



**CAPACITY/CAPABILITY
ASSESSMENT**

Country report: ECDC Public Health Emergency Preparedness Assessment for Luxembourg, 2024

Under Article 8 of the Regulation (EU) 2022/2371

ECDC ASSESSMENT

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This report was sent to the Luxembourgish Health Directorate at the Ministry of Health and Social Security for consultation by the relevant national experts involved in the PHEPA process.

Acknowledgements

The assessment team would like to thank Sébastien Français, Jean-Claude Schmit and Anne Vergison from the Luxembourgish Health Directorate at the Ministry of Health and Social Security for coordinating the PHEPA at the national level, and all the country experts that participated in the discussion and supported the process.

Suggested citation: European Centre for Disease Prevention and Control. Country report: ECDC Public Health Emergency Preparedness Assessment for Luxembourg, 2025. Stockholm: ECDC; 2025.

Stockholm, April 2025

ISBN: 978-92-9498-794-5

doi: 10.2900/5969036

Catalogue number: TQ-01-25-024-EN-N

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Abbreviations

AMR	Antimicrobial resistance
CNAL	National Purchasing and Logistics Centre
CTIE	State Information Technology Centre
ECDC	European Centre for Disease Prevention and Control
DISA	Health Directorate
EEA	European Economic Area
EU	European Union
EU-WISH	EU-Wastewater Integrated Surveillance for Public Health
FNR	Fond National de la Recherche
HAI	Hospital-Acquired Infections
HSC	Health Security Committee
HCPN	High Commission for National Protection
IHR	International Health Regulations
INSA	Sanitary Inspection Division of the Health Directorate
IPC	Infection Prevention and Control
LCSB	University of Luxembourg, Luxembourg Centre for Systems Biomedicine
LIH	Luxembourg Institute of Health
LNS	National Health Laboratory
LTCF	Long-Term Care Facilities
MCM	Medical Counter-Measures
NAP AMR	National action plan for antimicrobial resistance
PHEPA	Public Health Emergency Preparedness Assessment
PHRESH	Projects Establishing a Public Health Rapid Epidemiological Surveillance Hub
SCBTH	Serious Cross-Border Threats to Health
SPAR	State Party Self-Assessment Annual Report

Executive summary

Introduction

The aim of the Public Health Emergency Preparedness Assessment, as mandated in Article 8 of the EU Regulation on serious cross-border threat to health, is to improve prevention, preparedness and response planning in EU/EEA countries through the implementation of evidence-based recommendations following individual country assessments.

This report presents the findings and recommendations of the first assessment conducted in Luxembourg. As specified in the Regulation, each EU/EEA country will undergo an assessment every three years, with the first cycle of these occurring between 2024 and 2026. This involved a desk review of relevant documents, followed by a five-day mission between 2 to 6 December 2025. As per the assessment methodology, all the 16 capacities included in the Article 7 self-assessment questionnaire were assessed, with five of them considered in-depth. The five capacities assessed in depth were Laboratory; Surveillance; Health Emergency Management; Antimicrobial resistance (AMR) and healthcare-associated infections (HAIs); and Zoonotic diseases and environmental threats.

Key findings

The ECDC assessment confirmed the results of the Article 7 self-assessment, highlighting significant strengths in the public health infrastructure for managing health crises. Luxembourg is able to reallocate resources in a timely and effective way when needed, scale up laboratory and surveillance capacities, establish new processes, and coordinate activities across various sectors during health crises. Furthermore, there are provisions for updating the legal framework underpinning response mechanisms during crises, thus ensuring timely decision-making as needed.

Despite the high adaptability of processes, there is limited interoperability between databases and digital systems. This, coupled with a limited number of experienced specialised public health staff, could represent a weakness during major health crises. In such situations, reliance on pre-existing collaboration mechanisms can prevent acute straining of the healthcare and public health capacities. In addition, the limited interoperability can be mitigated by formalising and testing collaborations between the various players involved in a public health crisis, including partners from neighbouring countries. The ability to generate and monitor epidemiological indicators, such as severity, to inform decision-making can be strengthened by integrating surveillance as defined by the International Health Regulation (IHR) and Serious Cross-Border Threats to Health (SCBTH) Regulation (e.g. SARI) with other data sources, and by exploiting the high degree of health information digitalisation.

Main recommendations for each capacity assessed in depth

Health emergency management (Capacity 6)

- Develop a Preparedness and Response plan for public health emergencies with strategic and operational components, as well as generic and topic-specific modules. For implementation of the plan, develop a Public Health Emergency Operations Centre and corresponding procedures.
- Develop procedures for public health risk analysis and for independent, scientific assessment of serious (cross-border) threats to health.
- Formalise the process to collect data on supply of Medical Counter-measures, assess the supply chain vulnerabilities, and develop a business continuity plan to ensure availability of Medical Counter-measures.

Laboratory (Capacity 3)

- Include in the general preparedness plan a description of how laboratory capacity can be scaled up in crisis situations.
- Identify and implement ways to ensure transfer of relevant isolates from the private laboratories to the National Health Laboratory and ensure the link with epidemiological data at the Sanitary Inspection Division of the Health Board.
- Describe better the process to ensure laboratory diagnosis, including typing, in case of an outbreak investigation or management
- Finalise and implement the updated laboratory reporting system that allows for reporting of molecular typing and sequencing data.

Surveillance (Capacity 4)

- Enhance the case reporting system, in order to support and improve the reporting of epidemiological data by clinicians.

