

Syndromic entry and exit screening for epidemic-prone diseases of travellers at ground crossings

Evidence review and a call for research

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Cover photo: Guinea: Ebola outbreak response

On 28 February 2021, people return from Guinea to Liberia through Ganta border post after attending a weekly market in Guinea.

Country : Liberia

Date created : 28/02/2021

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Contents

Foreword	iv	2.2 Establishing the research question	2
Acknowledgements	v	2.3 Conducting the systematic review	4
Contributors	v	2.4 Searches	4
External Experts Group	v	2.4.1 SARS-CoV-2	4
Methodologists	vi	2.4.2 Other epidemic-prone diseases	4
Systematic review team	vi	2.5 Health equity assessment	4
External Review Group	vi	2.6 Quality assessment	4
Steering Group	vii	2.7 Evidence-to-decision process	5
Declaration of interests	viii	2.8 Rationale and supporting evidence	5
Funder	viii	3. Systematic review findings	6
Abbreviations and acronyms	ix	3.1 SARS-CoV-2 infections	6
Executive summary	x	3.2 Other epidemic-prone diseases	7
Context	x	4. Evidence-to-decision factors	9
Purpose of this document	x	4.1 SARS CoV-2	9
Research question	x	4.2 Other epidemic-prone diseases	9
Methods	x	5. Conclusion	10
Findings	xi	6. Research considerations	11
Conclusion	xi	7. Uncertainties and future research: a call for research	12
1. Background	1	8. References	14
2. Methods	2	Annex 1: Summary of findings table	16
2.1 Process	2		

Foreword

Syndromic entry and exit screening for fever and/or respiratory, gastrointestinal or haemorrhagic fever symptoms, using one or more methods such as temperature check, observation and health declaration forms, with subsequent follow-up interventions including testing and other additional health measures, has been conducted at ground crossings over decades for some epidemic-prone diseases such as Ebola virus disease (EVD) and other viral haemorrhagic fevers (VHFs), severe acute respiratory syndrome coronavirus (SARS-CoV) and other respiratory infections, as well as plague.

This document summarizes and evaluates available scientific evidence on the efficacy of syndromic entry and exit screening to prevent or limit the spread of epidemic-prone diseases at ground crossings and is intended as a call for research in this field. It is targeted at public health and ground crossing policy-makers, researchers and relevant stakeholders.

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Declaration of interests

All external contributors to the evidence review, including members of the External Experts Group, systematic review team and External Review Group, completed a WHO declaration of interests form in accordance with WHO policy for experts. These declarations of interest and the results of a web-based search for each member of the External Experts Group were reviewed by the WHO Steering Group. No conflict of interest was declared by any member of the External Experts Group.

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Abbreviations and acronyms

CINAHL	Cumulative Index to Nursing and Allied Health Literature
COVID-19	Coronavirus disease 2019
EtD	Evidence-to-decision
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HCoV	Human coronavirus
IDSR	Integrated Disease Surveillance and Response
IHR	International Health Regulations
MERS-CoV	Middle East respiratory syndrome-related coronavirus
NOS	Newcastle-Ottawa Scale
PICO	Population, intervention, comparator and outcome
POE	Point of entry
PROGRESS	Place of residence, race or ethnicity, occupation, gender and sex, religion, education, socioeconomic status, and social capital or resources
SARS-CoV-1	Severe acute respiratory syndrome coronavirus 1
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
VHF	Viral haemorrhagic fever
WHO	World Health Organization

Executive summary

Context

Syndromic entry and exit screening for fever and/or respiratory, gastrointestinal or haemorrhagic fever symptoms, using one or more methods such as temperature check, observation and health declaration forms, with subsequent follow-up interventions including testing and other additional health measures, has been conducted at ground crossings over decades for some epidemic-prone diseases (1) such as Ebola virus disease (EVD) and other viral haemorrhagic fevers (VHFs), severe acute respiratory syndrome coronavirus (SARS-CoV) and other respiratory infections, as well as plague.

It has been questioned whether entry and exit syndromic screening is an effective means of controlling the spread of epidemic-prone diseases among travellers crossing land borders. Unlike air travellers, such persons cross borders much more frequently and even on a daily basis. They include commuting workers, market salespeople, students, people seeking health care and those visiting family members. Communities straddling land borders are often very closely connected by economic and social activities and family ties. They also include migrants and refugees, whose reasons for crossing borders are often quite different from those of most air and marine travellers, though no study included in this evidence review referred to them. The issue of informal ground crossings and porous borders adds complexity to any assessment of the effectiveness of interventions to control the spread of epidemic-prone diseases.

Purpose of this document

This document summarizes and evaluates available scientific evidence on the efficacy of syndromic entry and exit screening to prevent or limit the spread of epidemic-prone diseases at ground crossings and is intended as a call for research in this field. It is targeted at public health and ground crossing policy-makers, researchers and relevant stakeholders.

Research question

Developed using the population, intervention, comparator and outcome (PICO) model, the research question was defined as follows: what is the impact of syndromic entry/exit screening at ground crossings in preventing the transmission of epidemic-prone diseases, between travellers at ground crossings, and into the destination country/local area? For this evidence review, we focused our systematic review on the following epidemic-prone diseases for which entry and exit syndromic screening have been implemented in the past: infectious respiratory diseases (MERS-CoV, SARS-CoV-1), Ebola and other VHFs (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue) as well as plague.

Methods

WHO commissioned two systematic reviews based on the above PICO research question regarding SARS-CoV-2 and other epidemic-prone infections. The quality of studies identified was assessed using the Newcastle-Ottawa Scale (2). The quality of the evidence was rated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (3–5).

