

# Early response to the emergence of influenza A(H7N9) virus in humans in China: the central role of prompt information sharing and public communication

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**Problem** In 2003, China's handling of the early stages of the epidemic of severe acute respiratory syndrome (SARS) was heavily criticized and generally considered to be suboptimal.

**Approach** Following the SARS outbreak, China made huge investments to improve surveillance, emergency preparedness and response capacity and strengthen public health institutions. In 2013, the return on these investments was evaluated by investigating China's early response to the emergence of avian influenza A(H7N9) virus in humans.

**Local setting** Clusters of human infection with a novel influenza virus were detected in China – by national surveillance of pneumonia of unknown etiology – on 26 February 2013.

**Relevant changes** On 31 March 2013, China notified the World Health Organization (WHO) of the first recorded human infections with A(H7N9) virus. Poultry markets – which were rapidly identified as a major source of transmission of A(H7N9) to humans – were closed down in the affected areas. Surveillance in humans and poultry was heightened and technical guidelines were quickly updated and disseminated. The health authorities collaborated with WHO in risk assessments and risk communication. New cases were reported promptly and publicly.

**Lessons learnt** The relevant infrastructures, surveillance systems and response capacity need to be strengthened in preparation for future emergencies caused by emerging or existing disease threats. Results of risk assessments and other data should be released promptly and publicly and such release should not jeopardize future publication of the data in scientific journals. Coordination between public health and veterinary services would be stronger during an emergency if these services had already undertaken joint preparedness planning.

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

## Problem

Severe acute respiratory syndrome is a zoonotic viral infection that probably first occurred, in late 2002, in the south of China's Guangdong province.<sup>1</sup> Although the syndrome eventually spread to more than 30 countries – with more than 8000 probable cases and more than 800 deaths reported worldwide – most of the probable cases occurred in mainland China.<sup>2</sup>

In March 2003, the World Health Organization (WHO) issued a global alert and travel advisory following the identification of clusters of cases of “severe atypical pneumonia” in hospitals in Guangdong and the Hong Kong Special Administrative Region in China and Hanoi in Viet Nam.<sup>2</sup> By April 2003, a coronavirus had been identified as the infectious agent responsible for this pneumonia and the pneumonia itself had been called severe acute respiratory syndrome (SARS).<sup>3</sup>

The early stages of the SARS epidemic went largely unnoticed. Many clinicians were unaware of the epidemic threat posed by the “atypical pneumonia”; cases went undetected because of poor surveillance and an inadequate network of clinical laboratories, and poor information transfer meant that the epidemic had gained considerable strength before it was recognized.<sup>4</sup> China's delayed detection of the outbreak and – in particular – its poor level of communication during the response to the emergency probably led to many avoidable cases of SARS and damaged China's economy and reputation.

## Approach

Heavy criticism of China's response in the early stages of the SARS outbreak led to huge investments in public health by the Chinese government. There has been substantial investment in public health infrastructure, such as new buildings, improvements in Internet connectivity and the purchase of technically advanced equipment. The government has also supported the development of the national Centre for Disease Control and Prevention (China CDC) and the provincial and county-level Centres for Disease Control and Prevention. China CDC has remodelled its surveillance of infectious diseases<sup>5</sup> – with an emphasis on severe respiratory diseases and the development of a national influenza surveillance network. The Chinese health authorities have initiated training programmes in field epidemiology – at the national, provincial and municipality levels – and strengthened emergency preparedness and response capacity. The detailed investments that the Chinese government has made to improve the surveillance and control of “high-priority” infectious diseases have been well documented.<sup>6</sup>

The aims of China's post-SARS investments in public health were to improve disease surveillance and make the country's response to future disease outbreaks both swift and effective. To see if these aims had been achieved, we investigated China's early response to the emergence of avian influenza

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(Submitted: 11 June 2013 – Revised version received: 22 November 2013 – Accepted: 25 November 2013 – Published online: 16 December 2013)