- Develop a plan to monitor healthcare capacity and continue efforts on the digitalisation of surveillance, including for Severe Acute Respiratory Infections (SARI), bloodstream infections (BSI), and sexually transmitted infections (STI);
- Identify and implement tools to improve the collection of routinely recorded health data on vaccination and immunisation.

Antimicrobial resistance and healthcare-associated infections (Capacity 12)

- Strengthen intersectoral and interdisciplinary collaboration through regular exchanges on antimicrobial resistance (AMR) strategies. Focus the indicators and targets of the next NAP AMR on a few targets to engage all stakeholders and translate them into actions that can be adapted by actors in the human health, animal health, and eventually environmental sectors.
- Provide capacity at national level to obtain and analyse laboratory and epidemiological data for high-priority multi-drug resistant organisms (MDRO) and investigate the role long-term care facilities play in the potential spread of MDROs. Implement multidisciplinary MDRO alert and response at a national level, with particular attention to carbapenem resistance.
- Explore strategies and future mechanisms for antibiotic prescriber feedback.
- Document the national strategy for Hospital-Acquired Infections (HAI) and Infection Prevention and Control (IPC) to facilitate stakeholder engagement and evaluate the national IPC programme.

Zoonotic diseases and threats of environmental origin, including those due to the climate (Capacity 10)

- Strengthen intersectoral and cross-border collaboration through the One Health Working Group and embed the One Health approach into relevant legal frameworks as well as specific strategies and operational plans.
- Include a One Health approach in climate change adaptation strategies. Ensure the implementation and monitoring of the climate change adaptation plan 2025–2035.

Conclusions

The public health authorities of Luxembourg showed a high degree of awareness of the strengths and limitations of their preparedness and response mechanisms and presented a clear plan for continued improvement. The recommendations of this report should serve as guidance to further refine and prioritise such actions.

Introduction

The aim of the Public Health Emergency Preparedness Assessments, as mandated in Article 8 of the EU Regulation on serious cross-border threats to health, is to improve prevention, preparedness and response planning in EU/EEA countries through the implementation of evidence-based recommendations following individual country assessments.

This report presents the findings and recommendations of the first assessment conducted in Luxembourg. As specified in the Regulation, each EU/EEA country will undergo an assessment every three years, with the first cycle of these occurring between 2024 and 2026. This process involved a desk review of relevant documents, followed by a five-day country visit. As per the assessment methodology, all of the 16 capacities included in the Article 7 self-assessment template were reviewed, with five of them considered in-depth.

Background and legal basis

During the COVID-19 pandemic, it was recognised that the legal framework for combatting serious cross-border threats to health, provided for in Decision No 1082/2013/EU, needed to be broadened and enhanced to ensure a more effective response across the European Union (EU) to deal with health-related emergencies. Hence, the European Commission developed and published on 23 November 2022 the Regulation (EU) 2022/2371 on serious cross-border threats to health¹.

Within this Regulation it is recognised that prevention, preparedness and response planning are essential elements for combatting serious cross-border threats to health. In addition to creating a Union Health Crisis and Pandemic Plan, the Regulation also outlined the importance of updating and seeking coherence with Member States' prevention, preparedness and response plans.

To monitor the implementation of the plans, the Member States shall report to the Commission regarding their prevention, preparedness and response planning at the national level every three years. For this purpose, a template was developed under Article 7 of the Regulation², complementary to the International Health Regulation (IHR) State Party Self-Assessment Annual Report (SPAR)³.

In order to support the assessment of these plans, as per Article 8 of the Regulation, ECDC has the responsibility – in coordination with relevant Union agencies and bodies – to conduct assessments of all 30 European Union and European Economic Area (EU/EEA) countries every three years. The procedures, standards and criteria for the assessments of the state of implementation of national prevention, preparedness and response plans and their relation with the Union prevention, preparedness and response plan are defined by the Commission Delegated Regulation (EU) 2024/1232, adopted in March 2024⁴.

ECDC has developed a methodology for Public Health Emergency Preparedness Assessment to implement Article 8 of the Regulation on serious cross-border threats to health. The assessment process addresses the 16 capacities included in the template produced under Article 7 of the Regulation and is designed to maintain consistency within the EU/EEA countries throughout the three-year cycle, while allowing for adaption of plans if the national circumstances require.

Aim and objectives

The aim of the ECDC Public Health Emergency Preparedness Assessment process, drawn from Article 8 of the Regulation on serious cross-border threats to health, is to improve prevention, preparedness and response planning in EU/EEA countries through the implementation of recommendations following individual country assessments. Countries are asked to provide an action plan addressing the proposed recommendations of the assessment within nine months of the receipt of the ECDC report.