Findings

There is a paucity of evidence on this intervention for most infections. We included evidence from 14 studies for four epidemic-prone conditions – SARS-CoV-2, SARS-CoV-1, Ebola and yellow fever – in just seven countries. Available evidence for SARS-CoV-2 included seven observational studies from Bulgaria, China, China, Hong Kong SAR, Germany, Nepal, South Sudan and Uganda but only one of these studies, from Uganda, sought to determine the effectiveness of syndromic screening (using thermal screening) at a ground crossing. The proportion of persons testing positive for SARS-CoV-2 was 6.7% (95% CI: 6.1–7.3). The sensitivity and specificity of thermal screening were 9.9% (95% CI: 7.4–13.0) and 99.5% (95% CI: 99.3–99.6), respectively. Available evidence for other epidemic-prone diseases included seven observational studies from the Democratic Republic of the Congo, Sierra Leone, China and United Kingdom. Of these, only four studies presented evidence of effectiveness for SARS-CoV-1, Ebola and yellow fever. Alerts of suspected cases were notified across studies, but the number of positive cases identified as a percentage of the entire screened population ranged from 0 to 2.4%, this variation being a result of the different screening methods used. Syndromic screening alone did not detect positive cases of Ebola but did detect positive cases of human coronavirus when conducted in combination with follow-up testing. Three observational studies highlighted issues such as the need for adequate infrastructure, intra-country coordination, and operational and financial resources, all of which varied between settings. Positive (such as public acceptability) and negative (such as stigma) societal factors were identified.

Conclusion

There is presently insufficient evidence to develop an evidence-based guideline for or against syndromic entry and exit screening of travellers at ground crossings.

WHO therefore calls for research on the effectiveness of entry and exit syndromic screening of travellers at ground crossings to prevent the transmission of epidemic-prone diseases and on the unintended consequences of screening, both positive and negative. This appeal is based on the paucity of evidence to support the prevention of transmission, variations in the intervention depending on the nature of disease, screening method and health system setting, and available evidence of the public acceptability of syndromic screening.

The effectiveness of entry and exit syndromic screening of travellers at ground crossings to prevent the transmission of epidemic-prone diseases is an important factor in how Member States decide to respond to an outbreak using a risk-based approach, and evidence supports its public acceptability. However, there was no quality evidence in the systematic review suggesting that the intervention is effective in preventing transmission. Likewise, no evidence of harm or benefit exists which might support or discourage the intervention. It is therefore urgent that efforts be made to generate and publish research in this field.

A research project could investigate variations in entry and exit syndromic screening for different diseases in different health systems, various screening strategies (combination or layered interventions), and degrees of acceptability of screening for different diseases at different phases of an outbreak. The influence of contextual considerations such as feasibility, resources and human rights on delivery of the intervention could also be explored.



Guinea: Ebola outbreak response

On 1 March 2021, a view of the town of Sibata near the Guinea/Liberia border. This is the first time the disease has been reported in Guinea since the previous outbreak ended in 2016. The Ministry of Health of the Republic of Guinea announced a new outbreak of Ebola virus disease on 14 February 2021 after a cluster of cases was reported in the sub-prefecture of Gouéké, N'Zérékoré Region. WHO is supporting the Government-led response to set up testing, treatment structures, and with medical supplies, vaccines, therapeutics, and diagnostic capacities to quickly contain the outbreak.

Country : Guinea

Date created : 01/03/2021

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1. Background

Syndromic screening at borders is defined in this document as entry or exit screening of travellers at ground crossings for fever and/or respiratory, gastrointestinal or haemorrhagic fever symptoms, using one or more methods such as temperature check, observation and health declaration forms. The aim of such interventions is to identify inbound or outbound travellers who are exhibiting signs and symptoms of infectious diseases with epidemic potential, to identify travellers with a history of exposure to these diseases, and to provide an effective, coordinated response to protect the health of travellers and communities.

Land travellers are often cross-border commuters such as workers, salespersons selling products in a market across the border, pupils and students, patients attending health facilities or visiting family members on the other side of the border, and migrants. Communities neighbouring ground crossings are often very closely connected by economic and social activities, as well as by family ties. The issue of informal and porous borders adds complexity to any assessment of the effectiveness of interventions to control the spread of infectious diseases. In developing this evidence review, we attempted to maximize the number of studies that could be identified for inclusion in a systematic review by considering land travellers at domestic and international ground crossings.

Diseases categorized as epidemic-prone are listed in WHO's technical guideline for Integrated Disease Surveillance and Response (1) (Box 1). These diseases can be airborne (such as Middle East respiratory syndrome-related coronavirus [MERS-CoV] or severe acute respiratory syndrome coronavirus [SARS-CoV]), vector-borne (such as Crimean-Congo haemorrhagic fever, Rift Valley fever, dengue or yellow fever) or contact-driven, including viral haemorrhagic fevers ([VHFs] such as Lassa, Ebola or Marburg). In this document, we present limited evidence on SARS-CoV-2 and other epidemic-prone diseases (Ebola, yellow fever and SARS-CoV-1). Given the fast-evolving situation and the urgent need for suitable output for evidence review, data on SARS-CoV-2 was synthesized and examined separately from that on other epidemic-prone diseases (6).

In reviewing evidence, we considered different contexts and systemic factors (such as inter-country variability in health systems including strength, human resources, financial resources and infrastructure), differences in implementation (such as protocol/standard operating procedure updates and national regulations), societal factors (such as public perception and acceptability) and inter-country agreements. Monitoring and evaluation concerns (such as adherence to protocols, cost-benefit evaluations, framework for key performance indicators and evaluation of cases identified) were also assessed.

2. Methods

2.1 Process

The External Experts Group is a group of experts selected in their personal capacity following WHO rules and protocols to ensure their independence and impartiality when assessing systematic review findings and drawing conclusions. When establishing the External Expert Group for land travel, WHO selected members to ensure a global geographical representation, gender balance, and appropriate technical and clinical expertise.

