

Entry and exit screening of airline travellers during the A(H1N1) 2009 pandemic: a retrospective evaluation

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Objective To evaluate the screening measures that would have been required to assess all travellers at risk of transporting A(H1N1)pdm09 out of Mexico by air at the start of the 2009 pandemic.

Methods Data from flight itineraries for travellers who flew from Mexico were used to estimate the number of international airports where health screening measures would have been needed, and the number of travellers who would have had to be screened, to assess all air travellers who could have transported the H1N1 influenza virus out of Mexico during the initial stages of the 2009 A(H1N1) pandemic.

Findings Exit screening at 36 airports in Mexico, or entry screening of travellers arriving on direct flights from Mexico at 82 airports in 26 other countries, would have resulted in the assessment of all air travellers at risk of transporting A(H1N1)pdm09 out of Mexico at the start of the pandemic. Entry screening of 116 travellers arriving from Mexico by direct or connecting flights would have been necessary for every one traveller at risk of transporting A(H1N1)pdm09. Screening at just eight airports would have resulted in the assessment of 90% of all air travellers at risk of transporting A(H1N1)pdm09 out of Mexico in the early stages of the pandemic.

Conclusion During the earliest stages of the A(H1N1) pandemic, most public health benefits potentially attainable through the screening of air travellers could have been achieved by screening travellers at only eight airports.

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Introduction

New infectious diseases appear to be emerging faster now than ever before, and many diseases that were once controlled are re-emerging.¹ These trends are probably driven by the convergence of various global forces, including growth in the human population, urbanization, changes in the interactions between human and animal populations, climate change, and increases in international travel and trade.^{2–6} Each year, more than 700 airlines transport over 2.5 billion (i.e. 2500 million) travellers between 4000 airports. While growth in air travel confers tremendous benefits to humankind, it also expands the opportunities for local infectious disease outbreaks to transform swiftly into international epidemics that can threaten global health, security and prosperity.^{7,8} In 2005, in response to the changing patterns observed in the global spread of several infectious diseases, the World Health Assembly ratified changes to the 1969 International Health Regulations.⁹ The stated aims of the revised regulations were “to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade”.⁹ These aims can be achieved by addressing the local conditions that contribute to the emergence of epidemics of infectious disease and – if such prevention fails – by tackling local infectious disease outbreaks before they evolve into international events. Since public health capacity can be easily overwhelmed,

particularly in resource-limited countries, some infectious disease epidemics will inevitably spread across international borders.¹⁰ In these instances, national authorities worldwide will face difficult, time-sensitive decisions about whether the entry screening of international travellers is warranted. These decisions require not only a clear, a priori articulation of the goals of traveller screening – specifically, whether the objective is to prevent the importation of a pathogen or just to delay such importation and so “buy” a little time to enhance preparedness – but also rigorous assessments of the expected costs and benefits of screening and of the probability of its success (with estimates of uncertainty), as well as predictions of the morbidity and/or mortality that could be averted by screening.

While outright travel restrictions are generally regarded as excessively disruptive, current opinions on the health screening of travellers – and the best strategies to adopt – are mixed.^{11–18} In attempts to model the public health impact of traveller screening, little attention has been paid to the location of the cities that are contemplating screening in relation to the location of the epidemic or pandemic of interest within the global air transportation network. Decisions about traveller screening are frequently made on the basis of suboptimal evidence and, in consequence, may be unduly influenced by public or political perception of the risks to health posed by a particular pathogen. Recently, a panel of international experts in the field evaluated the performance of the 2005 International Health Regulations during the influenza A (H1N1) 2009 pandemic and highlighted the need for stronger evidence

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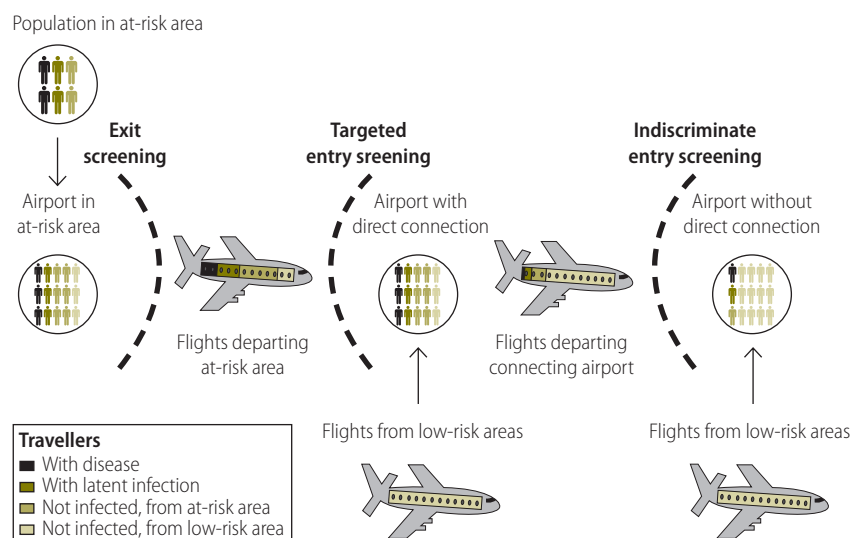
to justify any public health measures that could substantially disrupt international travel and trade.¹⁹ The panel recommended that the World Health Organization review and assess the effectiveness and impact of the border measures that were implemented during the A(H1N1) 2009 pandemic, to provide evidence-based guidance for managing future infectious disease events of international concern.²⁰ Responding to this recommendation, we studied worldwide patterns of air travel to and from Mexico, the country where the A(H1N1) 2009 pandemic presumably began,¹⁹ both before and during the pandemic. A central aim of this study was to define and distinguish screening measures that are “commensurate with and restricted to public health risks” from those that cause “unnecessary interference with international traffic”.¹⁹