¹ European Commission (EC). Regulation (EU) 2022/2371 of the European Parliament and of the Council of 23 November 2022 on serious cross-border threats to health and repealing Decision No 1082/2013/EU. Brussels: EC; 2022. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R2371&from=EN>

² European Commission (EC). Commission Implementing Regulation (EU) 2023/1808 of 21 September 2023 setting out the template for the provision of information on prevention, preparedness and response planning in relation to serious cross-border threats to health in accordance with Regulation (EU) 2022/2371 of the European Parliament and of the Council. Brussels: EC; 2023. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1808>

³ World Health Organization (WHO). IHR (2005) States Parties self-assessment annual reporting tool, 2nd ed. Geneva: WHO; 2021. Available at: <https://www.who.int/publications/i/item/9789240040120>

⁴ European Commission (EC). Supplementing Regulation (EU) 2022/2371 of the European Parliament and of the Council as regards assessments of the state of implementation of national prevention, preparedness and response plans and their relation with the Union prevention, preparedness and response plan. Brussels: EC; 2024. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401232

The specific objectives of the assessment process are to:

- Assess the countries' self-assessments of preparedness in the 16 capacities covered by the outputs from the most recent International Health Regulation State Party Self-Assessment Annual Report and the Article 7 template.
- Collaborate with countries to identify good practice, challenges, bottlenecks, gaps or areas for improvement concerning the 16 capacities referred to in Article 7 (a list of the capacities assessed is available in Annex 1).
- Encourage the inclusion of key elements within the prevention, preparedness and response planning structure such as cross-sectorial and cross-border coordination, crisis management, response governance, communication, plan testing, evaluation and regular reviews, according to the lessons identified from the response to public health emergencies.
- Use the opportunity of a standardised approach to the assessment process to contribute to the improvement of EU/EEA prevention, preparedness and response capacities by promoting a common understanding of key elements and a coordinated approach.
- Provide support to countries in enhancing their national prevention, preparedness, and response capacities through recommendations based on the assessment, and provide targeted assistance upon request.

Assessment process

An ECDC-led team composed of eight ECDC experts and five experts from DG SANTE (2), DG HERA, WHO Regional Office for Europe and a country expert from France was assembled to conduct the assessment, in collaboration with the country focal point and national experts from Luxembourg. The assessment process consisted of a desk review phase and a country visit that took place between 2 and 6 December 2025.

As per the established process, the team reviewed Luxembourg's responses to the Article 7 self-assessment questions, with five of them considered in depth: Laboratory (Capacity 3); Surveillance (Capacity 4); Health Emergency Management (Capacity 6); Antimicrobial resistance (AMR) and healthcare-associated infections (Capacity 12), and Zoonotic diseases and environmental threats (Capacity 10).

The discussions prior and during the country visit were conducted in an open and transparent spirit. The experts from Luxembourg were very well prepared to present the status and activities in their field. The key stakeholders from Luxembourg were actively engaged in productive discussions and provided extensive context and answers to questions from the assessment team.

Further details regarding the practical aspects of the mission are available in Annex 2.

Main findings and recommendations regarding cross-cutting aspects

Cross-cutting aspects have been assessed considering the following specificities related to Luxembourg:

- The small size of the country.
- The fact that it borders three countries.
- That about 50% of the working population live abroad (i.e. commutes daily) and two thirds of the population of Luxembourg city are foreigners. This has an impact on country's housing, transport and health organisation. Furthermore, this brings language and cultural challenges, as well as the risk of low public health coverage for hard-to-reach segments of the population.
- There is low unemployment rate and high GDP per capita, with 5.7% of GDP spent in health (public compulsory scheme and private scheme).

After the COVID-19 pandemic, Luxembourg has invited in 2022 the OECD to comprehensively assess its response to the emergency. This report was shared with the team and considered in the current assessment.

Luxembourg has a Ministry of Health and Social Security in charge of the government policies in public health matter and supervision of the health and social security institutions and services. One of these administrations is the Health Directorate, responsible for providing science-based evidence to contribute to the decision-making process in health-related topics.

During the discussion the agility and flexibility of the system was identified as a strength, as well as the person-based communication and collaboration, which facilitates the timely reaction in crisis. However, the shortage of highly qualified healthcare professionals was identified as a gap. Additionally, the lack of some written procedures (plans, SOPs) formalising cross-cutting collaborations may impact negatively the effectiveness and coherence of the response to a crisis.

Recommendations

- Timely communication with neighbouring countries could be streamlined and improved, learning from past experiences.
- Establishing interoperability of information systems should be considered if deemed cost-effective.
- Although the country's response capacity has improved and there is evidence of its ability to deal with medium to large epidemics, the decision-making process can be improved in order to strengthen effective response to larger epidemics or crises.
- Continue with the efforts to overcome the shortages of human resources and ensure implementation of business-continuity plans.
- The establishment of an overarching legal framework to manage health crisis, including provisions to exchange on legal and policy matters with other countries (network of countries working on legal preparedness), should be considered.
- The process to adapt international risk assessments to the national context could be clarified/developed.
- Crisis management procedures should be documented, without jeopardising the agility and flexibility of the current response mechanisms.

Findings and recommendations per capacity

A list of the capacities that were included in the assessment is available in Annex 1.

Capacities assessed in depth

Health emergency management (Capacity 6)

Planning

Both at the level of the High Commission of National Protection and of the Health Directorate, generic and specific preparedness plans are actively being developed or updated. The current preparedness plans are limited in their operational detail, which may give rise to unclarity and possibly slow down decision-making in emergencies.

At the Health Directorate, a preparedness plan for the health sector is being drafted that will consist of a strategic framework and an operational plan. This plan also refers to a training programme to build up and maintain the appropriate capability and capacity with regards to crisis preparedness and crisis management. The operational plan will entail cross-cutting procedures, that can be mobilised regardless of the nature of the crisis, and topic-specific modules. The first three modules are currently being prepared (radionuclear, mass gathering and chemical risk). The heat wave module had already been updated previously.