The Steering Group comprises World Health Organization (WHO) and relevant United Nations (UN) staff with expertise in the technical areas of infectious diseases, laboratory, surveillance, International Health Regulations, health systems, disability, international travel and border health, international migration and occupational health, as well as WHO regional office representatives. Steering Group members developed the draft population, intervention, comparator and outcomes (PICO) research question and helped to identify appropriate External Review Group (ERG) members, who provided feedback for the Steering Group and External Experts Group to consider. Methodologists worked as liaisons between the External Experts Group and the systematic review team, and also assisted the External Experts Group in the evidence-to-decision (EtD) process. External Experts Group meetings were held to discuss methodologies, make final decisions on PICO questions, review synthesized evidence findings and the GRADE summary of findings tables provided by the systematic review team, develop the WHO-INTEGRATE-informed EtD framework and draft evidence review documents based on consensus through discussion. The work started in April 2022 and concluded in November 2023.

2.2 Establishing the research question

The Steering Group developed a population, intervention, comparator and outcomes (PICO) model (Box 1) for the effectiveness of syndromic screening at ground crossings as a potential intervention to mitigate the transmission of epidemic-prone diseases. For this research, epidemic-prone diseases for which entry and exit syndromic screening have been conducted in the past were selected as follows: respiratory infections (MERS-CoV, SARS-CoV-1), and Ebola and other viral haemorrhagic fevers (VHF) (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue). In April 2022, the External Expert Group was tasked to review and finalize the research question using this model via email consultation. In parallel, during the same period, they were separately tasked to do the same for SARS-CoV-2.

The research questions agreed upon were as follows.

1) What is the effectiveness of entry and exit syndromic screening at ground crossings in preventing the transmission of SARS-CoV-2 between travellers at ground crossings and into the destination country/local area?

Box 1. Population-intervention-comparator-outcome (PICO) model for determining the research question

Population. Travellers at ground crossings exposed to or at risk of *epidemic-prone diseases**. Both domestic and international, frequent and infrequent travellers at ground crossings will be included in the systematic review. The population will be stratified by specific categories of travellers (such as tourists, cross-border workers and lorry drivers), and possibly also by groups that are vaccinated, recovered, tested (RDTs, rRT-PCR or sniffer dogs) and exempt (from health measures), as well as variants of these categories, if applicable.

Intervention. Syndromic entry or exit screening of travellers at ground crossings for fever, respiratory symptoms, gastrointestinal symptoms and/or haemorrhagic fever symptoms, using one or more methods such as temperature check, observation and health declaration forms. Testing and other additional health measures, if used as a follow-up intervention after screening, will be included in the systematic review; the population will also be stratified by these categories.

Comparator. No syndromic entry or exit screening of travellers at ground crossings.

Outcome. (i) Transmission and outbreak dynamics of epidemic-prone diseases: (a) transmission among travellers at ground crossings; (b) importation of cases into the destination country/local area; (c) transmission in the destination country/local area; and (d) time to outbreak in the destination country/local area.

(ii) Unintended negative consequences: (a) to individual health (such as injury from specimen collection); (b) additional financial cost incurred by travellers; (c) to health equity and human rights (such as accessibility of travel and screening, differential experience of syndromic screening according to demographic stratifiers, fear of consequences of screening positive, increased anti-immigrant sentiments); and (d) operational (such as creation of bottlenecks, change of migration patterns).

(iii) Decisional factors with quantitative or qualitative outputs: (a) fiscal, including economic costs of implementation; (b) feasibility (individual, groups, cross-border workers); (c) user acceptability (such as passenger confidence, fear of consequences of screening positive); (d) health systems (minimum requirements in terms of infrastructure, logistics and human resources for routine standing capacity; predictable seasonal surge capacity; and unforeseeable ad hoc emergency surge capacity); (e) sociocultural and/or political (such as cross-border agreements); and (f) static checks, intermittent dynamic checks, cross-border joint statements and other).

***Epidemic-prone diseases according to WHO IDSR guideline (1)** include: 1. acute haemorrhagic fever syndrome; 2. anthrax; 3. bacterial meningitis; 4. Chikungunya; 5. cholera; 6. dengue fever; 7. diarrhoea with blood (Shigella); 8. listeriosis; 9. malaria; 10. Middle East respiratory syndrome (MERS); 11. Mpox (monkeypox); 12. plague; 13. SARS/SARIs; 14. typhoid fever; 15. yellow fever; 16. Zika virus disease.

It is important to remember that countries may select from this list according to the national priorities and epidemic situation. For this evidence review, we focused our systematic review on the following epidemic-prone diseases for which entry and exit syndromic screening have been implemented in the past: infectious respiratory diseases (MERS-CoV, SARS-CoV-1), Ebola and other VHF (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue) and plague.

RDT: rapid diagnostic test; rRT-PCR: real-time reverse-transcription polymerase chain reaction; SARS: severe acute respiratory syndrome; SARIs: severe acute respiratory infections

2) *What is the effectiveness of entry and exit syndromic screening at ground crossings in preventing the transmission of epidemic-prone diseases between travellers at ground crossings and into the destination country/local area? For this evidence review, we focused our systematic review on the following epidemic-prone diseases for which entry and exit syndromic screening have been implemented in the past: infectious respiratory diseases (MERS-CoV, SARS-CoV-1), Ebola and other VHFs (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue) and plague.*

2.3 Conducting the systematic review

Based on the agreed research questions as determined by the PICO framework (Box 1), the systematic review team, including systematic review experts, clinical experts, clinical epidemiologists and biostatisticians, conducted an independent systematic review using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) evidence-to-decision (EtD) framework (3–5,8,9), rating the quality of evidence as either high, moderate, low or very low. The systematic review report including the search strategies can be found in Annex 1.

