food handling. These 18 sessions were held at canteens near the markets and addressed waste management, food safety, recognition of signs of infection with avian influenza A(H5N1) virus and notification of affected fowl. The staff of CHF International developed key messages based on the WHO guideline and provided the training.[4] Information was discussed and monitoring protocols and logs were developed during these 18 sessions.

Progress in implementing the intervention was evaluated through a post-intervention inspection, interviews with market managers, sanitation teams and poultry vendor surveys. These activities were conducted by a two-person team composed of one external evaluator (GS) experienced in avian influenza control in live bird markets[2,8]and one NGO officer responsible for overseeing guideline implementation at both markets. GS developed the necessary evaluation tools based on the WHO guideline and provided one day of training to the NGO officer on questionnaire administration and data collection and recording.

An unannounced one-day inspection was conducted at each market by the team one month after the intervention. The team used a checklist to confirm that the necessary goods had been installed and that the protocols and logs developed were in use. Interviews with market managers and sanitation teams were conducted using semi-structured questionnaires developed with guidance from WHO and field tested locally.[6] The questions explored the presence of any roadblocks to guideline implementation and the adequacy of the change process and the interventions. Answers to each question were summarized and differences in perspectives identified.

Changes in vendor knowledge, attitudes and behaviour before and after the intervention were measured using a field-tested, structured survey instrument containing 38 close-ended questions. The survey was conducted verbally in the local dialect. The NGO officer conducted the pre- and post-intervention surveys among 34 and 29 poultry vendors, respectively (Table 1). These numbers represent all vendors present in the market on the days the interviews were conducted. Changes in vendors' knowledge, attitudes and behaviours before and after the intervention were analysed using χ^2 or Fisher's exact tests, as required.

Ethics approval for the study was obtained from the Health Research Ethics Committee at the Indonesian Ministry of Health and from the Australian National University Human Research Ethics Committee.

Findings

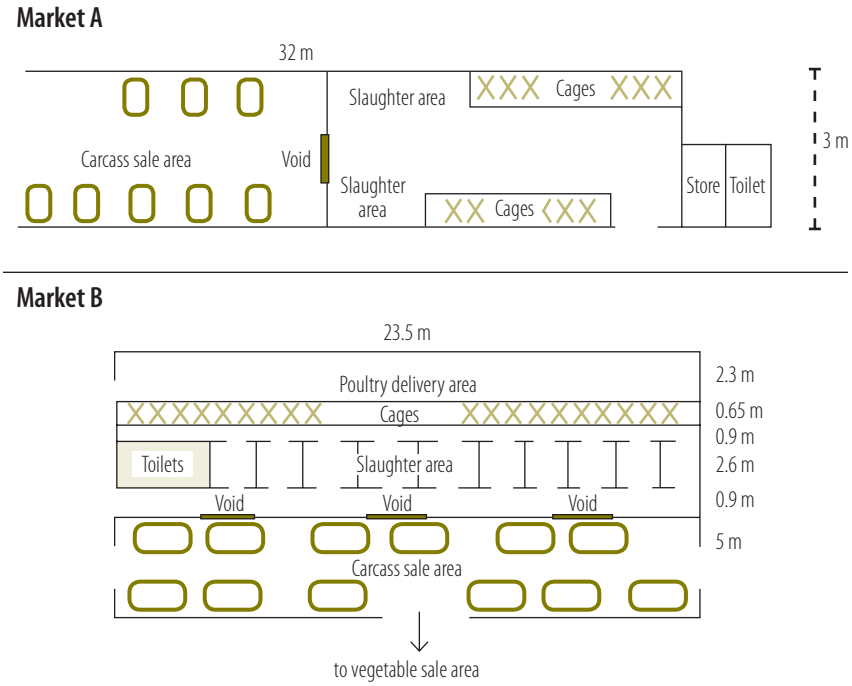
Education and awareness

Poultry vendors' knowledge and attitudes surrounding avian influenza A(H5N1) virus transmission improved after the intervention. Six vendors from both markets continued to slaughter sick chickens and to sell sick or dead chickens (Table 1). They stated that they sold these chickens as feed for fish farms, but no follow-up was conducted to verify this information.