Given the dynamic nature of many crises, the procedures described in the health plan need to fit well with the national crisis plan of the High Commission of National Protection to allow for a smooth transition and cooperation. To this end, the interplay between both needs to be described in sufficient detail. Also for crises that are not dealt with at the national crisis level, intersectoral collaboration and a one-health approach need to be incorporated. The Health Directorate may also consider defining in its plan an alert phase, for example when a threat that could become a serious (cross-border) threat to health is identified, in order to both, work on a national risk assessment and carry out the necessary activities to potentially scale up to crisis-mode.

The operational plan addresses the cross-border and international dimension of crisis management, which in the case of Luxembourg is particularly important given the size and location of the country, and the exceptionally high proportion of cross-border commuting population. The framework for cooperation agreements has been developed but specific agreements have not been discussed yet.

Risk profiling and risk assessment

Luxembourg has a High Council of Infectious Diseases, which provides independent scientific advice. On the other hand, there is no defined process for the production of public health risk identification, analysis, and prioritisation (outside events) or for the production of (rapid) risk assessment (during events).

Incident Management System

As mentioned in the comprehensive OECD assessment report, Luxembourg has employed during the COVID-19 pandemic an agile and flexible approach to risk management.

The Health Directorate has no defined emergency operation centre to manage health crises. Such functional entity, which requires consideration of logistical, digital, and human resource aspects, would allow for an appropriate working environment to scale up and down from day-to-day business to crisis mode.

Public Health and Social Measures

Decisions and actions regarding public health and social measures appear in different formats (e.g. communication to target groups, legislation, etc.) without a standardised way to capture the overview. This may hamper evaluation and learning.

Medical counter-measures: emergency logistic and supply chain management

Luxembourg is currently in a transitional phase between the end of the COVID-19 pandemic and the implementation of the lessons learned. Many procedures that were used during the COVID-19 pandemic did not exist before and are now being formalised.

Two new entities have been created at the Health Directorate (the Emergency Preparedness and Response Unit, and the Health Risk Unit), both tackling health crisis preparedness and response. INSA has increased resources and personnel to incorporate epidemiological surveillance, alerting and crisis management.

There are currently two laws being examined by the Parliament: one regarding the National Purchasing and Logistics Centre (Centrale nationale d'achat et de logistique, or CNAL), the other one on the Medicines Agency. Another bill is being drafted that will include provisions on health emergency management. All these structures are expected to improve the preparedness and response to a future health crisis in terms of Medical Counter-Measures (MCM).

CNAL is to be established and fully operational by 2030/2031 and will be responsible for the purchasing and logistics of MCMs. Currently, the agency exists as a project with limited powers and scope of action.

The list of critical MCMs is not a legal document; its drafting will be the responsibility of the newly established CNAL with the Health Directorate. The exact process is however yet to be clarified, as is the methodology to draft the list.

Luxembourg has concluded an agreement with neighbouring countries concerning possible aid in the event of a health crisis (notably with France and Belgium). There is no formal agreement concerning the vulnerability of the supply chain.

The primary obligation to ensure that enough MCMs are available lies with individual hospitals. Once CNAL has been established, it will be responsible for ensuring that sufficient MCMs are available through its business continuity plan. CNAL will also be responsible for critical medical stocks.

Recommendations

- Develop a Preparedness and Response plan for public health emergencies with strategic and operational components, as well as generic and topic-specific modules.
- Develop a Standard Operating Procedure for public health risk analysis and for independent, scientific assessment of serious (cross-border) threats to health, in collaboration with relevant institutions and possibly ad-hoc involvement of experts or the High Council of Infectious Diseases.
- Develop, in connection with the health emergency preparedness planning and IHR focal point (and the development of a public health reserve), the appropriate work environment to address health crises in the format of a Public Health Emergency Operations Centre and corresponding procedures.
- Develop a methodology to draft the list of critical Medical Counter-measures.
- Formalise the process to collect data on supply from the industry and on demand from the terrain and make it more inclusive.
- Once CNAL has been set up, assess the supply chain vulnerabilities and potential barriers.
- Once CNAL has been set up, develop a business continuity plan to ensure enough Medical Counter-measures are available.
- Develop methodology on defining the national stock of Medical Counter-measures.

Laboratory (Capacity 3)

Luxembourg has a strong public health microbiology system that includes private laboratories, hospital laboratories and the National Health Laboratory (LNS). The National Health Laboratory operates under the supervision of the Ministry of Health and includes laboratories with formal or informal reference functions. The majority of the reference laboratories in Luxembourg are situated in the LNS, with the exception of the reference laboratory for measles and rubella, located in the Luxembourg Institute of Health, which also serves as one out of three WHO European regional reference laboratories for this area.

All laboratories in the country are accredited following international standards by an official accreditation body. The capacity offered by the laboratory system, for both clinical and public health purposes, is high and a significant surge capacity can be mobilised. During the COVID-19 pandemic, laboratories in the national system contributed to the overall capacity, but large-scale testing campaigns also relied heavily on commercial laboratories that were contracted to conduct testing reimbursed by the health system in Luxembourg. The high-capacity system set up during the pandemic, with sometimes over 8% of the population tested on a weekly basis, was organised ad hoc and no plan is available should this capacity be needed again.

The laboratory system of Luxembourg is flexible and new tests can rapidly be made available for patient testing and data reporting. This ability was critical in the early response to SARS-CoV-2 but was also invoked in the Mpox response in 2022. The laboratory reporting system allows laboratories to report notifications to central level on real time basis, but the system does not allow for reporting of detailed molecular typing or sequencing information. A

new system for reporting such data is under development and is planned to be in routine use in the coming two years.