2.4 Searches

2.4.1 SARS-CoV-2

The systematic review team initially searched biomedical databases (Medline, Embase, Global Health, CINAHL and Web of Science) up to the cut-off date 13 April 2022.

2.4.2 Other epidemic-prone diseases

The systematic review team initially searched biomedical databases (Medline, Embase, Global Health, CINAHL and Web of Science) up to the cut-off date 6 June 2022, and the preprint database MedRxiv up to the cut-off date 29 June 2022. This search included the following epidemic-prone diseases for which entry and exit syndromic screening have been implemented in the past: infectious respiratory diseases (MERS-CoV, SARS-CoV-1), Ebola and other VHFs (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue) and plague but did not include SARS-CoV-2. This search was updated to 8 May 2023.

2.5 Health equity assessment

The systematic review team also examined the available literature for key health equity factors: place of residence, race or ethnicity, occupation, gender and sex, religion, education, socioeconomic status, and social capital or resources (PROGRESS).

2.6 Quality assessment

The systematic review team then used the Newcastle-Ottawa Scale (NOS) (2) to assess the quality of the included studies and summarized the evidence from systematic reviews in GRADE evidence profiles. The External Expert Group requested that studies with a low NOS score should be downgraded. Given that studies were likely to demonstrate variability in reporting findings, it was agreed not to downgrade for imprecision.

2.7 Evidence-to-decision process

A virtual External Expert Group meeting was held on 17 June 2022 for SARS-CoV-2 infections, on 1 July 2022 for other epidemic-prone infections as specified in PICO question and on 19 May 2023 for both. Participants focused on reviewing the evidence and agreeing on conclusions. The WHO-INTEGRATE EtD framework (10) was used to review evidence. It comprises seven GRADE concerns about the quality of evidence: balance of health benefits and harms; human rights; sociocultural acceptability; health equity, equality and non-discrimination; societal implications; financial and economic considerations; and feasibility and health system considerations. These criteria are underpinned by an overall quality-of-evidence grading, representing a comprehensive EtD framework rooted in WHO values to inform transparent and trustworthy recommendations. All decisions were made by discussion until a consensus was reached.

2.8 Rationale and supporting evidence

Syndromic screening at ground crossings has been implemented over the years for epidemic-prone diseases such as Ebola and SARS-CoV, in line with previously available guideline documents that were largely based on expert opinions and rapid literature reviews (11,12). A rigorous systematic review and decision on how to proceed was therefore urgently needed. The audience for this document includes public health authorities, including those at ground crossings, policy makers and researchers.



COVID-19: THAILAND

At the Sa Keow Border Checkpoint, WHO and Ministry of Public Health representatives look at a Ministry of Public Health application that gathers information on Thais returning home from Cambodia through all border checkpoints. The application is one measure to help tracking and keeping out COVID-19.

Country: Thailand

Date created: 28/05/2020

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3. Systematic review findings

3.1 SARS-CoV-2 infections

The review team provided a narrative synthesis of their findings on the effectiveness of syndromic screening at ground crossings as a potential intervention to mitigate transmission of SARS-CoV-2.

The evidence was limited to seven observational studies from Bulgaria, China, Germany, Hong Kong SAR, Nepal, South Sudan and Uganda published from 2020 to January 2022 (13–19). Only one of these studies, from Uganda by Nsawotebba et al. (19), evaluated the effectiveness of syndromic screening (using thermal screening) at a ground crossing. The sensitivity and specificity of thermal screening were 9.9% (95% CI: 7.4–13.0) and 99.5% (95% CI: 99.3–99.6), respectively, leading the authors to conclude that thermal screening alone was ineffective for detecting SARS-CoV-2 infections at ground crossings. The other studies used syndromic screening in association with other follow-up measures, including SARS-CoV-2 testing or quarantine. Across studies, the proportion of cases detected by screening at the ground crossing ranged from 0.53% to 10%. There was no study that demonstrated that syndromic screening at ground crossing contributed to the change of transmission outcome as laid out in the PICO outcome section.

There was no evidence in this review that indicated harms associated with syndromic screening.

The body of main and supporting literature reported some PROGRESS factors but generally did not stratify effectiveness outcomes according to such factors. In three of seven studies included in the systematic review, incidence, positivity rates or other main outcomes were reported according to sex, gender or age (14,16–19). One retrospective observational cohort study reported an absence of association between sex and presence of symptoms (14). One study that reported case positivity stratified for age (14) described the highest case positivity and/or symptomatic illness rates in age brackets older than 20. In the seven studies reporting on or inferring the place of residence of the study population (13–19), two concerned low-income countries (South Sudan, Uganda) and one a low- to middle-income country (Nepal), according to World Bank definitions (20). In no included studies was the religion of participants reported. The occupation of study participants was noted in one of the seven studies, which was conducted exclusively on truck drivers (19). On the PROGRESS factor of literacy and/or language fluency, one study reported that health education materials – including infographics, pamphlets and posters – were translated and made available to nine ethnic minorities, which relates to the race and ethnicity factor (16). No other included studies reported on race, ethnicity or language fluency. Aggregate analysis of themes relating to health equity and human rights in the seven observational studies revealed that 9% (n=1) cited potential economic factors or aspects of public health and social measures (including methods to detect SARS-COV-2) that may have affected individuals or societies (18). No study reported that public health and social measures were applied differently at the population level according to religion, but one reported on nationality (17).

3.2 Other epidemic-prone diseases

The review team provided a narrative synthesis of their findings on the effectiveness of syndromic screening at ground crossings as a potential intervention to mitigate transmission of the epidemic-prone diseases that were included in the search, namely, respiratory infections (MERS-CoV, SARS-CoV-1), Ebola and other viral haemorrhagic fevers (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue).