Methods

We studied the flight itineraries of international travellers who had arrived in or departed from Mexico before the A(H1N1) 2009 pandemic and during its earliest stages. The main aims were to determine how news of an emerging pandemic threat affected the patterns of air traffic over Mexico and to quantify the relative disruption in international air traffic that would have resulted had all travellers who might have transported A(H1N1)pdm09 out of Mexico been subjected to health screening – either as they departed from airports in areas of Mexico at risk or as they arrived, via direct or connecting flights from Mexico, at airports in other countries (Fig. 1). We did not evaluate a particular method of health screening (e.g. infrared thermography) but focused on quantifying the total number of airports where traveller health screening would have been needed, and the total number of travellers who would have had to be screened, to assess all international travellers at risk of transporting A(H1N1)pdm09 out of Mexico during the earliest stages of the pandemic. All of the underlying assumptions that were made in the analysis are shown in Box 1.

We first analysed data on worldwide flight itineraries collected by the International Air Transport Association.²¹ These data were used to quantify the monthly numbers of international travellers arriving in or departing from Mexico in 2007, 2008 and 2009. To

Fig. 1. **Conceptual framework for the airport-based screening of travellers for infectious disease**



Note: If this framework had been applied to the early phases of the A(H1N1) 2009 pandemic, air travellers who had initiated travel in Mexico, on their way to a non-Mexican destination, would have been considered “at-risk”. All other international travellers, including those who had not begun their trips in Mexico but made a connecting flight at a Mexican airport en route to another international destination, would have been considered “low-risk”. The screening of travellers at Mexican airports before they boarded flights out of Mexico would have been considered “exit screening”. The screening of travellers at other airports as they arrived on direct flights from Mexico would have been categorized as “targeted entry screening”. The screening of all international air travellers arriving at their destination international airports would have been considered “indiscriminate entry screening”.

Box 1. Assumptions underlying data analysis

- Screening has the potential to detect travellers with clinical signs or symptoms of infectious disease.
- Differences in effectiveness across screening modalities are not considered.
- “Disruption” is defined as a delay in air travel.
- The A(H1N1) 2009 pandemic had a single geographic focus for long enough to allow implementation of traveller health screening measures.
- Health outcomes or cost-effectiveness of screening modalities are not explicitly considered.

determine the origins and final destinations of these air travellers accurately, we analysed full-route flight itineraries from a database of the International Air Transport Association that covered more than 6 billion individual passenger trips that occurred in 2007–2009 (or an estimated 95% of the world’s commercial air traffic over this period).²¹ We then quantified the weekly numbers of A(H1N1) pandemic-related news stories that were recorded in 2009 by the Global Public Health Intelligence Network²² – an epidemic-intelligence tool that monitors thousands of web sites in seven languages for news of emerging infectious disease threats. The trends in the weekly numbers of such stories were then compared with the deviations (from the “usual” traffic

observed in the pre-pandemic years of 2007 and 2008) seen in international air traffic over Mexico in 2009.

Next, we analysed the flight itineraries of individual international travellers who departed from Mexico in April or May of 2009. The time period of this investigation was centred upon the first detection of signs of an A(H1N1) epidemic in Mexico in 2009 (in early April 2009) and the time when the international significance of the epidemic was first recognized (in late April 2009).²³ Over this period, any person who initiated travel from any domestic or international airport in Mexico was categorized as being “at-risk” of carrying A(H1N1)pdm09. All other air travellers, including those who initiated travel outside Mexico but changed flights at a Mexican airport en

route to a non-Mexican destination, were considered to be at low risk of carrying A(H1N1)pdm09.

We then compared the relative disruption in international air traffic that would have resulted from the screening of air travellers at the point of their departure from any international airport in Mexico (i.e. “exit” screening) with that which would have resulted from the screening of all passengers arriving at other international airports after flying from Mexico on a direct flight (i.e. targeted “entry” screening) or by any, direct or connecting flight (i.e. indiscriminate “entry” screening). For each scenario, disruption in air traffic was evaluated by considering (i) the numbers of cities and countries where health screening would have been needed to screen all at-risk travellers and (ii) the number of travellers who would have had to be screened for every traveller at risk.

The probability that travellers who had departed from Mexico while latently infected with A(H1N1)pdm09 (undetectable at exit screening) developed symptomatic disease during the course of travel (and so became potentially detectable by any subsequent entry screening) was estimated. For this, the median travel times (and interquartile ranges) for all at-risk travellers, from their initial flight in Mexico until their departure from one of Mexico’s international airports or their arrival at either any international airport receiving flights directly from Mexico or the last international airport in their final destination country, were determined. These values represent the median times between the at-risk travellers beginning their international trips and the latest opportunity when they could have been assessed by exit screening, targeted entry screening and indiscriminate entry screening, respectively. Travel times were calculated using the relevant 2009 flight schedules. These schedules were investigated using aviation databases from OAG (Luton, United Kingdom of Great Britain and Northern Ireland),²⁴ assuming that all flights arrived and departed on time.