Apart from positive test results, the national laboratory reporting system also provides information of negative tests and thereby the positivity rate for selected diseases including COVID-19, measles and mpox. For routine surveillance purposes, the laboratory system is effective and delivers most expected outputs, but there are concerns about the availability of isolates.

The National Health Laboratory has BSL-3 facilities that can be used for diagnostic and public health purposes. Activities that require BSL-4 laboratory containment level are performed in other countries with such facilities, including Belgium, Germany and France. The use of such services are routinely conducted, including safe shipment of samples following international regulations and practices. However, no formal agreement exists for BSL-4 laboratory service requests. Guidelines for biosafety and biosecurity are in place for laboratories in Luxembourg, and all laboratories apply these. Elements of biosafety and biosecurity are also included as part of work processes required to be an accredited laboratory.

Recommendations

- Include in the general preparedness plan a description of how laboratory capacity can be scaled up in crisis situations.
- Identify and implement ways to ensure transfer of relevant isolates from the private laboratories to the National Health Laboratory and ensure the link with epidemiological data at the Sanitary Inspection Division of the Health Directorate. This can be done by providing protocols to the private laboratories with clear expectations on what isolates are to be transferred to LNS for further analysis.
- Describe better the process to ensure laboratory diagnosis, including typing, in case of an outbreak investigation or management
- Finalise and implement the updated laboratory reporting system that allows for reporting of molecular typing and sequencing data.
- Ensure the availability of written agreement for services requiring BSL-4 facilities.

Surveillance (Capacity 4)

In Luxembourg, communicable diseases surveillance, including mandatory notifiable diseases, is undertaken within the public health core functions of the Health Directorate. A Grand-Ducal Regulation lists a set of compulsory notifiable diseases and diseases posing a serious threat to public health for public health surveillance purposes, including minimum epidemiological and laboratory data to be reported, the mode of reporting, and timing of reporting. Currently, the list of mandatory notifiable communicable diseases includes 74 diseases, 64 of which must be declared by clinical laboratories and 48 by medical doctors and dentists. In recent years, this legislation was rapidly modified to adapt to new public health threats, such as COVID-19.

The surveillance system for communicable diseases is currently based on two types of reporting. Epidemiological case reporting is performed by medical doctors and dentists, through a secure tool (i.e. MyGuichet.lu) and via phones and fax. This tool provides a web-based platform to report clinical and epidemiological information, in disease-specific forms. However, there are limitations to the completeness and timeliness of reported information by medical doctors and dentists. The case reporting tool is separate from electronic health record systems used by clinicians, and does not contain any clinical decision support system for automated alert, analysis or feedback to the reporting clinician.

All clinical laboratories, both public and private (including hospital laboratories), use an electronic laboratory reporting system, based on regular extractions of microbiological results from each laboratory information system, reported electronically using a common standard profile. National health informatics agencies centrally coordinate the maintenance, updates, and deployment of this interoperable standard. In recent years, a feedback and communication approach has been implemented with the publication of an annual report on notified diseases and with an annual meeting with representatives of the country's eight clinical laboratories. During COVID-19, this specific reporting system was combined to a specific case management homemade software (i.e. Care Plus) allowing for a robust and timely surveillance and response system particularly in adapting to the throughput of information related to the several mass testing campaigns in the early stages of the pandemic in Luxembourg. Since then, and to professionalise the outbreak and case management, an open-source tool (SORMAS) has been implemented. It has been set for COVID-19 management, including self-reporting by individuals and recently for RSV and Influenza. It is planned to be implemented for all mandatory notifiable diseases.

Regarding respiratory virus surveillance, a sentinel surveillance system for influenza and other respiratory viruses, active since 2003, is carried out in collaboration between the Health Directorate and the National Health Laboratory (LNS). This sentinel network includes general practitioners and paediatricians reporting information to the Health Directorate and sending samples for testing at LNS. Sentinel samples are collected and tested for a panel of eight respiratory viruses, including Influenza, SARS-CoV-2, and RSV. Particularly for influenza, further virological assessment from positive samples includes typing, subtyping, and sequencing (Whole Genome Sequencing). During the COVID-19 pandemic, traditional mailing of these samples to LNS was severely constrained, requiring

patients to collect samples at a clinical laboratory. Positive samples would then be sent to the LNS. Since the 2023–24 season, doctors could again send samples directly to the LNS. Doctors report weekly number of patients with acute respiratory infection (ARI) and influenza-like illness (ILI), as well as the total number of visits. Long-standing time-series allow for monitoring of ILI trends, supported by the definition of epidemic activity thresholds. Since 2023–24, non-sentinel data for influenza, RSV and SARS-CoV-2 cases are also reported to the Health Directorate via the mandatory laboratory reporting system, and samples are further typed at LNS. Both data streams contribute to the communication and publication of weekly reports in Luxembourg, as well as to the EU/EEA-level surveillance of respiratory viruses.

Surveillance of severe acute respiratory infections (SARI) is currently not in place. Nonetheless, several projects are under development to implement SARI surveillance. The Health Directorate has started the development of the “RASSUR” surveillance system, intended to improve the detection of new public health threats. The main goal of this system is to develop a more efficient, comprehensive, and robust real-time surveillance system based on automatic data extraction from existing hospital information systems and Electronic Health Records (EHR)-based data. One of its specific objectives is to monitor SARI trends and their impact on hospitalisation and in-hospital mortality, and to ensure early detection and response to unusual events caused by respiratory pathogens. Since September 2024, the system has been piloted at one hospital centre, accounting for approximately 24% of all hospitalisations in the country, albeit with limited coverage of the paediatric population. Currently, linkage between different data sources, such as hospital admission or discharge, and laboratory databases, is not possible and only anonymised data are collected, according to national GDPR interpretation. Aligned with the development of the “RASSUR” surveillance system, Luxembourg is also an active participant in an EU/EEA-level multi-country project to implement national SARI surveillance systems using routinely collected data from electronic health records.