The evidence was limited to seven observational studies from China, Democratic Republic of the Congo, Sierra Leone and United Kingdom (at an international rail terminal) published from 2003 to 2022 that evaluated the implementation of ground crossings measures or outbreak investigations (21–27).

Two were conducted in China on SARS-CoV-1 (21,22), two in the Democratic Republic of the Congo, one for Ebola and the other for yellow fever (23,24), one in Sierra Leone (25) for routine infectious diseases screening owing to past outbreaks of imported diseases (Ebola, cholera and Lassa fever) and two in the United Kingdom on Ebola (26,27). Four of the seven studies were retrospective cohort studies (22–24,26), two were cross-sectional studies (21,25) and one was a qualitative before/after study (27). The systematic review team did not identify any modelling studies.

All studies reported that interventions were conducted on all individuals entering the country, especially from high-risk areas. All seven studies were based on entry screening, and none on exit screening. Syndromic screening was conducted alone or in association with other follow-up measures, including testing or quarantine (22). Across the studies, the number of positive cases identified as a percentage of the entire screened population ranged from 0 to 2.4%, this variation resulting from the different screening methods used. Studies in which syndromic screening was used with additional testing (blood specimen, chest radiograph (CXR), nasopharyngeal swabs) detected cases and transmission (21–23) of human coronaviruses and yellow fever. A study for syndromic screening for Ebola notified alerts but did not report confirmed cases (24).

There was very little evidence to suggest that syndromic surveillance eliminates the risk of disease crossing borders, and no study identified was able to signal an epidemiological shift as a result of international travellers entering the country when syndromic or symptom-based screening was conducted at ground crossings.

The body of main and supporting literature reported some PROGRESS factors but did not generally stratify effectiveness outcomes according to factors applicable to the research question. Positivity rates or other main outcomes were disaggregated for sex, gender or age in some studies. Three studies (21,23,27) reported that most individuals screened were males. One study (21) reported that the study population was children aged < 6 years, while a second (23) reported that the mean age of individuals screened was 31 years (range: 0–72 years). The differential impacts of multi-layered public health and social measures were also recorded by age in one study (22). Thirty-two percent (32%) of Beijing’s universities cancelled classes during the 2003 SARS outbreak, and all public elementary schools were closed for months.

One study (27) logged the nationality, occupation and place of residence of participants. This study further reported that “foreign nationals, particularly West Africans, were perceived to find the process more intimidating than British nationals due to the uncertainty about the process, the stigma of [Ebola virus disease] and wariness about whether screening related to immigration processes”. Moreover, the study reported that different measures were applied according to risk, with the occupation of health care worker directly influencing the risk level.

Only one study (22) explicitly stated the language(s) in which information was conveyed to participants, media and the public.

Three observational studies (23,25,26) highlighted issues such as the need for adequate infrastructure, intra-country coordination, and operational and financial resources, all of which showed wide variability depending on the setting. Positive (public acceptability) and negative (possibility of stigma) societal factors were identified.

Many PROGRESS factors (place of residence, race or ethnicity, occupation, gender, religion, education, socioeconomic position, and social capital) were not mentioned in any of the included studies.

The tables in Annex 1 present a summary of findings for the studies included in the systematic review.



COVID-19: THAILAND

As part of COVID-19 prevention measures implemented at points of entry in Thailand, a border health officer takes the temperature of a traveller returning home at Thailand's Klong Luek border checkpoint.

Country: Thailand

Date created: 28/05/2020

Credit: WHO / Ploy Phutpheng

Copyright notice: © WHO / Ploy Phutpheng

Reference: HQ71349

4. Evidence-to-decision factors

4.1 SARS CoV-2

The overall certainty of evidence for the effectiveness of syndromic screening for SARS CoV-2 infections at ground crossings was assessed to be very low.

The evidence was limited to seven observational studies which evaluated border measures or outbreak investigations which had been put into effect (13–19). These studies were based on syndromic screening alone or in association with other follow-up measures, including testing or quarantine. Across studies, the proportion of cases detected by screening ranged from 0.53 to 10%, with marked variation due to the screening method used.

Additional considerations were that most studies took place early in the pandemic before vaccine deployment, and all studies took place before the emergence of circulating variants, which are associated with different transmission dynamics and symptoms. Assessing the real-world impact of syndromic screening is challenging in the context of SARS-CoV-2; however, there was very little evidence to suggest that syndromic surveillance eliminates the risk of the disease crossing borders, and no study was able to signal an epidemiological shift due to entry of international travellers into the country when syndromic or symptom-based screening was conducted at ground crossings. Available evidence also fails to support an association between syndromic screening and unintended consequences.

At present, there is insufficient evidence to develop an evidence-based guideline for or against this intervention.

4.2 Other epidemic-prone diseases

There is a paucity of evidence that this intervention prevents the transmission of epidemic-prone infections; furthermore, the overall quality of evidence for the effectiveness of syndromic screening at ground crossings was assessed as very low. Wide variations in the nature, severity and public health impact of the different epidemic-prone diseases in question made the evidence-to-decision process even more difficult.

As for unintended consequences, seven observational studies (21–24,26–27,28) indicated that there were some benefits of syndromic screening beyond prevention of onward transmission of various non-SARS-CoV-2 infections. This included sensitization of travellers to information about the disease for which they were being screened, discouraging ill persons from travelling, and allowing international travel to continue. Many travellers felt reassured and found syndromic screening to be acceptable. However, one observational study (26) showed that some travellers were sceptical about the utility or accuracy of syndromic screening. Two observational studies (25,26) reported that screeners reported diverse experiences including negative impacts on their normal roles, difficult interactions with travellers, pressure to identify Ebola cases, and constant changes in policy, protocol and procedures. Three observational studies (23,25,26) pointed out that resourcing for staffing, infrastructure and materials was variable and could be quite limited.