Results

Mexico experienced a precipitous but short-term decline in international air travel once news of the A(H1N1) outbreak in the country reached the mainstream media, in late April 2009 (Appendix A, available at: http://www.biodiaspora.com/BWHO_Appendices.pdf). There was no evidence to indicate that news of an emerging pandemic threat triggered a sustained exodus of travellers out of Mexico, as the falls seen in the monthly numbers of international air travellers arriving in Mexico were matched by similar drops in the corresponding numbers of air travellers who left Mexico (Table 1).

Table 1. Pandemic A(H1N1)-related online media activity^a and deviations in international air traffic arriving in and departing from Mexico, March to August 2009

Month in 2009	Percentage change in online media reporting ^b	Percentage change in international arrivals ^c	Percentage change in international departures ^c
March	–	–11.9	–11.5
April	+395	+2.6	+3.5
May	+635	–37.8	–39.2
June	+354	–18.9	–23.6
July	+270	–11.4	–13.7
August	+402	–8.4	–8.8

^a Online news stories collected and translated by the Global Public Health Intelligence Network in Arabic, traditional and simplified Chinese, English, French, Portuguese, Russian, Spanish, and that included any of the following key words: *H1N1*, *influenza*, *swine flu*, *epidemic* or *pandemic*.

^b Percentage change in online news indexed to baseline levels in March 2009 (i.e. before international awareness of the A(H1N1) 2009 influenza pandemic).

^c Change in traveller volumes to and from Mexico are indexed to the corresponding months in 2008.

Analysis of the flight itineraries of the 583 774 at-risk travellers who flew out of Mexico in May 2009 revealed that exit screening would have caused the least disruption to international air traffic (Table 2). Using this method of screening, all travellers at risk of transporting A(H1N1)pdm09 could have been assessed as they departed from one of Mexico’s 36 international airports (which are in 35 different cities). Exit screening at just six airports in Mexico would have allowed for the assessment of about 90% of all travellers at risk (Appendix B, available at: http://www.biodiaspora.com/BWHO_Appendices.pdf). Only 6017 (1%) of the international air travellers who left Mexico in May 2009 were categorized as being at low risk of infection with A(H1N1)pdm09. Targeted entry screening, although involving the same travellers as exit screening, would have been more complicated, since it would have required health screening at 82 international airports in 26 countries. Indiscriminate entry screening would have been highly impractical and inefficient, since 67.3 million “low-risk” travellers at 1111 international airports would have had to be assessed to ensure that every at-risk

traveller from Mexico was screened. The results for the at-risk travellers who flew out of Mexico in April 2009 were generally similar (Appendix C, available at: http://www.biodiaspora.com/BWHO_Appendices.pdf). Entry screening has an advantage over exit screening in that it can detect travellers latently infected with a pathogen when they initiate travel but who go on to become symptomatic during the course of travel. However, this potential advantage will be small when the time spent in the air is only a small proportion of the incubation period of the pathogen. The median incubation period for A(H1N1)pdm09 in humans is about 2 days (range: 1–7),²⁵ but 78% and 91% of the at-risk travellers who flew from Mexico in May 2009 should have ended their air travel within 6 and 12 hours, respectively. At this time, the median scheduled travel time for direct flights between Mexico and 80 of the 82 cities that received such flights was < 12 hours, and even the longest direct flights from Mexico – those to Shanghai (20.17 hours) and Tokyo (17.25 hours) – should have taken less than one day (Fig. 2).

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Discussion

The 194 national signatories to the 2005 International Health Regulations agreed collectively to mitigate the spread of infectious diseases in a manner that would avoid “unnecessary interference with international traffic and trade”.⁹ To achieve this goal, national authorities worldwide need to be able to distinguish interventions with “reasonable” public

Table 2. **Characteristics of the health screening strategies that might have been used to detect A(H1N1) pandemic influenza in travellers in May 2009^a**