Monitoring

With the aid of municipal agriculture officers, both markets developed disease-

Fig. 1. **Layout of the poultry areas in markets A and B after interventions in both poultry markets, Makassar, Indonesia, 2008–2009**



Note: Pre-intervention layout not shown because each poultry kiosk operated all aspects of the workflow inside the kiosk without zoning.

monitoring protocols. These protocols provided for simple visual inspection of incoming birds, a cost-free intervention. Monitoring logs were filled daily by market managers in both markets and kept in the communal poultry holding zone.

Visual inspection

Posters and protocols for poultry inspection and disease notification were developed and placed in a visible location in the poultry area of each market. More poultry vendors could correctly identify signs of avian influenza A(H5N1) virus infection in birds after the intervention than before it ($P = 0.09$) (Table 1).

Personal protective equipment

Poultry vendors rejected face masks and goggles because they made them feel too hot when worn during poultry slaughter. However, the use of plastic aprons increased after the intervention ($P = 0.001$).

Market zoning

The poultry area was completely reconstructed within a four-month period in both markets. The new structures adhered to zoning and unidirectional workflow, as per the WHO guideline (Fig. 1).[4] Of the 29 poultry vendors surveyed after the intervention, 25 (86%) expressed satisfaction with the changes. The remaining vendors indicated that they had fewer buyers because the area where poultry is sold to the public had been isolated. Eleven vendors (38%) mentioned a dip in sales after the interventions, but seven of these vendors (64%) still felt satisfied with the changes.

Water

In both markets, existing water wells were closed and city water was piped to the poultry areas. Toilets with handwashing facilities were installed, with easy access for all workers and customers.

Cages and holding practices

After the intervention, poultry species were placed in separate holding zones and kept in clean cages. More vendors reported cleaning cages and trays daily ($P = 0.027$; Table 1). Market A vendors expressed concern that the poultry holding zone was too hot because of limited airflow. Additional fans were installed to overcome this design problem, but management still faced difficulty in getting vendors to hold poultry in that zone.

Cleaning

Market sanitation teams were provided with high-pressure hoses. Easy to clean stainless-steel work surfaces were installed. Cleaning logs were filled daily by the market sanitation teams. Cleaning practices by poultry vendors improved after the intervention (Table 1).

Utilities

The poultry areas were provided with electricity, and an anaerobic wastewater treatment system that decreases organic matter was installed in them. Composting bins and rubbish bins with lids were provided and placed in visible locations, and drains were covered and sloped. One vendor who was unhappy with the intervention claimed that drainage was slow. On verification, market managers suggested that this vendor was unhappy with his corner location in the sale area as he felt that it was isolated. No other vendor complained about the drainage.

Conclusion

Behavioural change was critical to the adoption of hygienic practices and the implementation of the WHO guideline. Since people tend to resist changes in their work routines,[9,10] we achieved success in this respect by applying the participatory approach consisting of regular consultations, educational sessions and by making infrastructural changes that facilitated and provided an incentive for behaviour change.[11]

Market managers and the municipal market authority assumed important leadership roles in overseeing adoption of the guideline. All stakeholders recognized the need to regulate market sanitation practices and utilities to maintain consumer interest and sustain live bird markets as points of municipal revenue. This resulted in a commitment by the municipal market authority to use funds already allocated by the local government to provide maintenance and uninterrupted supplies of electricity and water, without additional cost to vendors in the two markets. We believe this commitment will ensure the intervention's sustainability. It may also provide impetus for the municipal market authority to roll out the intervention in Makassar's other 20 live bird markets over the next 5 years using municipal funds.

Box 1. **Summary of main lessons learnt**

- The interventions outlined in the World Health Organization's guide to healthy food markets can be implemented in low-resource settings endemic for avian influenza A(H5N1) virus.
- To implement the interventions and maximize potential for sustainability, various stakeholders had to be involved in the change process, including the government market authority, market managers, sanitation teams and poultry vendors.
- Regular consultation and education sessions, as well as infrastructural changes with financial incentives, facilitated behaviour change and the adoption of hygienic practices by market stakeholders.