In view of these evidence-to-decision factors, it was decided that currently there is insufficient evidence to develop an evidence-based guideline for or against this intervention.

5. Conclusion

Given the outcome of this evidence review, it is apparent that more research on the effectiveness of entry and exit syndromic screening of epidemic-prone diseases at ground crossings will be needed in order to develop an evidence-based guideline.

WHO calls for:

- More research on the effectiveness of entry and exit syndromic screening of travellers at ground crossings to prevent the transmission of epidemic-prone diseases and on the unintended consequences of screening, both positive and negative. This appeal is based on the current paucity of evidence in support of transmission prevention, variations in the intervention depending on the nature of disease, method of screening and health system setting, and support for the public acceptability of syndromic screening.
- The effectiveness of entry and exit syndromic screening of travellers at ground crossings to prevent the transmission of epidemic-prone diseases is an important factor in how Member States decide to respond to an outbreak using a risk-based approach. However, there was no quality evidence in the systematic review suggesting that the intervention is effective in preventing transmission. Likewise, no evidence of harm nor benefit exists which might support or discourage the intervention. It is therefore urgent that efforts be made to generate and publish research in the field.
- Despite lack of evidence for the effectiveness of entry and exit syndromic screening in preventing the transmission of disease, there is some evidence that it has positive effects such as public acceptability: it is perceived as a reassuring measure and one which discourages ill persons from travelling. It is also appreciated as a source of tailored advice and information at border crossings.



Ebola outbreak in Uganda - June 2019
A small team of health volunteers are manning the border health screening station; the frontline in the fight to stop Ebola's spread into Uganda. The Ministry of Health and the World Health Organization (WHO) have confirmed a case of Ebola Virus Disease in Uganda. Although there have been numerous previous alerts, this is the first confirmed case in Uganda during the Ebola outbreak on-going in neighboring Democratic Republic of the Congo.
Country : Uganda
Date created : 09/05/2019
Credit : WHO / Matt Taylor
Copyright notice : © WHO / Matt Taylor
Reference : HQ116434

6. Research considerations

When designing and conducting research on the effectiveness of entry and exit syndromic screening for epidemic-prone diseases of travellers at ground crossings, various factors and aspects need to be considered. These include but are not limited to:

- 1) Factors influencing variations in the overall effectiveness of entry and exit syndromic screening efforts from country to country and the nature of the disease for which screening is being implemented.
- 2) Factors influencing the need for syndromic screening based on the level of risk tolerance, volume of travellers at ground crossings and the availability of alternatives.
- 3) Selection of strategies for syndromic screening that are part of a layered intervention including isolation of identified cases, quarantine, monitoring, case surveillance, additional testing and health measures, general health system preparations and combination of land with other travel routes such as sea and air.
- 4) Contextual considerations relating to syndromic screening for epidemic-prone diseases at ground crossings based on their public health impact and variability in health care system strength, including human and financial resources and infrastructure.
- 5) Variability of public acceptability depending on disease of interest and time. Syndromic screening is perceived to be informative by travellers and reassuring to the public but this degree of acceptability may vary and deliver a false sense of security to travellers and neighbouring countries.
- 6) Human rights considerations in implementing syndromic screening. Travellers should be treated with respect for their dignity, human rights and fundamental freedoms and any discomfort or distress associated with such measures minimized, as outlined in Article 32 of the International Health Regulations (IHR) (7). However, cases of enhanced syndromic screening can negatively impact human rights standards, especially if it is easier for persons of a higher economic status (literate, access to a smart phone for an online screening survey, etc.) to meet the syndromic screening requirements.

7. Uncertainties and future research: a call for research

This review examined a limited number of studies on syndromic entry screening for yellow fever, Ebola and SARS-CoV-1 and -2 in different countries and concluded that there was little to no evidence of its effectiveness in controlling disease transmission

More primary comparative research on syndromic screening of infectious diseases using different approaches at ground crossings will be helpful to guide future guideline development and implementation. A scoping review of all forms of entry and exit screening approaches (e.g. laboratory, syndromic, additional health measures) to detect infectious diseases in travellers at various ports of entry reported most evidence for airports but little evidence for ports and ground crossings.

Entry and exit syndromic screening for epidemic-prone diseases at ground crossings may be evaluated in terms of variability of disease patterns, risk tolerance for the disease, screening strategies, public acceptability and health care system strength, including human resources, financial resources and infrastructure.

Screening may be implemented by local health authorities, or by inter-country agreement. It may be set up using different methods (such as temperature screening and health declaration forms with or without follow-up testing), after a risk-benefit analysis has been made for each method. The choice of screening method may also be influenced by the perceptions of health authorities and workers conducting syndromic screening

A topic for investigation is the adverse impacts of entry and exit syndromic screening including social, economic, physical and mental health implications for affected travellers and affected subgroup populations such as people with a disability. For instance, people with a disability may be disproportionately affected by syndromic screening, which may isolate them from required health care services or caregivers across the border.

Future studies should also evaluate the acceptability of the methods used, for example, to measure temperature. An observational study noted that although a recognized method was used for measuring temperature during Ebola screening, some travellers raised concerns about the utility and accuracy of the type of thermometer used (27).

Barriers, enablers and contextual considerations in implementing the human rights measures outlined in the IHR (Article 32) (7) could be explored. All countries implementing the syndromic screening of travellers for epidemic-prone diseases at ground crossings should treat travellers with respect for their dignity, human rights and fundamental freedoms and minimize any discomfort or distress associated with such measures, as outlined in the IHR (Article 32) (7). For instance, enhanced syndromic screening can negatively impact human rights standards, especially if it is easier for persons of a higher economic status (literate, access to a smart phone for an online screening survey, etc.) to meet the syndromic screening requirements, or if the screening procedures themselves or the bottlenecks that they potentially create are likely to have a greater impact on socially more marginalized persons (e.g. those with limited sight, mobility, hearing or neurodivergence).