A(H7N9) virus in humans during April 2013. We compared the chronology of A(H7N9)-related events and responses with the level of A(H7N9)-related public attention. The latter variable was evaluated using Sina Weibo (SINA Corp., Shanghai, China), which is the largest social media network in China. Sina Weibo – which offers services similar to those of Twitter (Twitter Inc., San Francisco, United States of America) but in Chinese – is used by more than 30% of Chinese Internet users. In December 2012, Sina Weibo had more than 500 million registered users and dealt with about 100 million new messages each day.<sup>7</sup> For our study, we searched Sina Weibo daily – during the outbreak – for new A(H7N9)-related postings, by using the Chinese words for “H7N9” and “bird flu” as the search terms.

## Local setting and relevant changes

On 31 March 2013, China's National Health and Family Planning Commission notified WHO of three human infections with A(H7N9): two in the city of Shanghai and one in Anhui province. By 7 November 2013, 139 confirmed cases of human infection with A(H7N9) – including 45 fatal cases – had been reported in mainland China – in 10 provinces and two municipalities.<sup>8</sup> Although the animal reservoir of A(H7N9) infection involved in this outbreak has yet to be confirmed, it is probably poultry and most transmission to humans probably occurs in markets selling live poultry. The Chinese Ministry of Agriculture has already tested more than 1.2 million birds and other animals – from more than 69 000 different sites – for A(H7N9). By 9 December 2013, only 68 non-human samples had been found positive for the virus. The 68 positive samples – which were all collected in markets selling live poultry – came from poultry, a pigeon or feathers, bird faeces, cages or other “environmental” sources within the market.<sup>9</sup>

Although the investigation of more than 3000 close contacts of the confirmed cases has not revealed any evidence of sustained human-to-human transmission of the A(H7N9) virus, there is evidence of some human-to-human transmission among at least three family clusters.<sup>10–12</sup> China's National

Health and Family Planning Commission and WHO remain concerned about the threat posed by the A(H7N9) virus because it is an avian virus that seems to have recently infected humans, causes serious disease in humans and has genetic characteristics that indicate that it has enhanced capacity for mammalian infection.<sup>13,14</sup> It remains unclear, however, if A(H7N9) is common in poultry. It has been difficult to detect the virus in poultry or other birds because the virus causes little avian pathogenicity – and may therefore spread undetected within and between flocks of birds.