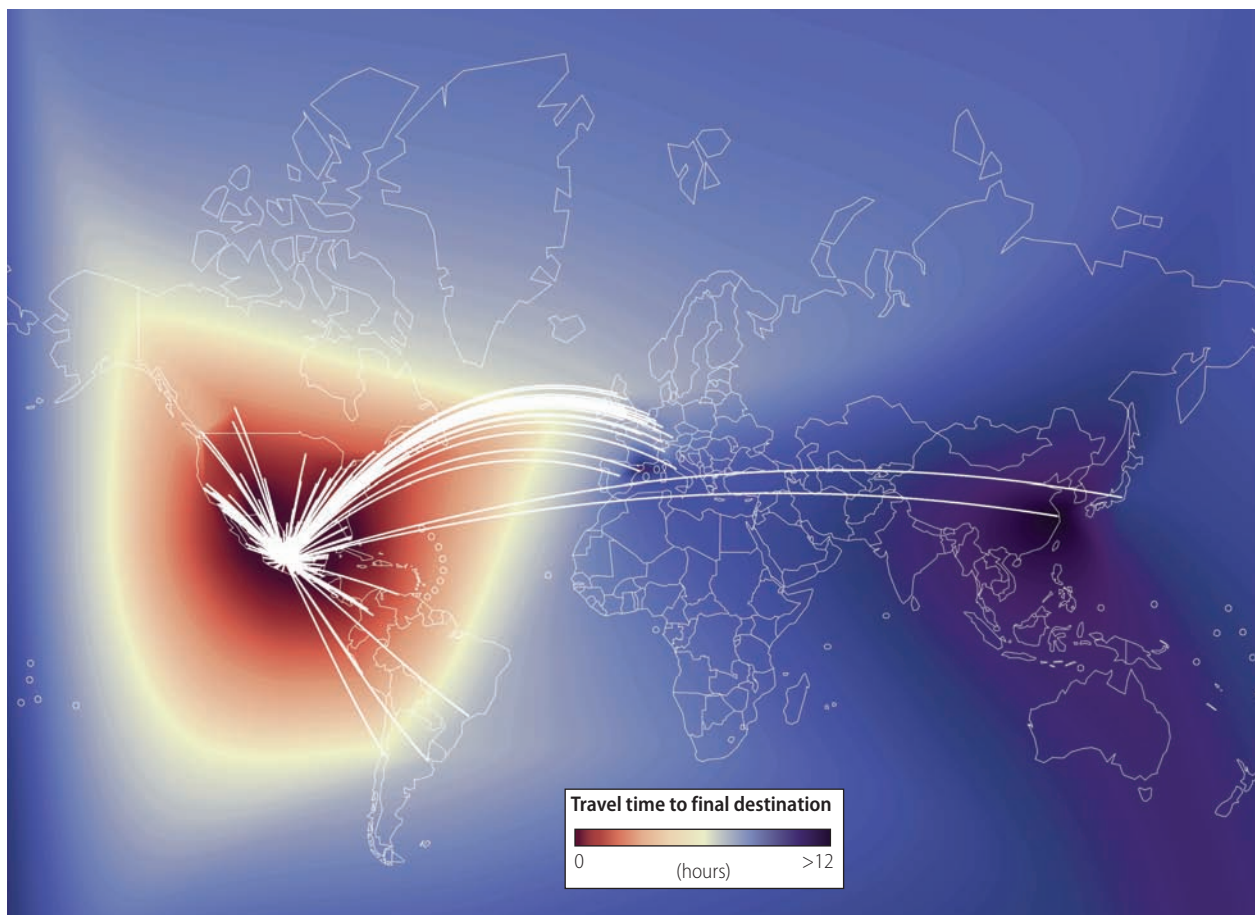
Characteristic	Strategy		
	Exit	Targeted entry ^b	Indiscriminate entry ^c
No. of cities where screening would have been required	35	82	1111
No. of low-risk travellers who would have had to be screened ^d	6017	6017	67 373 584
No. of travellers who would have had to be screened for every at-risk traveller ^d	1.01	1.01	116.4
No. of travel hours until screening			
Median (interquartile range)	0 (0–0)	3.37 (2.57–4.33)	3.35 (2.5–4.58)
Mean	0.1	4.28	4.32

^a The data come from modelled scenarios in which the theoretical aim was to prevent air travellers carrying A(H1N1)pdm09 out of Mexico in May 2009.

^b The screening of travellers on international flights arriving directly from Mexico.

^c The screening of travellers on international flights arriving from any international airport worldwide.

^d The 583 774 air travellers who initiated international travel from any domestic or international airport in Mexico in May 2009 were considered “at-risk” while all other travellers were considered “low-risk”.

Fig. 2. **International flights departing Mexico^a and corresponding travel times, May 2009**

^a 82 international cities received flights directly from Mexico in May 2009.

health returns from those that should be considered unnecessary because they are minimally effective and excessively disruptive to traffic and trade.¹⁹ The results of our analyses of the patterns of global air traffic during a real pandemic indicate that the indiscriminate entry screening of travellers on international

flights would be highly disruptive, inefficient and impractical. Compared with exit screening in areas at risk, indiscriminate entry screening could be marginally more effective but would be vastly more inefficient because the cohort to be screened would comprise at-risk travellers within a much larger pool

of low-risk travellers from areas of the world with little or no epidemic activity. According to our criteria, just 0.11% and 0.07% of all air travellers who arrived, in April and May of 2009, respectively, at international airports on international flights that did not originate in Mexico would have been at risk of infection

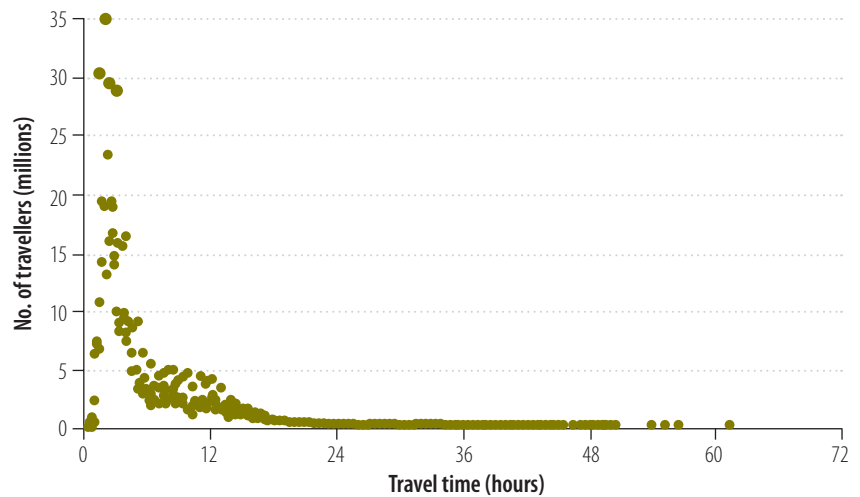
with A(H1N1)pdm09. The positive predictive value of the indiscriminate entry screening of international air travellers at this time would therefore have been extremely low, even if the screening method used had been highly sensitive and specific. For example, if 1% of the at-risk travellers who arrived in international airports on flights that did not originate in Mexico had had symptomatic A(H1N1)pdm09 infection and if the method used for entry screening for such infection had a specificity and a sensitivity of 99%, the positive predictive value of the screening would still have been <0.1% (i.e. fewer than 10 in every 10 000 travellers found positive in the screening test would actually have been infected with A(H1N1)pdm09). From a local public health standpoint, indiscriminate entry screening would probably be counterproductive, since it would draw valuable health and human resources away from areas of potentially greater need. Thus, in the A(H1N1) 2009 pandemic, assessment of the health status of travellers at 99.3% of the world's international airports could have been foregone at the expense of very few missed opportunities to prevent or delay the spread of A(H1N1)pdm09.