Most people crossing borders and subject to screening are not likely to be harbouring any disease: persons who may have been exposed in the departure country and are at risk of developing and translocating disease to the arrival country will most often be incubating the disease and asymptomatic. There may therefore be other reasons for implementing a screening strategy at a ground crossing, such as making it easier to monitor at-risk people.

Substantial knowledge gaps exist from a data stratification and reporting viewpoint (including effectiveness outcomes stratified according to socioeconomic status, occupation, ethnicity, religion or citizenship, immune status such as vaccinated and/or recovered, etc.), as well as from a traveller experience viewpoint (such as adherence to standards set by the IHR, corroborated both subjectively and objectively across stakeholder groups). However, one of the studies included (22) reported that “community health workers and volunteers brought quarantined individuals food and other essential supplies, paid for mostly by the municipality”. The fact that another study (27) cited the stigmatizing nature of the “identification process and handling by Border Force officials” based on nationality raises the opportunity for generating knowledge in relation to equitable stakeholder acceptance and experience. Such gaps highlight the need for future active surveillance in this field, as well as research design that meaningfully disentangles the differential impacts of syndromic screening strategies at the individual and population levels.

Better reporting of population characteristics using the recommended reporting guidelines (29) is encouraged in future studies on syndromic screening of epidemic-prone conditions.

For SARS-CoV-2, future research is needed to address the impact of new variants/variants of concern and the impact they have on syndromic screening. All the studies reviewed date to before June 2022. There is an urgent need for research that targets current SARS-CoV-2 strains, which have different transmission dynamics that may modify the impact of the various syndromic measures that need to be taken.

Clearly defining the goals of the process and how to determine whether these goals are met would allow better analysis of emerging data. Future studies should also include evaluations of exit screening approaches since we have been unable to identify any evidence for the effectiveness of exit screening or its unintended consequences.

Finally, some studies noted that resources allocated for control and screening of travellers, as well as for supplies and transport to assess disease outcomes in the screening process, were insufficient. Information on how to evaluate the effectiveness and cost-benefit of these interventions was lacking (23,25,27). **More studies are needed to guide decision-making on cost considerations** for travellers, implementing authorities and the community as a whole. **Assessments providing better quality data** may be possible if the objectives – and key performance indicators as well as tools for measuring those indicators – are defined prior to the screening process.

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Annex 1: Summary of findings table

Table A1.1. Summary of systematic review findings for SARS-CoV-2

Outcome	Number of studies	Summary of findings	Quality of evidence
Outcome category: 1. Cases avoided due to measure			
Outcome category: 2. Shift in epidemic development			
No studies found			
Outcome category: 3. Cases detected due to the measure			
Number or proportion of cases detected	7 observational studies: Bulgaria (July 2020) (13) China (Apr 2020) (14) China, Hong Kong SAR (Jan 2020) (16) Germany (Nov 2020) (15) Nepal (Jan 2020) (17) South Sudan (Mar 2020) (18) Uganda (May 2020) (19)	One study (19) reported sensitivity of symptom screening at land borders as 9.9% when compared with the gold standard, while others incorporated symptom screening among evaluation at POEs. Other studies' results incorporated land borders within overall outcomes: sensitivity ranged from 2.2% to 43.6%. One study (17) reporting on setting up a SARS-CoV-2 screening protocol at a POE (fever and at least x1 symptom of ARI) detected 9 cases among 1697 tested.	Very low ⊕○○○ Downgraded for Inconsistency
Positive predictive value (PPV)	1 observational study: Uganda (May 2020) (19)	The single study reported a PPV of 57.8% (95% CI: 46.5–68.6) (3)	Very low ⊕○○○ Downgraded for study quality
Outcome category: 4. Secondary outcomes			
Infectious disease transmission outcomes	1 observational study: Uganda (May 2020) (19)	The single study reported that thermal screening lacks sensitivity to reliably detect SARS-CoV-2 (sensitivity: 9.9% (95% CI: 7.4–13.0), specificity: 99.5% (95% CI: 99.3–99.6, negative predictive value: 93.9 (95% CI: 93.3–94.4), positive likelihood ratio: 19 (95% CI: 12.4–29.1), negative likelihood ratio: 0.9 (95% CI: 0.88–0.93).	Very low ⊕○○○ Downgraded for study quality

Table A1.2. Summary of systematic review findings for other epidemic-prone diseases

(For this evidence review, we focused our systematic review on the following epidemic-prone diseases for which entry and exit syndromic screening have been implemented in the past: infectious respiratory diseases (MERS-CoV, SARS-CoV-1), Ebola and other VHF (yellow fever, Marburg fever, Lassa fever, Crimean-Congo fever, Rift valley fever and dengue) and plague.)