Luxembourg has implemented a wastewater surveillance system with the aim of supporting the early detection of pathogens and assessments of community-level transmission. This system is based on weekly sampling and testing of eight regional wastewater treatment plants (WWTP), representative for the country, using 24-hour composite sample collections from the WWTP inlet. This system monitors several respiratory virus (i.e. SARS-CoV-2, RSV), and norovirus. It has been set up with the collaboration of several stakeholders, such as the Luxembourg Institute of Health (LIH), the LNS, the University of Luxembourg (LCSB), wastewater worker unions, and municipal administrations. It is currently funded by the Fond National de la Recherche (FNR) under project CORONASTEP+, the water administration and the Health Directorate (project SUPERVIR). Importantly, wastewater monitoring has been integrated with other public health surveillance data, particularly for respiratory viruses, although the applicability and interpretability of its estimates still require further standardisation and study. Luxembourg also contributes to the EU-Wastewater Integrated Surveillance for Public Health (EU-WISH) project.

During the COVID-19 pandemic, Luxembourg was able to scale up several components of its surveillance system and establish the monitoring of several healthcare capacities, across different healthcare levels. COVID-19-related healthcare data were collected daily from hospitals and long-term care facilities (LTCFs), which enabled the crisis management team to follow the evolution of the pandemic and respond in a timely manner. However, reporting of this information was not automated in most cases and relied on ad hoc systems. While interoperable systems for automated laboratory reporting made it possible to reliably adapt and scale up the system in one week, hospitals and LTCFs reported data through ad hoc channels with standalone files. The scaling up of contact tracing capacity was also timely and robust, due to the existing ability to quickly and efficiently manage logistical, human resources, and training needs. Of note, Luxembourg implemented during the pandemic a vaccination registry for COVID-19 vaccinations which contributed to monitor population coverage and vaccination uptake.

Luxembourg has established capacity to assess multiple aspects of public health emergencies, including through studies on routes of transmission, transmissibility, and effective reproduction number, and forecasting through mathematical modelling. Due to limited digitalisation of certain types of health data, the assessment of severity and vaccination-related indicators is constrained. Paper-based death certificates are sent to the Health Directorate by municipalities as part of mandatory reporting and evaluated daily. Linkage of data for causes of death is still manual and dependent on linkable non-anonymised primary data sources. Notably, Luxembourg does not have a population-based vaccination register. Furthermore, the incorporation of vaccination or immunisation data in electronic health records is also limited by the uptake of different tools and the pace of digitalisation of data sources across healthcare levels and systems (e.g. electronic vaccination card, the perinatal health register, the child health record, and the school health record). Apart from COVID-19, vaccination status of reported notifiable cases is also not integrated into the current mandatory case reporting system.

It is significant that Luxembourg has demonstrated that it has the capacity, capability, and expertise to design, implement, and maintain a population-based vaccination register, as was carried out for COVID-19. Such a system could provide several benefits both at individual patient level and the population level. On the one hand, the system could harmonise and standardise the collection of vaccination-related electronic health data for primary healthcare provision or to inform individual personal health. On the other hand, for public health purposes, a population-based vaccination register could support more efficient outbreak control and management, assist vaccination coverage monitoring, and contribute to studies on vaccine effectiveness or assessment of public health interventions.

Recommendations

- Enhance the case reporting system, in consultation with relevant national stakeholders, in order to support and improve the reporting of epidemiological data by clinicians;
- Develop a plan to monitor healthcare capacity and continue efforts on the digitalisation of surveillance, including for Severe Acute Respiratory Infections (SARI), bloodstream infections (BSI), sexually transmitted infections (STI), and all diseases planned to be implemented in SORMAS;
- Identify and implement tools to improve the collection of routinely recorded health data on vaccination and immunisation, consulting and working with relevant national stakeholders. This should be aligned, as far as possible, with ongoing legislative and digitalisation initiatives for electronic health data interoperability across different healthcare levels.
- Continue implementing SORMAS as a tool for epidemiological case and outbreak management.

Antimicrobial resistance and healthcare-associated infections (Capacity 12)

The first National Action Plan for Antimicrobial Resistance (NAP AMR), or 'Plan National Antibiotiques' 2018–2024, is ending, and the country will soon embark on developing its second NAP AMR. An intermediate evaluation of the implementation of the first NAP AMR was conducted in 2023, and the final evaluation will be published by the end of 2024. Some needs for the second NAP AMR were identified by these external evaluations and include: 1) to prioritise and focus actions (the first NAP AMR had too many objectives to realistically achieve); 2) to strengthen the One Health approach, particularly in analysing data across sectors; and 3) to assess mortality as an indicator. Once the final report on the first NAP AMR is published, the Steering Committee ('Comité National Antibiotiques') will discuss the objectives of the second NAP AMR.