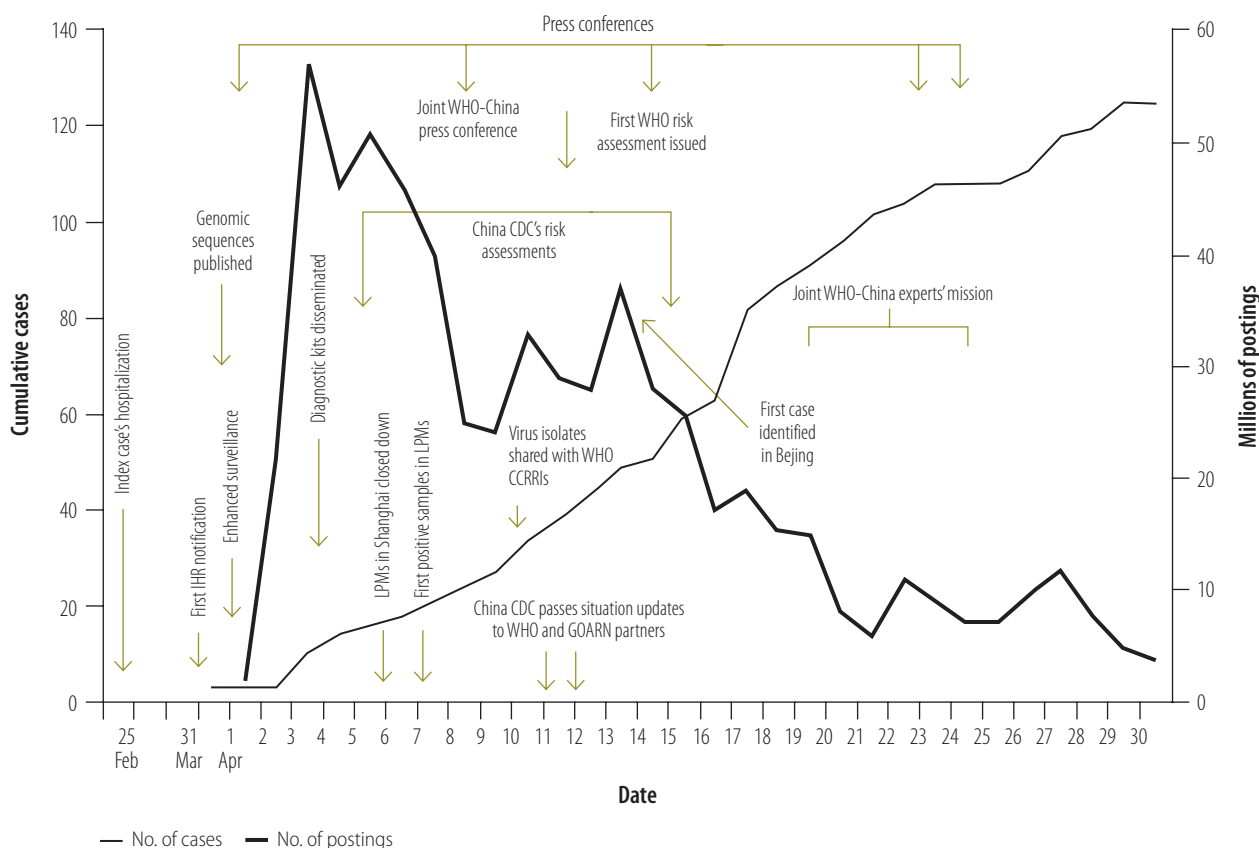
As with A(H5N1),<sup>15</sup> new sporadic cases and small clusters of human infection with A(H7N9) infection are likely to continue. WHO remains alert to any changes in the behaviour of the A(H7N9) virus in humans and poultry and the resistance of the virus to antiviral drugs will be carefully monitored. More or larger clusters of human cases – or evidence of sustained human-to-human transmission – could indicate that the virus is acquiring qualities compatible with pandemic potential.

The 2013 outbreak of human infection with A(H7N9) appears to have begun when a family cluster of three cases of severe pneumonia – which was recognized as abnormal by astute clinicians – triggered an alert to the Shanghai Centre for Disease Control and Prevention on 26 February 2013.<sup>13</sup> The influenza A virus found in the cluster did not match any known subtype. Within 4 weeks of the cluster being reported, staff at the China CDC – the WHO Collaborating Centre for Reference and Research on Influenza (WHO CCRI) in Beijing – had discovered that the virus belonged to a novel strain: A(H7N9). This viral strain was identified much more quickly than SARS coronavirus or A(H5N1), which took about 5 and 3 months to identify, respectively.<sup>4,16</sup> The viral genomic sequences from the first three known human cases of A(H7N9) infection were published, via the Global Initiative on Sharing Avian Influenza Data, on 31 March 2013. On the following day, the National Health and Family Planning Commission enhanced surveillance of pneumonia of unknown etiology and influenza-like illnesses across China. Two days later, molecular diagnostic kits were distributed to the National Veterinary Services, the laboratories in provincial Centres for Disease

Control and Prevention and clinical pathology laboratories in major hospitals. By 3 April 2013 – just 4 days after WHO had been notified of this family cluster – the relevant guidelines regarding infection control, clinical management and surveillance had been updated and the updated guidelines had been issued. On the same day, the national government established a taskforce – for the control of A(H7N9) – that included representatives from 16 ministries and was led by the National Health and Family Planning Commission. Staff at the Shanghai Centre for Disease Control and Prevention quickly identified markets that sold live poultry to be the main locations of human infection with A(H7N9). On 6 April 2013, the city's mayor ordered all such markets in Shanghai to be closed. Isolates of the virus were sent to other WHO CCRRIs on 10 April 2013. This sharing led to the investigation of viral mutations and the development of new probes and primers for use in diagnostic tests. As the number of cases continued to increase, China CDC conducted a series of rapid risk assessments to address the likelihood of sustained human-to-human transmission and further cases of human infection. Although these initial assessments were disseminated to all of China's Centres for Disease Control and Prevention – and were generally similar to the risk assessments that were made, independently, by WHO – they were not released publicly.