For the initial stages of the A(H1N1) 2009 pandemic – and, presumably, for other pandemics caused by pathogens that have similar or longer incubation periods than A(H1N1) pdm09 in humans – the potential benefits of targeted entry screening over exit screening appeared marginal because most international flights are of short duration relative to the incubation period of most pathogens. In 2009, most international flights took less than 12 hours (Fig. 3), with most such flights occurring within the same global region or between neighbouring regions (Appendix D, available at: http://www.biodiaspora.com/BWHO_Appendices.pdf). If travellers are harbouring infectious agents with very short incubation periods and are travelling on long, intercontinental, non-stop flights from areas with substantial epidemic activity, then entry screening at their destination airports – as a supplement to exit screening at the airports where the flights began – may be a reasonable option. In general, such “supplementary” entry screening should be minimally disruptive to international travel because – since traveller numbers tend to be inversely

correlated with travel distance and flight duration (Fig. 4) – the numbers of travellers involved should be relatively small. However, the full, global public health benefits of targeted entry screening are only likely to be observed if all of the destination airports implement such screening in unison, which may be an unrealistic goal.

Although exit screening is more efficient than entry screening, significant political, legal and practical obstacles often hamper the timely and effective implementation of national strategies for exit screening. Currently, most national quarantine authorities are structured to prevent the import of pathogens but not their export. Similarly, the customs and

Fig. 3. Travel times spent on international trips by air travellers, 2009



Note: The travel times represent the combined durations of any domestic and international flights made by the travellers between the first and last airports on their trips. The data relate to 840.8 million travellers. Of these travellers, 746.2 million (88.8%), 91.0 million (10.8%), 3.6 million (0.4%) and 2559 (0.0003%) spent <12 hours, from 12 to 24 hours, from 24 to 36 hours and from 36 to 72 hours in travel between their first departure from an airport and their last arrival at an airport, respectively.

Fig. 4. Number of travellers arriving at international destinations on flights departing from Mexico with corresponding travel times, May 2009

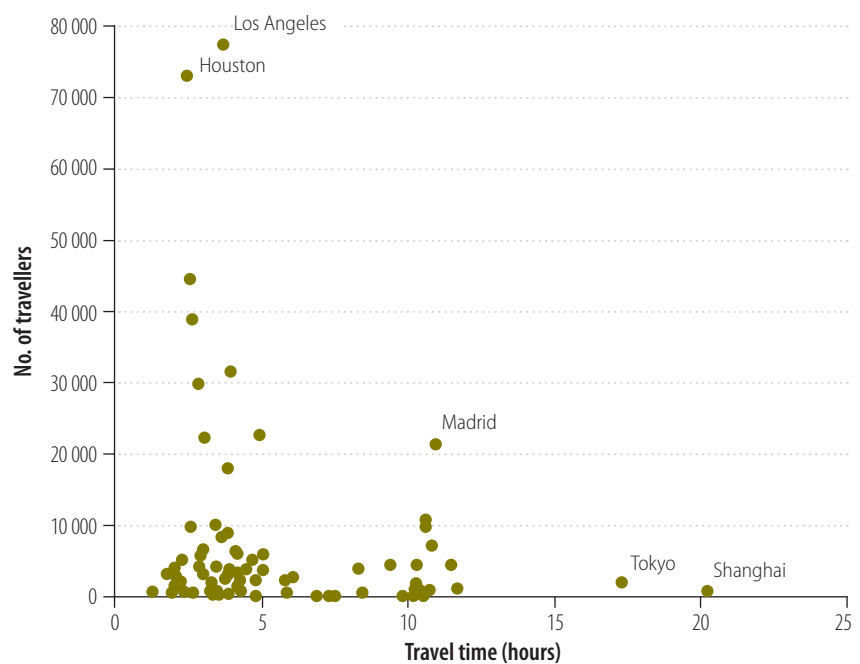
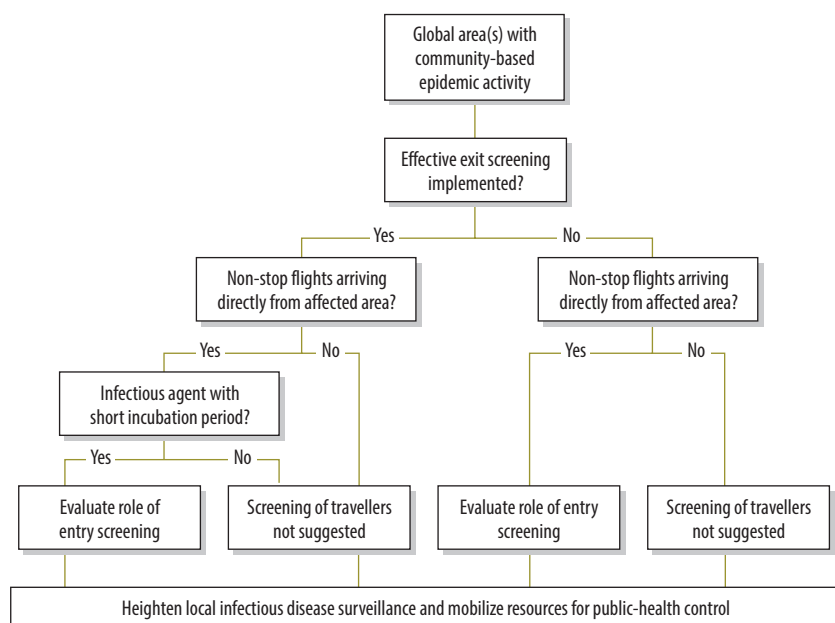