For antimicrobial consumption, the EU indicators (total annual antibiotic consumption in humans and percent of antibiotic consumption from the 'Access' group of antibiotics, per Council Recommendation 2023/C 220/01⁵) show improvements in Luxembourg since 2019, and national antibiotic consumption rates are around the EU average. It should be noted, however, that the EU average is not the goal for Luxembourg. Planned efforts involve strengthening data-driven antimicrobial stewardship actions to contribute to the prevention of multidrug-resistant organisms (MDRO).

For AMR, the EU-recommended targets for 2030 have already been met by Luxembourg for the incidences of bloodstream infections with methicillin-resistant *Staphylococcus aureus* (MRSA) and third-generation cephalosporin-resistant *Escherichia coli*, but the incidence of carbapenem-resistant *Klebsiella pneumoniae* infections is rising. National recommendations for MRSA were published in 2018 by the 'Groupe National de Guidance en matière de Prévention des Infections Nosocomiales' (GNPIN). In 2013, GNPIN also developed a comprehensive guidance document on the control of carbapenemase-producing Enterobacterales. However, implementation of screening and control measures for carbapenemase-producing organisms in Luxembourg's four hospitals is not assessed at the national level. Regular bi-monthly meetings of the Health Directorate's Division of Curative Medicine and Healthcare Quality with hospital infection prevention and control (IPC) teams allow for exchange on MDRO prevention and control strategies, but national oversight over IPC in hospitals is limited. The Ministry of Health and Social Security does not conduct hospital inspections; two of the four hospitals in the country are accredited by the Joint Commission International. One establishment is also accredited with the Accreditation Canada International. On the other hand, a legal mandate for the Sanitary Inspection of the Health Directorate to visit long-term care facilities in the country has been established since the COVID-19 pandemic. The Health Directorate and the Ministry of Family Affairs are therefore developing a collaboration regarding disease prevention and control in these settings which are considered non-medical but at high-risk for spread of communicable diseases.

The prevention of MDRO could be improved by clarifying the roles and missions of implicated institutions in MDRO surveillance in a collaborative framework. While invasive infections with carbapenem-resistant Enterobacterales (CRE), MRSA, and vancomycin-resistant Enterococcus spp. (VRE) are all notifiable diseases - meeting the requirements for ECDC's EU-level surveillance, only limited case information is currently shared with the National Health Laboratory and the Health Directorate. The National Health Laboratory has reportedly identified molecular clusters of MDRO cases within hospitals and communicated potential outbreaks back to the hospitals; however, follow-up actions are unknown at the national level. It remains therefore unclear what the specific risks and impacts of AMR are in the context of Luxembourg's unique healthcare system.

⁵ Council of the European Union. Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023/C 220/01). Official Journal of the European Union C 220/1. Available at: [https://eurlex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023H0622\(01\)](https://eurlex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023H0622(01))

Recommendations

National Action Plan for AMR

- Strengthen intersectoral and interdisciplinary collaboration by establishing regular exchanges on antimicrobial resistance (AMR) strategies. During these regular exchanges, focus on examining the available data together and translating data into actions for each AMR prevention and control stakeholder. Periodic reassessment of participants invited to the NAP AMR Steering Committee ('Comité National Antibiotiques') and working groups can help ensure that all relevant stakeholders are actively participating in the NAP AMR as it evolves.
- When developing indicators and targets for the next NAP AMR, focus on a few targets that can be leveraged to engage all stakeholders. The targets should be easily translated into actions that can be adapted by actors in the human health, animal health, and eventually environmental sectors. When considering mortality as an indicator, bear in mind that it is an extreme outcome of AMR and could be difficult to monitor annually as it needs to be estimated by modelling studies. Consider the TrACCS indicators for identifying areas for improvement and benchmarking as well.
- Incorporate actions to strengthen infection prevention and control (IPC) in the NAP AMR. Other recommendations below should also be considered for the NAP AMR.

MDRO preparedness

- Ensure that there is capacity at national level to obtain and analyse laboratory and epidemiological data for high-priority multi-drug-resistant organisms (MDRO). This is necessary to understand the epidemiological risk factors for MDROs in Luxembourg. Understanding the role of long-term care facilities in the potential spread of MDROs is particularly important. ECDC's Learning Portal and other training programmes can support this capacity. Ensuring a legal basis for obtaining necessary laboratory and epidemiological data in a timely manner is also vital for understanding the risks and impacts of AMR.
- As carbapenem resistance becomes an increasing concern in Europe, practise multidisciplinary MDRO alert and response at a national level: investigate cases of carbapenem resistance at a national level to understand how spread can be prevented and controlled. Consider investigating cases beyond the scope of EU-level surveillance (invasive cases, limited bug-drug combinations) for an understanding of MDRO outbreaks in Luxembourg.

Antimicrobial stewardship

- Explore strategies and future mechanisms for antibiotic prescriber feedback, as this is an evidence-based strategy for optimising antibiotic prescribing practices. It would be ideal to incorporate the collection of data on indications for antibiotic prescriptions in community and hospital electronic prescribing platforms.

HAI surveillance and national IPC programme

- Document the national strategy for Hospital-Acquired Infections (HAI) and Infection Prevention and Control (IPC) to facilitate stakeholder engagement. Initiatives of the Division of Curative Medicine and Health Quality, High Council for Infectious Diseases, and the Scientific Council for Health should be clearly communicated to healthcare professionals and other communities.
- National HAI surveillance data should be used to identify priorities for national IPC initiatives.
- Evaluate the national IPC programme to ensure that WHO's Core Components are addressed. Additionally, the hospital IPC programmes can be evaluated to identify areas for improvement. Existing assessment tools can be used such as the WHO assessment tool of the minimum requirements for IPC programmes at the national level⁶ and the WHO IPC assessment framework at the facility level⁷.