By the second week of April 2013, the China CDC was regularly sharing data – on the human infections with A(H7N9) – with WHO's Regional Office for the Western Pacific, WHO's headquarters in Geneva and other members of the Global Outbreak Alert and Response Network. New cases of human infection and the type and collection site of each A(H7N9)-positive animal sample were promptly reported on official websites. This allowed members of the public to follow the epidemic situation. There was an initial delay in the collection and sharing of the detailed information needed to evaluate the risks of human-to-human transmission accurately and determine the underlying medical conditions of patients with symptomatic A(H7N9) infections. Nonetheless, the first detailed virological and epidemiological results of investigations on the outbreak were published in scientific journals in mid-April 2013.<sup>11,13</sup>

Fig. 1. **Events during emergence of A(H7N9) virus as human pathogen and numbers of related postings on social media network, China, 2013**



CCRRI, Collaborating Centre for Reference and Research on Influenza; China CDC, Chinese Centre for Disease Control and Prevention; GOARN, Global Outbreak Alert and Response Network; IHR, International Health Regulations; LPMs, live-poultry markets; WHO, World Health Organization.  
Notes: the plotted lines show the cumulative number of cases of human infection with the influenza A(H7N9) virus and the daily number of postings on Sina Weibo – China's largest social media network – that mentioned "bird flu", "H7N9" or both of these terms.

To improve clinical management of severely ill patients and to plan for appropriate research, WHO facilitated discussion between key Chinese clinicians and international experts on influenza. WHO and China's National Health and Family Planning Commission jointly coordinated a mission by internationally-recognized influenza experts, who visited Beijing and Shanghai from 19 to 25 April 2013 to assess the A(H7N9) situation.<sup>17</sup> The main aims of this mission were to provide expert opinions on the level of the A(H7N9) threat and encourage investigators to close any relevant gaps in our critical knowledge and understanding.

From the first recognition of the outbreak, WHO participated – with China's National Health and Family Planning Commission – in national risk assessments and press conferences. Some outbreak-related events appeared related to increases or decreases in the

daily numbers of A(H7N9)-related messages posted on Sina Weibo. The first main surge in the number of cases reported daily – on 4 April 2013 – and the report of the first case to be identified in Beijing – on 13 April 2013 – were followed by dramatic rises in the number of A(H7N9)-related postings. In contrast, a press conference on 8 April 2013 – presented jointly by WHO and the National Health and Family Planning Commission – and a public announcement on 17 April 2013 – on the WHO's experts' mission to China – each appeared to be

associated with a subsequent fall in the daily number of such postings (Fig. 1).

## Lessons learnt

The main lessons learnt are summarized in Box 1. China's prompt communication and collaboration with WHO in assessing and responding to human infections with the novel influenza A(H7N9) virus were the result of sound preparedness and close and continuing international collaboration. Above all, China's apparently effective response to

### Box 1. Summary of main lessons learnt

- Countries should invest in preparedness to respond to emerging and existing disease threats by strengthening the relevant infrastructures, surveillance systems and response capacity.
- Risk assessments should be released publicly and should not jeopardize authors' plans to publish in scientific journals.
- Coordination between public health and veterinary services would be stronger during an emergency if these services had already undertaken joint preparedness planning.

the A(H7N9) outbreak in 2013 should be perceived both as one of the major returns on the investment that China has made in public health since the SARS epidemic in 2003 and as a useful – if still not optimal – model for responses to similar outbreaks in the future. The International Health Regulations that were formulated in 2005 – partly in response to the emergence of SARS – have helped catalyse a standardized international framework in which WHO provides a system to enable prompt information sharing.