Fig. 5. Evidence-based decision-support tool for cities at risk of the importation of a pathogen causing infectious disease



Note: As a supplement to exit screening, targeted entry screening might be useful for pathogens with short incubation periods and travellers who have been on long, non-stop, international flights. Although there are no predefined thresholds for "short" incubation periods or "long" non-stop flights, the probability of a traveller with an undetectable latent infection at the point of departure developing potentially detectable active disease during the course of his or her travel increases with increasing flight times and/or decreasing incubation periods. To maximize the efficiency of entry screening, travellers would have to be assessed at the arrival gates where their flights land (i.e. before travellers at risk of infection mix with other travellers at low risk of infection in the destination airport).

passport control infrastructures at most international airports – which could be used as the basis of a health screening programme – are focused on arrivals rather than departures. Furthermore, at least in the short-term, the benefits of exit screening in any country with an epidemic would be realized entirely by other countries while placing additional strain on the source country.²⁶ These realities should create incentives for countries that are currently unaffected by the pathogen producing the epidemic – particularly those with strong travel ties to the affected country – to offer international assistance as a means to protect their own vital interests. If epidemic source control and timely and effective exit screening are not attainable, then targeted entry screening could mitigate the impact of imported disease, as a supplement to a robust, community-level response.

Based on the results of the present, retrospective evaluation, we developed a decision-support tool for national authorities confronted with the formidable challenge of making rational, timely and defensible decisions about

the health screening of travellers during future epidemics of international concern (Fig. 5). Importantly, this tool takes account of the position of the city in which screening is being contemplated, in relation to the geographical source of the epidemic of concern as well as the continuously evolving, global network of air travel and transportation. Hence, it can offer recommendations that are customized to individual cities responding to epidemic threats that are emerging in different geographical regions and at different times. If this tool had been used during the initial stages of the A(H1N1) 2009 pandemic, we estimate that over 90% of the public health benefits attainable worldwide by screening international travellers could have been realized by intervening at just eight international airports (i.e. by exit screening at Mexico's six largest international airports and targeted entry screening at the international airports in Shanghai and Tokyo).

The present study has several limitations. We did not address the issues of whether international air travellers should be screened at all or, if it is de-

termined that they should, of when the screening programmes should be initiated and discontinued. We believe that the answers to these questions cannot be easily generalized but, instead, must be adapted to the articulated goals of any screening, the levels of risk tolerance of national health authorities, and the specific circumstances that arise during future epidemics or pandemics of infectious disease. Factors that could influence the decision to screen travellers include (but are not limited to): (i) the estimated probability of successful source control and, failing that, the estimated probability of the international export of the pathogen; (ii) the estimated prevalences of infection and symptomatic disease in travellers¹¹; (iii) the clinical spectrum of illness and the ability to detect relevant illness through direct observation, traveller health declarations, and/or complementary tests such as infrared thermography; (iv) the operating characteristics and limitations of the available screening methods²⁷; (v) the global epidemiologic pattern of the epidemic disease at the time when traveller screening is first contemplated¹⁰; (vi) the opportunity costs of detecting other infectious diseases of lesser significance as a consequence of screening²⁸; (vii) the perceived contagiousness and severity of the epidemic disease and its estimated domestic health and economic impacts²⁹; (viii) the availability and costs of any effective methods for the prevention or treatment of the epidemic disease; and (ix) the projected public health benefits of health screening at airports (relative to those that could be realized by intervening at other international and/or domestic frontiers).

The conclusions of our analysis are drawn from the experience of a pandemic emerging in Mexico, which is not a leading transit hub for international travellers. If a future pandemic were to emerge around a major international transit hub (e.g. Frankfurt), a greater proportion of travellers departing from that hub would be low-risk travellers who had initiated trips from areas of the world with little or no infectious disease activity and were simply passing through the hub, en route to their final destinations. In such instances, the prevalence of detectable disease – and, consequently, the positive predictive value of any screening method – would decline unless international transit travellers

could easily be separated from other international travellers within the hub.