Anaerobic wastewater treatment systems and composting reduce the risk of contamination with the A(H5N1) virus and are cheap and easy to maintain.[12] Composting also enables sanitation staff to supplement their income by turning poultry waste into a marketable commodity. Such economic incentives increase compliance with interventions, especially in low-resource settings.[13]

The intervention did not result in any increase in kiosk fees, since it was funded through CHF International. Although cost-sharing would have been favourable, initial buy-in from authorities and vendors was limited by the fact that WHO's guideline had never before been applied in Indonesia. Therefore, this experience was treated as a proof-of-concept. Future applications of the guideline in Indonesia should explore other funding models (e.g. public–private co-contributions).

The fact that the two bird markets were chosen because their management teams showed readiness to implement the interventions may have increased the likelihood of success. However, the intervention should yield similar results in other low-resource settings, since the workflow in markets is generic. Furthermore, managers of other live bird markets may be motivated by the lessons learnt from this experience (Box 1).[6] Since the WHO guideline prioritizes certain interventions more than others, managers of markets with limited resources may choose to implement the interventions having higher priority. ■

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ملخص

تطبيق دليل أسواق الأطعمة الصحية على سوقين إندونيسيين للحد من انتقال "أنفلونزا الطيور"

المشكلة وضعت منظمة الصحة العالمية (WHO) مبادئ توجيهية تحتوي على 10 تدابير مكافحة تهدف إلى الحد من انتقال فيروس أنفلونزا الطيور A(H5N1) في الأسواق في المواقع منخفضة الموارد. ولم يتم تناول الجوانب العملية لتنفيذ الدليل بالوصف على الإطلاق.

الأسلوب تم تنفيذ المبادئ التوجيهية الخاصة بمنظمة الصحة العالمية في سوقين إندونيسيين في مدينة ماكاسار لمحاولة الحد من انتقال فيروس A(H5N1). وأصبحت المبادئ التوجيهية نافذة باستخدام نهج تشاركي لطرح مجموعة من التغييرات في البنية التحتية والسلوك.

المواقع المحلية تعتبر أنفلونزا الطيور متوطنة في الطيور في ماكاسار. وتم اختيار سوقين من أسواق الطيور المهملة ذات الإدارة السيئة بالمدينة البالغ عدد أسواقها 22 سوقًا لإجراء الدراسة. وقبل التدخل، لم يكن أي من السوقين يتبع أيًا من تدابير المكافحة العشرة الموصى بها من قبل منظمة الصحة العالمية باستثناء التجهيز على دفعات.

التغيّرات ذات الصلة تحسنت معرفة أصحاب المصالح في السوق بفيروس أنفلونزا الطيور A(H5N1) بعد التدخلات. وبدأت توصيات المبادئ التوجيهية لمنظمة الصحة العالمية حول الفحص البصري وممارسات تنظيف وحمل الدجاج، بالإضافة إلى متطلبات البنية التحتية للتقسيم إلى مناطق وتوفير المياه والمرافق في التوافق مع المبادئ التوجيهية لمنظمة الصحة العالمية. ولاقت الحلول التي لا تتطلب سوى القليل من الصيانة مثل تركيب أنظمة معالجة مياه الصرف والحوافز الاقتصادية مثل التسميد ترحابًا ووجدت ملائمة للمواقع منخفضة الموارد.

الدروس المستفادة كان دمج تغييرات البنية التحتية في تدخلات تغيير السلوك مهمًا لتنفيذ المبادئ التوجيهية. وعلى الرغم من المقاومة الأولية لتغيير السلوك، يسر النهج التشاركي الذي تضمن استشارات شهرية وجلسات تعليمية تبني ممارسات التداول الآمن للغذاء وخدمات الإصحاح. وتولت سلطات السوق أدوارًا قيادية هامة أثناء التدخلات، وساعد هذا في تحول الاتجاهات نحو التنظيم واحتياجات صيانة السوق. وقد يعزز هذا التحول من استدامة التدخلات.