Epidemics caused by emerging infectious diseases often generate substantial public concern. By publicly communicating about the risks – from the early stages of a possible epidemic – health authorities can help to build trust in governments, public health workers and the public. The public needs to have prompt access to appropriate public health information.

The use of Sina Weibo and similar social networks to monitor public inter-

est in a health threat – or any other health topic – and also, perhaps, to disseminate health education merits further research. In our study, certain major events during the outbreak were associated with major increases in A(H7N9)-related postings but some more formal announcements about the outbreak appeared to reduce public interest. It seems possible that the formal announcements simply reduced public concern about the outbreak.

Risk assessment is a systematic process that can be used to assess the level of threat and facilitate the selection of the most appropriate interventions in an often-complex situation. Such assessment often helps to identify gaps in our critical knowledge and weaknesses in the relevant infrastructure. It may also help to identify the better strategies for closing the knowledge gaps and strengthening infrastructures. As the A(H7N9) virus emerged as a public health emergency of international concern, the public health community and the threatened public expected to

be kept informed of all of the relevant data. The findings of national risk assessments should therefore be rapidly released publicly and – in due course – published in full in scientific journals. Journal editors should be willing to publish articles based on data that – for public benefit – have already been released to the public in summary form.

China's prompt response to the emergence of the A(H7N9) virus as a human pathogen – which spanned multiple governmental departments and ministries at national, provincial and municipal level – was mainly the result of strong leadership in a critical situation. We believe that strong and well integrated coordination between veterinary and public health services can be best sustained by joint preparedness planning and the creation of joint response systems – as already promoted by international health organizations under the "One Health" approach.<sup>18</sup> ■

**Competing interests:** None declared

## ملخص

### الاستجابة المبكرة لظهور فيروس الأنفلونزا (A(H7N9)) لدى البشر في الصين: الدور المركزي للتبادل الفوري للمعلومات والاتصال العام

تم تحديدها على نحو سريع كمصدر رئيسي لسريان فيروس A(H7N9) إلى البشر – في المناطق الموبوءة. وتم زيادة الترصد لدى البشر والدواجن وتحديث المبادئ التوجيهية التقنية ونشرها على نحو سريع. وتعاونت السلطات الصحية مع منظمة الصحة العالمية في تقييمات المخاطر والإبلاغ عن المخاطر. وتم الإبلاغ عن الحالات الجديدة على نحو فوري وبشكل علني. الدروس المستفادة يتعين تعزيز البنى التحتية ونظم الترصد والقدرة على الاستجابة ذات الصلة للتأهب للطوارئ المستقبلية الناجمة عن التهديدات المرضية القائمة أو المستجدة. وينبغي إعلان نتائج تقييمات المخاطر وغيرها من البيانات على نحو فوري وبشكل علني وينبغي ألا يهدد هذا الإعلان نشر هذه البيانات في المجلات العلمية المستقبلية. وسوف يصبح التنسيق بين خدمات الصحة العمومية والخدمات البيطرية أقوى أثناء الطوارئ إذا قامت هذه الخدمات بالفعل بالتخطيط المشترك للتأهب.

المشكلة في عام 2003، تم توجيه نقد لاذع لتعامل الصين مع المراحل المبكرة لجائحة المتلازمة الرئوية الحادة الوحيدة (سارس) واعتباره دون المستوى بشكل عام. الأسلوب أقامت الصين استثمارات ضخمة بعد فاشية سارس لتحسين الترصد والتأهب للطوارئ والقدرة على الاستجابة وتعزيز مؤسسات الصحة العمومية. وفي عام 2013، تم تقييم عوائد هذه الاستثمارات عن طريق تحري استجابة الصين المبكرة لظهور فيروس الأنفلونزا الجديد لدى البشر. المواقع المحلية تم اكتشاف مجموعات العدوى البشرية بفيروس الأنفلونزا الجديد في الصين – عن طريق الترصد الوطني للالتهاب الرئوي غير معروف الأسباب – في 26 شباط / فبراير 2013. التغيرات ذات الصلة في 31 آذار / مارس 2013 أخطرت الصين منظمة الصحة العالمية (WHO) بأول عدوى بشرية بفيروس A(H7N9) تم تسجيلها. وتم إغلاق أسواق الدواجن – التي