For the present evaluation, we used static definitions of “at-risk” and “low-risk” travellers based on the presumption that the international spread of A(H1N1)pdm09 out of non-Mexican cities in April and May of 2009 was negligible. During this period, however, there was community-based transmission of the virus in many cities in Europe and North America, some of which became secondary sources for the pathogen’s international spread.³⁰ This serves as a reminder that the definitions of “at-risk” and “low-risk” travellers may need frequent revision and that the advantages of targeted entry screening, compared with those of indiscriminate entry screening, decrease as an epidemic becomes globalized. Although over the course of an international epidemic, health officials could regularly expand the list of at-risk areas and subject only travellers arriving from such areas to entry screening, this approach would increasingly dis-

rupt the flow of international air traffic while providing diminishing public health benefits. Conversely, short-term exit screening – whether directed solely at the epicentre of an epidemic or at any city with community-based epidemic activity that could lead to the international export of the pathogen – would cause significantly less disruption to air traffic and would more closely align with the stated purpose and spirit of the 2005 International Health Regulations.⁹

For centuries, countries have been screening travellers arriving at their borders to protect their own health, security and economic interests.³¹ In an increasingly globalized world, where the interests of cities and countries are increasingly intertwined, entry screening – although deeply rooted in a sense of self-preservation – appears to be an anachronism. From a contemporary perspective, interventions to mitigate the international spread of infectious disease – whether through preparedness or response – would have the greatest global impact if implemented as close

as possible to the sources of any future epidemic threats.³² ■

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ملخص

فحص المسافرين جواً لدى دخولهم البلد وخروجهم منها أثناء جائحة أنفلونزا الخنازير A(H1N1) لعام 2009: تقييم

استرجاعي

مطاراً في 26 بلداً أخرى إلى تقييم جميع المسافرين الجويين المعرضين لمخاطر نقل جائحة أنفلونزا الخنازير A(H1N1)pdm09 إلى خارج المكسيك مع بداية الجائحة. واستلزم الأمر إجراء فحص دخول المسافرين البالغ عددهم 116 مسافراً القادمين من المكسيك على متن رحلات مباشرة أو عابرة لكل مسافر يتعرض لمخاطر نقل جائحة أنفلونزا الخنازير A(H1N1)pdm09. وأدى الفحص في ثمانية مطارات فقط إلى تقييم 90٪ من جميع المسافرين الجويين المعرضين لمخاطر نقل جائحة أنفلونزا الخنازير A(H1N1)pdm09 إلى خارج المكسيك في المراحل المبكرة للجائحة. الاستنتاج أثناء المراحل الأولى لجائحة أنفلونزا الخنازير A(H1N1)، تم التمكن من تحقيق معظم مزايا الصحة العمومية التي يتمتع بها بلوغها من خلال فحص المسافرين الجويين عن طريق فحص المسافرين في ثمانية مطارات فقط.

الغرض تقييم تدابير الفحص التي كانت مطلوبة لتقييم جميع المسافرين المعرضين لمخاطر نقل جائحة أنفلونزا الخنازير A(H1N1)pdm09 من المكسيك عن طريق الجو مع بداية جائحة عام 2009.

الطريقة تم استخدام البيانات الواردة من خطوط سير الرحلات الجوية للمسافرين الذين سافروا من المكسيك من أجل تقدير عدد المطارات الدولية التي احتاجت إلى اتخاذ تدابير الفحص الصحي، وعدد المسافرين الذين تعين فحصهم، لتقييم جميع المسافرين الجويين الذين نقلوا فيروس أنفلونزا H1N1 إلى خارج المكسيك أثناء المراحل الأولى لجائحة أنفلونزا الخنازير A(H1N1) لعام 2009.

النتائج أدى فحص الخروج في 36 مطاراً في المكسيك أو فحص دخول المسافرين على متن رحلات مباشرة من المكسيك في 82

摘要

2009年甲型H1N1流感大流行期间航空旅客出入境检查：回顾性评价

目的 对评估2009年流感大流行初期有可能从墨西哥向外传播甲型H1N1 pdm09的所有航空旅客所需的筛查措施进行评价。

方法 使用从墨西哥起飞的旅客的飞行旅程数据估计需要卫生检查措施的国际机场数量，以及必须接受检查的旅客数量，以评估在2009年甲型H1N1流感初始阶段可能从墨西哥向外传播H1N1流感病毒的所有航空旅客。

结果 在墨西哥36个机场进行出境检查，或者在26个其他国家的82个机场对墨西哥飞来的直达航班的入境旅客进行

检查，从而实现对流感大流行初始阶段可能从墨西哥向外传播甲型H1N1 pdm09的所有航空旅客的评估。要评估每个具有传播甲型H1N1 pdm09风险的乘客，需要对来自墨西哥的直航或转机的116名旅客进行入境检查。只需检查八个机场就可以评估流感初始阶段90%具有从墨西哥传播甲型H1N1 pdm09风险的旅客。

结论 在甲型H1N1流感大流行最初阶段，仅需在八个机场进行旅客筛查就可以实现通过航空旅客筛查获得的大部分潜在公共卫生益处。

Résumé

Dépistage d'entrée et de sortie des passagers aériens au cours de la pandémie de grippe A(H1N1) en 2009: une évaluation rétrospective

Objectif Évaluer les mesures de dépistage qui auraient été nécessaires pour dépister tous les voyageurs potentiellement porteurs du virus A(H1N1)pdm09 au départ du Mexique par avion au début de la pandémie de 2009.