摘要

印度尼西亚两个市场应用健康食品市场指导方针以减少"禽流感"传播

问题 世界卫生组织 (WHO) 制定了含有 10 种控制方法的指导方针，用于减少低资源配置市场中的 A(H5N1) 禽流感病毒的传播。指导方针实施的实际方面尚未描述。

方法 在印度尼西亚城市孟加锡的两个市场内实施 WHO 的指导方针，用以减少 A(H5N1) 病毒的传播。此指导方针采用参与式教学法实施，结合执行基础架构和行为变更。

当地状况 孟加锡禽类的禽流感较为常见。在该城市 22 个岌岌可危、管理不善的禽类市场中选择 2 个市场进行研究。在干预之前，两个市场都没有遵循 WHO 的 10 个建议控制方法（分批处理除外）。

相关变化 经过干预，市场利益相关者对禽流感 A(H5N1) 病毒的认识提高了。对目视检查、清洁和家禽保持实践以及分区和水源及设施的基础架构要求方面的 WHO 指导方针建议逐步符合 WHO 指导方针的要求。低维护解决方案如安装废水处理系统和经济刺激如堆制肥料均受到好评，适用于低资源配置。

经验教训 将基础架构变更和行动变更结合起来，对实施指导方针至关重要。尽管行动变更开始时遇到阻力，但涉及每月协商和教育讲习会的参与式教学方法还是促进了安全食品处理实践和卫生设施的采用。市场管理部门在干预中担任重要的领导角色，这有助于转变对管理和市场维护需求的态度。这种转变可以强化干预的可持续性。

Résumé

Application d'un guide des marchés d'alimentation saine à deux marchés indonésiens afin de réduire la transmission de la «grippe aviaire»

Problème L'Organisation mondiale de la Santé (OMS) a conçu un guide avec 10 mesures de contrôle permettant de réduire la transmission du virus de la grippe aviaire A(H5N1) sur les marchés à faibles ressources. Les aspects pratiques de l'application du guide n'ont jamais été décrits.

Approche Le guide de l'OMS a été appliqué à deux marchés indonésiens dans la ville de Makassar afin de tenter de réduire la transmission du virus A(H5N1). Le guide a été utilisé à l'aide d'une approche participative pour présenter une combinaison de changements infrastructurels et comportementaux.

Environnement local La grippe aviaire est endémique chez les oiseaux à Makassar. Deux des 22 marchés à oiseaux délabrés et pauvres de la ville ont été choisis pour l'étude. Avant l'intervention, aucun des deux marchés ne suivait les 10 mesures de contrôle recommandées par l'OMS, à l'exception du traitement des lots.

Changements significatifs Les connaissances des parties prenantes des marchés sur le virus de la grippe aviaire A(H5N1) se sont améliorées après les interventions. Les recommandations du guide de l'OMS en matière d'inspection visuelle, de nettoyage et de pratiques de conservation de la volaille, ainsi que les exigences infrastructurelles pour le zonage et pour les équipements et l'alimentation en eau ont commencé à être conformes au guide de l'OMS. Des solutions nécessitant peu de maintenance, comme l'installation de systèmes de traitement des eaux usées, ainsi que des incitations économiques comme le compostage ont été bien accueillies et s'adaptaient parfaitement au système à faibles ressources.

Leçons tirées Combiner les changements infrastructurels aux interventions de changements des comportements était essentiel à l'application du guide. Malgré une première résistance au changement comportemental, l'approche participative impliquant des consultations mensuelles et des sessions de formation ont facilité l'adoption d'une hygiène publique et de pratiques de gestion d'une alimentation saine. Les autorités des marchés ont joué un rôle de leader important lors des interventions, ce qui a aidé à modifier les attitudes envers la réglementation et les besoins en maintenance des marchés. Ce changement peut améliorer la durabilité des interventions.