## الخلاصة

مجموعتنا من البشر في الصين: الدور المركزي للتبادل الفوري للمعلومات والاتصال العام

**المشكلة** 2003年，中国对非典（SARS）流行早期阶段的处理广受诟病，普遍被认为是次优的处理。

**方法** SARS爆发事件后，中国投入巨资来改善监测、应急准备和响应能力以及加强公共卫生机构。2013年，通过调查中国应对人群中出现甲型H7N9禽流感病毒的早期响应来评估这些投资的回报。

**当地状况** 2013年2月26日，通过全国对不明原因肺炎的监测，检测到感染新型流感的人群。

**相关变化** 2013年3月31日，中国向世界卫生组织（WHO）通报了第一例记录在案的人感染甲型H7N9禽流感病毒。在发病地区，关闭了被迅速认定为人类感染甲型H7N9禽流感主要传染源的鸡鸭市场。增强



了人群和家禽监测，快速更新和分发了技术指南。卫生当局与世卫组织协作进行风险评估和风险沟通。新病例得到迅速公开的报告。

**经验教训** 为应对未来因新出现或现有疾病威胁引起的突发事件，需要加强相关的基础设施、监测系统和反

应能力。风险评估的结果和其他数据应及时和公开地发布，这种发布不应妨碍未来数据在科学期刊上的发表。如果公共卫生和兽医部门已落实了共同的准备计划，这些部门之间的协调就会更有力。

## Résumé

### Réponse précoce à l'émergence du virus de la grippe A(H7N9) chez l'homme en Chine: le rôle central du partage rapide des informations et de la communication publique

**Problème** En 2003, la gestion des premiers stades de l'épidémie du syndrome respiratoire aigu sévère (SRAS) par la Chine a été fortement critiquée et généralement considérée comme non optimale.

**Approche** Après l'épidémie de SRAS, la Chine a investi massivement pour améliorer sa surveillance, sa préparation aux situations d'urgence et sa capacité de réponse, et pour renforcer les établissements de santé publique. En 2013, le retour sur ces investissements a été évalué par l'examen de la réponse précoce de la Chine à l'émergence du virus de la grippe aviaire A(H7N9) chez l'homme.

**Environnement local** Des cas d'infection humaine au nouveau virus de la grippe ont été détectés en Chine le 26 février 2013 par le système de surveillance nationale des pneumonies d'étiologie inconnue.

**Changements significatifs** Le 31 mars 2013, la Chine a notifié à l'Organisation mondiale de la Santé (OMS) les premières infections humaines au virus A(H7N9) enregistrées. Les marchés de volaille – qui ont été rapidement identifiés comme des sources majeures de

transmission du virus A(H7N9) à l'homme – ont été fermés dans les zones touchées. La surveillance a été renforcée chez l'homme et les volailles, et les recommandations techniques ont été rapidement mises à jour et diffusées. Les autorités sanitaires ont collaboré avec l'OMS dans les domaines de l'évaluation des risques et de la communication des risques. Les nouveaux cas ont été signalés rapidement et publiquement.

**Leçons tirées** Les infrastructures concernées, les systèmes de surveillance et la capacité de réponse doivent être renforcés en prévision des futures urgences causées par les menaces de maladies émergentes ou existantes. Les résultats des évaluations des risques et les autres données doivent être communiqués rapidement et publiquement, et ces communications ne doivent pas compromettre la publication ultérieure des données dans les revues scientifiques. La coordination entre les services de santé publique et les services vétérinaires serait plus forte pendant une situation d'urgence si ces services avaient déjà engagé une planification préalable commune.

## Резюме

### Ранний ответ на появление вируса гриппа А (H7N9) у населения в Китае: центральная роль оперативного обмена информацией и информирования общественности

**Проблема** В 2003 году подход Китая к лечению населения на ранних стадиях эпидемии тяжелого острого респираторного синдрома (ТОРС) подвергся жесткой критике и считался неоптимальным.