Outcome	Number of studies	Summary of findings	Quality of evidence
Outcome category: 1. (a) Transmission between travellers			
No studies found			
Outcome category: 2. (b) Importation of cases			
(b) Importation of cases	4 observational studies: Liu 2017 (21), Pang 2003 (22), Otshudiema 2017 (23), Zakaria 2019 (24)	<p>HCoVs, China (21). A total of 3298 nasopharyngeal swabs samples were collected from children (< 6 years) who passed Shenzhen border, linking southern China and Hong Kong SAR, China from 2014 to 2015, and showed symptoms of respiratory tract infection such as fever (body temperature > 37.5 C) and cough. Of these, a total of 78 (2.4%) tested positive for HCoVs.</p> <p>HCoVs, China (21). In late April 2003, fever checks were instituted at major train stations and all 71 roads connecting Beijing to other areas. As of 30 June 2003, over 5 million passengers had been screened at train stations: 2575 (0.05%) were febrile and 2 (< 0.001%) were identified as having probable SARS. Over 7 million passengers were screened for fever at roads: 577 (0.008%) were febrile and 0% had probable SARS.</p> <p>Yellow fever, Democratic Republic of the Congo (23). A total of 35 of the 37 confirmed cases (18 August 2016) were imported; two thirds of confirmed cases occurred in those who crossed the border with Angola, where at least 40 000 travellers cross the border each week on market day.</p> <p>Ebola, Democratic Republic of the Congo (24). By the end of June 2018, screening and risk communication for travellers were being conducted in 65 priority locations. Over 120 000 travellers were informed about Ebola and checked for signs, symptoms and exposure to the virus, of which 74 alerts were notified. No alert was confirmed to be a case of Ebola.</p>	<p>Very low</p> <p>⊕⊖⊖⊖⊖ Downgraded for study quality</p>

Outcome	Number of studies	Summary of findings	Quality of evidence
(c) Number/ proportion of cases seeded by imported cases	No studies found		
(d) Time to outbreak	No studies found		
Outcome category: 3. (ii) Unintended negative consequences			
(a) Harms to individual health	One observational/ qualitative study: Kesten 2018 (27)	Ebola, United Kingdom (27). Screeners identified a mismatch between public perception and the reality of what screening could achieve, leading to concerns that if a positive case was not detected the public would think screening had failed. One screener commented: “There seems to be a bit of a gap between the public reassurances because the public think that we’re checking whether or not anyone’s got Ebola. I suppose actually we are just putting people on a system and following them up. So then if somebody gets Ebola then people think we’ve failed.”	Very low ⊕○○○ Downgraded for study quality
(b) Financial costs to travellers	No studies found	—	—
(c) Health equity and human rights	No studies found	—	—
(d) Operational consequences	No studies found		
Outcome category:4: (iii) Decisional factors with quantitative or qualitative outputs			
(a) Fiscal	1 observational study: Pang 2013 (22)	“The screening at points of transportation required a large amount of human and financial resources to maintain but identified very few cases of SARS.”	Very low ⊕○○○ Downgraded for study quality

Outcome	Number of studies	Summary of findings	Quality of evidence
(b) Feasibility	2 observational studies: Cleary 2017 (26) Kesten 2018 (27)	<p>Ebola, United Kingdom (26). Key to success of the screening programme at the train station was multi-agency cooperation among Public Health England, the United Kingdom Border Force, Eurostar, Network Rail and the Cabinet Office. Challenges included the constant (daily) changes initiated by the National Screening Cell, guidance leads and station colleagues (or even from within the team) and keeping the workforce informed. Although all staff worked at a single site, no more than two worked on the same shift. There were some initial issues identifying and deploying staff, and staff were dispersed temporally. A clear and comprehensive induction process describing where to find more information and how changes were made and communicated, accessible checklist to guide staff, explicit protocol for logging and managing incoming and outgoing tasks, protocol for managing email and a clear document control protocol were found to be required.</p> <p>Ebola, United Kingdom (27). Despite recognizing procedural modifications as improvements, the dynamic nature of the programme made keeping up to date with the procedures challenging.</p>	<p>Very low ⊕○○○ Downgraded for study quality</p>

Outcome	Number of studies	Summary of findings	Quality of evidence
(c) Acceptability	2 observational/ qualitative studies: Kesten 2018 [27] Pang 2013 [22]	<p>Ebola, United Kingdom [27]. Screeners and one traveller felt the process should not be called “screening” because it was unable to confirm the presence or absence of Ebola. Indeed, using temperature measurements to screen was not seen as evidence-based by some travellers, and a small number raised thermometer accuracy issues (thermometer type, non-contact method). One screener commented: “I think screening is not the right word because it’s about getting people into the system rather than actually checking whether people have got Ebola.”</p> <p>Kesten et al. [27] concluded: the screening process was valued for its provision of information and reassurance;</p> <p>most travellers felt that screening was acceptable (several commented that familiarity with temperature checking while in West Africa contributed to this); screeners reported diverse experiences of screening (e.g. negative impacts on their normal roles, difficult interactions with passengers and pressure to identify positive Ebola cases); and screening was considered unlikely to identify individuals with symptoms of Ebola (with some screeners suggesting it was driven by political concerns rather than empirical evidence).</p> <p>Pang et al. [22] reported that the checkpoints assured the local and international community that proactive infection control steps were being taken to control the spread of SARS.</p>	Very low ⊕○○○ Downgraded for study quality

Outcome	Number of studies	Summary of findings	Quality of evidence
(d) Health system	3 observational studies [16,18,19]: Otshuediema 2017 [23] Kamara 2021 [25] Cleary 2017 [26]	<p>Yellow fever, Democratic Republic of the Congo [23]. Resources allocated for control and screening of $\leq 40\,000$ travellers daily through the market city (on border with Angola) were insufficient; timely laboratory test confirmation was not possible because of insufficient laboratory supplies and delayed transport of specimens to the laboratory, and human resources were insufficient to conduct adequate case-based surveillance and health screening in a context of substantial population movement across porous borders.</p> <p>Any infectious disease, Sierra Leone [25]. Availability of infrastructure and materials (infection prevention and control) at Gbalamuya and Jendema ground crossing screening stations were 87.5% (7/8) and 75.0% (6/8), respectively.</p> <p>Ebola, United Kingdom [26]. Staff comprised an administrative officer, health protection practitioner and operational support manager. Consultant support was provided by telephone from the Northeast and Central London Health Protection Unit.</p>	<p>Very low</p> <p>⊕○○○</p> <p>Downgraded for study quality</p>
(e) Sociocultural and/or political	No studies found	—	—

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