Резюме

Реализация указаний по охране здоровья на продовольственных рынках на двух индонезийских рынках в целях снижения передачи "птичьего гриппа"

Проблема Всемирная организация здравоохранения (ВОЗ) разработала указания, содержащие 10 мер, направленных на снижение передачи вируса птичьего гриппа A(H5N1) на рынках в условиях с ограниченными ресурсами. Практические аспекты реализации инструкции ранее никогда не были описаны.

Подход Указания ВОЗ были реализованы на двух индонезийских рынках в городе Макассар в целях уменьшения передачи вируса A(H5N1). Реализация указаний была осуществлена с использованием активного подхода и была нацелена на совместное внедрение инфраструктурных и поведенческих изменений.

Местные условия Птичий грипп является эндемическим для птиц в Макассаре. Для исследования были выбраны два из 22 ветхих и плохо организованных птичьих рынков. До реализации мероприятий ни один из рынков не выполнял ни одной из 10 рекомендуемых ВОЗ мер контроля, за исключением контроля партий товара.

Осуществленные перемены Осведомленность заинтересованных лиц, участвующих в работе рынка, о птичьем гриппе A(H5N1) после реализации мероприятий улучшилась. Рекомендации ВОЗ, касающиеся визуального осмотра, чистки и содержания птиц, а также инфраструктурные требования к зонированию, водоснабжению и системам коммунального обслуживания стали соответствовать указаниям ВОЗ. Такие решения с низкими эксплуатационными расходами, как установка систем очистки сточных вод, а также такие экономические стимулы, как, например, компостирование, были хорошо приняты и подходят для условий с ограниченными ресурсами.

Выводы Сочетание инфраструктурных изменений с мерами, направленными на изменение поведения, имеет решающее значение для реализации указаний. Несмотря на первоначальное сопротивление изменению поведения, подход, предполагающий активное участие и включающий ежемесячные консультации и учебные занятия, способствовал принятию практик безопасного обращения с пищевыми продуктами и санитарии. Руководство рынка в течение проведения мероприятий приняли на себя важную направляющую роль, что помогло склонить заинтересованных лиц в пользу осознания необходимости регулирования и содержания рынка в надлежащем состоянии. Такое изменение отношения может повысить устойчивость результатов от реализации мероприятий.

Resumen

Aplicación de la guía para mercados de alimentos saludables en dos mercados indonesios con el fin de reducir la transmisión de la «gripe aviar»

Situación La Organización Mundial de la Salud (OMS) desarrolló una guía con 10 medidas de control para reducir la transmisión del virus de la gripe aviar A(H5N1) en mercados en entornos con escasez de recursos. Nunca se describieron los aspectos prácticos de la aplicación de dicha guía.

Enfoque La guía de la OMS se aplicó en dos mercados indonesios de la ciudad de Makassar con el fin de intentar reducir la transmisión del virus A (H5N1). La guía se hizo más funcional a través un enfoque participativo para introducir una combinación de cambios tanto en las infraestructuras como en los comportamientos.

Marco regional La gripe aviar es endémica en las aves de Makassar. Para este estudio se eligieron dos de los 22 mercados de aves deteriorados y mal gestionados de la ciudad. Antes de la intervención, ninguno de los dos mercados seguía ninguna de las 10 medidas de control recomendadas por la OMS, exceptuando la de procesamiento en lotes.

Cambios importantes Tras la intervención, se observó una mejora considerable de los conocimientos de los participantes en el mercado sobre el virus de la gripe aviar A (H5N1). Empezaron a aplicarse las recomendaciones de la guía de la OMS en cuanto a inspección visual, limpieza y prácticas de explotación avícola. Del mismo modo, los requisitos infraestructurales de distribución en zonas, suministro de agua y servicios públicos empezaron a adherirse a la guía de la OMS. Las soluciones de bajo mantenimiento como la instalación de sistemas de tratamiento de aguas residuales y los incentivos económicos como el del compostaje fueron bien recibidos y adecuados para este entorno con escasez de recursos.