Méthodes Les données provenant des itinéraires de vol des voyageurs qui ont quitté le Mexique en avion ont été utilisées pour estimer le nombre d'aéroports internationaux où des mesures de dépistage médical auraient été nécessaires, et le nombre de voyageurs qui auraient dû être dépistés afin d'évaluer tous les voyageurs aériens qui pourraient avoir été porteurs du virus de la grippe H1N1 au départ du Mexique pendant les premiers stades de la pandémie A(H1N1) de 2009.

Résultats Le dépistage de sortie dans 36 aéroports mexicains, ou le dépistage d'entrée des voyageurs arrivant sur des vols directs depuis le Mexique dans 82 aéroports de 26 autres pays, aurait permis d'évaluer

tous les voyageurs aériens potentiellement porteurs du virus A(H1N1)pdm09 au départ du Mexique au début de la pandémie. Le dépistage d'entrée de 116 voyageurs arrivant du Mexique par des vols directs ou des correspondances aurait été nécessaire pour chacun des voyageurs aériens potentiellement porteurs du virus A(H1N1)pdm09. Le dépistage dans 8 aéroports seulement aurait permis d'évaluer 90% de tous les voyageurs aériens potentiellement porteurs du virus A(H1N1)pdm09 au départ du Mexique lors des premiers stades de la pandémie.

Conclusion Au cours des premiers stades de la pandémie de grippe A(H1N1), la plupart des points bénéfiques pour la santé et potentiellement réalisables par le biais du dépistage des voyageurs aériens auraient pu être obtenus en dépistant les voyageurs dans seulement 8 aéroports.

Резюме

Входной и выходной скрининг авиапассажиров в ходе пандемии гриппа A(H1N1) в 2009 г.: ретроспективная оценка

Цель Оценить меры по скринингу, которые могли бы потребоваться для проверки всех пассажиров на предмет риска переноса A(H1N1)pdm09 из Мексики по воздуху в начале пандемии 2009 г.

Методы Данные о маршрутах полетов пассажиров, которые вылетели из Мексики, были использованы для оценки числа международных аэропортов, где требовались меры по скринингу, и числа пассажиров, которые должны были бы пройти скрининг, с целью оценки общего количества авиапассажиров, которые могли бы являться переносчиками вируса гриппа H1N1 из Мексики на начальном этапе пандемии вируса гриппа A(H1N1) в 2009 г.

Результаты Выходной скрининг в 36 мексиканских аэропортах или входной скрининг лиц, прибывающих прямыми рейсами из

Мексики, в 82 аэропортах 26 других стран позволил бы провести оценку всех авиапассажиров на предмет риска переноса вируса A(H1N1)pdm09 из Мексики в начале пандемии. Входной скрининг 116 пассажиров, прибывших из Мексики на прямых или стыковочных рейсах, был бы необходим для оценки каждого пассажира, находящегося в группе риска переноса A(H1N1)pdm09. Скрининг всего в восьми аэропортах позволил бы оценить 90% всех авиапассажиров на предмет риска переноса A(H1N1)pdm09 из Мексики на ранних стадиях пандемии.

Вывод На самых ранних стадиях пандемии A(H1N1) наибольшая потенциально достижимая польза от скрининга авиапассажиров для общественного здравоохранения могла бы быть достигнута при организации скрининга авиапассажиров всего в восьми аэропортах.

Resumen

Detección sistemática en las entradas y salidas de pasajeros de avión durante la pandemia de la gripe A (H1N1) en 2009: evaluación retrospectiva

Objetivo Evaluar las medidas de detección sistemática que tendrían que haberse aplicado con el fin de analizar a todos los pasajeros de avión con riesgo de transportar el virus de la gripe A (H1N1) pdm09 desde México al principio de la pandemia de 2009.

Métodos Se analizaron los datos de los itinerarios de vuelo de los pasajeros que volaron desde México en esas fechas. A partir de dichos datos, se calculó el número de aeropuertos en los que habría sido necesario aplicar medidas de control sanitario y el número de pasajeros que se habría sometido a una detección sistemática. De este modo, se habría analizado a todos los que podrían haber transportado el virus de la gripe H1N1 desde México durante las fases iniciales de la pandemia de gripe A (H1N1) de 2009.

Resultados La detección sistemática a la salida de 36 aeropuertos mexicanos o a la entrada de los pasajeros de vuelos directos procedentes de México en 82 aeropuertos de 26 países podría haber dado como resultado la evaluación de todos los pasajeros de avión con riesgo de

transportar el virus de la gripe A (H1N1)pdm09 desde México al principio de la pandemia. Para poder detectar a todos los pasajeros de avión con riesgo de transportar el virus de la gripe A (H1N1)pdm09 habría sido necesario aplicar la detección sistemática a la entrada de 116 pasajeros de los aviones procedentes de México (directos o con escala). De haber aplicado la detección sistemática en tan solo ocho aeropuertos se habría obtenido una evaluación del 90% de todos los pasajeros con riesgo de transportar el virus de la gripe A (H1N1) desde México en las primeras fases de la pandemia.

Conclusión Durante las primeras fases de la pandemia del virus de la gripe A (H1N1) podrían haberse alcanzado los mayores beneficios en cuanto a sanidad pública aplicando la detección sistemática de pasajeros en tan solo ocho aeropuertos.

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