**Подход** После вспышки ТОРС Китай направил крупные инвестиции на укрепление институтов общественного здравоохранения, улучшение качества эпиднадзора, готовность к чрезвычайным ситуациям и скорость реагирования. В 2013 году эффективность этих инвестиций была оценена путем исследования стратегии раннего реагирования Китая на появление у населения вируса птичьего гриппа типа А (H7N9).

**Местные условия** 26 февраля 2013 года Агентством национального эпиднадзора за случаями пневмонии неизвестной этиологии в Китае были обнаружены кластеры инфицирования людей новым вирусом гриппа.

**Осуществленные перемены** 31 марта 2013 года Китай уведомил Всемирную организацию здравоохранения (ВОЗ) о первых зарегистрированных случаях инфицирования людей вирусом А (H7N9). В инфицированных районах были закрыты птичьи

рынки, которые были быстро идентифицированы как основной источник передачи гриппа А (H7N9) человеку. Был усилен эпиднадзор среди населения и домашней птицы, а также обновлены и распространены соответствующие технические инструкции. Органы здравоохранения сотрудничали с ВОЗ в оценке рисков и информировании о них. О выявлении новых случаев заболевания сообщалось быстро и публично.

**Выводы** Соответствующие инфраструктуры, системы эпиднадзора и ответные меры должны быть усилены при подготовке к будущим чрезвычайным ситуациям, вызванным новыми или существующими заболеваниями. Результаты оценки риска и прочие данные должны сообщаться немедленно и публично, и такие сообщения не должны препятствовать будущей публикации этих данных в научных изданиях. Координация между общественным здравоохранением и ветеринарными службами была бы более эффективной в чрезвычайных ситуациях, если бы эти службы осуществили совместное планирование мероприятий на случай чрезвычайных ситуаций.

## Resumen

### La respuesta temprana en la aparición del virus de la gripe A(H7N9) en humanos en China: el papel central del intercambio de información y la comunicación pública a tiempo

**Situación** En 2003, la gestión de China de las primeras etapas de la epidemia del síndrome respiratorio agudo severo (SRAS) se criticó duramente y se consideró insuficiente por lo general.

**Enfoque** Tras el brote de SRAS, China realizó grandes inversiones para mejorar la vigilancia, la preparación para emergencias y la capacidad de respuesta, así como para fortalecer las instituciones de salud pública.

En 2013, se evaluó la rentabilidad de estas inversiones mediante una investigación sobre la respuesta temprana de China a la aparición del virus de la gripe aviar A(H7N9) en humanos.

**Marco regional** El 26 de febrero de 2013 se detectaron grupos de infecciones humanas con el nuevo virus de la gripe en China mediante la vigilancia nacional de la neumonía de etiología desconocida.

**Cambios importantes** El 31 de marzo de 2013, China comunicó a la Organización Mundial de la Salud (OMS) las primeras infecciones humanas del virus A(H7N9) registradas. Los mercados de aves de corral, que se identificaron de inmediato como una fuente importante de transmisión del virus A(H7N9) a los humanos, se cerraron en las zonas afectadas. Se reforzó la vigilancia en humanos y aves de corral a la vez que se actualizaron y difundieron las directrices técnicas con rapidez.

Las autoridades de salud colaboraron con la OMS en la evaluación de los riesgos y la comunicación de los riesgos. De inmediato, se anunciaron los nuevos casos públicamente.

**Lecciones aprendidas** Deben reforzarse las infraestructuras pertinentes, los sistemas de vigilancia y la capacidad de respuesta como preparación a las futuras emergencias causadas por la amenaza de enfermedades nuevas o existentes. Los resultados de las evaluaciones de riesgo y el resto de datos deben divulgarse rápida y públicamente, pero dicha divulgación no debe poner en peligro la futura publicación de los datos en las revistas científicas. La coordinación entre la salud pública y los servicios veterinarios sería más fuerte durante una emergencia si estos servicios planificaran de antemano la preparación conjunta.

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