Lecciones aprendidas La combinación de intervenciones para realizar cambios en las infraestructuras y en el comportamiento resultó fundamental en la puesta en práctica de la guía. A pesar de la resistencia inicial a los cambios de comportamiento, el enfoque participativo con consultas mensuales y sesiones educativas facilitó la adopción de unas prácticas seguras de manipulación de alimentos y de saneamiento. Las autoridades competentes asumieron un importante rol de liderazgo durante las intervenciones, lo que ayudó a cambiar actitudes respecto a las necesidades de regulación y de mantenimiento de los mercados. Este cambio podría potenciar la sostenibilidad de las intervenciones.

References

1. Woo PC, Lau SK, Yuen KY. Infectious diseases emerging from Chinese wet-markets: zoonotic origins of severe respiratory viral infections. *Curr Opin Infect Dis* 2006;19:401–7. doi:10.1097/01.qco.0000244043.08264.fc PMID:16940861
2. Indriani R, Samaan G, Gultom A, Loth L, Indryani S, Adjid R et al. Environmental sampling for avian influenza virus A (H5N1) in live-bird markets, Indonesia. *Emerg Infect Dis* 2010;16:1889–95. PMID:21122218
3. Kung NY, Morris RS, Perkins NR, Sims LD, Ellis TM, Bissett L et al. Risk for infection with highly pathogenic influenza A virus (H5N1) in chickens, Hong Kong, 2002. *Emerg Infect Dis* 2007;13:412–8. doi:10.3201/eid1303.060365 PMID:17552094
4. *A guide to healthy food markets*. Geneva: World Health Organization; 2006. Available from: www.who.int/foodsafety/publications/capacity/healthymarket_guide.pdf [accessed 20 January 2012]
5. International Food Policy Research Institute [Internet]. Overview on poultry sector and HPAI situation for Indonesia with special emphasis on the island of Java. Washington: IFPRI; 2008 (*Africa/Indonesia Region Report No. 3)*. Available from: http://www.ifpri.org/publication/overview-poultry-sector-and-hpai-situation-indonesia-special-emphasis-island-java [accessed 20 January 2012]
6. *A manual for improving biosecurity in the food supply chain: focusing on live bird markets.* New Delhi: World Health Organization, Regional Office for South-East Asia; 2006. Available from: www.searo.who.int/en/Section23/Section1001/Section1110_11528.htm [accessed 20 January 2012].
7. Hart E, Bond M. *Action research for health and social care: a guide to practice.* Buckingham: Open University Press; 1996.
8. Samaan G, Gultom A, Indriani R, Lokuge K, Kelly PM. Critical control points for avian influenza A H5N1 in live bird markets in low resource settings. *Prev Vet Med* 2011;100:71–8. doi:10.1016/j.prevetmed.2011.03.003 PMID:21489646
9. Hinsz VB, Nickell GS, Park ES. The role of work habits in the motivation of food safety behaviors. *J Exp Psychol Appl* 2007;13:105–14. doi:10.1037/1076-898X.13.2.105 PMID:17535135
10. Wilcock A, Ball B, Fajumo A. Effective implementation of food safety initiatives: managers', food safety coordinators' and production workers' perspectives. *Food Contr* 2011;22:27–33. doi:10.1016/j.foodcont.2010.06.005
11. Ball B, Wilcock A, Aung M. Factors influencing workers to follow food safety management systems in meat plants in Ontario, Canada. *Int J Environ Health Res* 2009;19:201–18. doi:10.1080/09603120802527646 PMID:20183193
12. Guan J, Chan M, Grenier C, Wilkie DC, Brooks BW, Spencer JL. Survival of avian influenza and Newcastle disease viruses in compost and at ambient temperatures based on virus isolation and real-time reverse transcriptase PCR. *Avian Dis* 2009;53:26–33. doi:10.1637/8381-062008-Reg.1 PMID:19432000
13. Fraser RW, Williams NT, Powell LF, Cook AJ. Reducing Campylobacter and Salmonella infection: two studies of the economic cost and attitude to adoption of on-farm biosecurity measures. *Zoonoses Public Health* 2010;57:e109–15. doi:10.1111/j.1863-2378.2009.01295.x PMID:19968845