Zoonotic diseases and threats of environmental origin, including those due to the climate (Capacity 10)

The One Health approach is a multidisciplinary strategy that recognises the interconnectedness of human, animal and environmental health. In Luxembourg, addressing zoonotic diseases through the One Health approach involves coordination and collaboration between various sectors, including public health, food safety and veterinary services and environmental agencies. Luxembourg's application of the One Health approach aligns with the guidance available from the Quadripartite (FAO, UNEP, WOA and WHO) and broader European Union strategies, fostering collaboration at national and international levels to manage zoonotic diseases effectively.

There are several initiatives and projects in Luxembourg incorporating a One Health approach. For surveillance, joint collaborative procedures for priority foodborne pathogen surveillance have been established. This includes data from public and private laboratories in the human and animal health sectors and food safety. A formal One

⁶ World Health Organization. Assessment tool of the minimum requirements for infection prevention and control programmes at the national level. 2021. Available at: <https://www.who.int/publications/m/item/assessment-tool-of-the-minimum-requirements-for-infection-prevention-and-control-programmes-at-the-national-level>

⁷ World Health Organisation. Infection prevention and control assessment framework at the facility level. WHO/HIS/SDS/2018.9 Available at: <https://www.who.int/publications/i/item/WHO-HIS-SDS-2018.9>

Health Working Group has been established at government level, currently chaired by the Ministry of Environment. The Working Group was created with a focus on foxes, but work is ongoing to expand the scope of its work to cover all zoonotic diseases.

As an initial task, the Working Group is undertaking a prioritisation exercise. Each sector—animal, human, and environmental—is independently developing a list of priority diseases based on their specific criteria. Subsequently, the group will collaborate to merge these three prioritisation lists. The methodology for weighting various factors to create a unified prioritisation list is currently under discussion. Collaboration between the animal and human sectors is good, with smooth communication as needed. Certain activities can be implemented jointly on an ad hoc basis such as risk assessments during zoonotic disease outbreaks, or certain steps in the outbreak investigation process like laboratory information sharing. However, this collaborative work remains informal and is not documented in written procedures. Additionally, the environmental sector appears to have limited involvement in some One Health activities, possibly due to resource constraints and a lack of awareness regarding their key role.

Several initiatives are ongoing in Luxembourg to increase and facilitate the information sharing between the three sectors. Work is in progress under the PHRESH project (Projects Establishing a Public Health Rapid Epidemiological Surveillance Hub in Luxembourg), to establish a One Health national exchange platform to allow communication and information sharing between key stakeholders. This project is led by the Health Directorate and endorsed by the Ministry of Health and Social Security and other stakeholders were consulted before finalising the project proposal. In parallel, a project to develop an integrated surveillance, outbreak response management, and analysis (SORMAS) system is also ongoing. An environmental module should be implemented in SORMAS within the PHRESH project.

Work is ongoing to embed the One Health approach into relevant legal frameworks as well as strategic and operational plans and procedures for emergencies prevention, preparedness and response.

Regarding budget allocation, One Health initiatives are currently funded by the respective ministries—Ministry of Health, Ministry of Agriculture, and Ministry of Environment—based on the sector leading the activity. This funding structure may hinder the implementation of certain activities due to potential disagreements or differing priority perceptions among the sectors.

A climate change adaptation plan was in place between 2018 – 2023 and is now being revised and updated for the period 2025-2035. The Ministry of Environment is leading the updating of the plan and is now in the phase of consulting with different sectors after having finalised the first draft. Health aspects have been included across the document, including activities with a One Health component.

Since 2020, work is in progress to develop a national plan for environmental health. An interministerial group, including the sectors of agriculture, environment, health and labour, is working on identifying certain priority areas and defining a list of key actions to include in the plan.

Recommendations

- Strengthen intersectoral and cross-border collaboration:
 - Formalise and strengthen the existing One Health Working Group.
 - Ensure alignment in prioritisation activities between different sectors, for example, by setting common prioritisation criteria.
 - Increase the involvement of the environmental sector in all the activities by improving their awareness about the relevance of multi-sectorial collaboration and coordination and their specific contribution. Encourage a full environmental approach (e.g., including ecosystem surveillance and land use change) which may result in key outcomes for the environmental sectors and may help their ownership and engagement in the One Health approach.
 - Assess the need for participation of the occupational health sector in different activities, especially related to trainings, IPC measures and protocol implementation related to workers.
- Embed the One Health approach into relevant legal frameworks as well as strategic and operational plans:
 - Include the One Health approach in the generic preparedness and response plan under development, maintaining the agile and flexible coordination between sectors
 - The development of a One Health action plan or inclusion of One Health aspects in a larger action plan can help defining and prioritising the needs to implement the One Health approach across different activities.
 - Develop Standard Operating Procedures (SOP) or practical guidelines to define certain aspects of the response to emergencies such as a One Health crisis management plan or a strategy to assess the risks with a joint approach.
 - Formalise the collaboration between the animal and human health laboratories to ensure the mutual support in case of a need (e.g., scaling-up laboratory capacity, need of a specific technical requirement with limited availability).

- Enhance emergency preparedness and response:
 - Continue developing a platform for communication (PHRESH) and for integrated surveillance to ensure that all the requirements from different sectors are covered. Consider adding a module under the platform for communication to facilitate the joint risk assessment process. Standardise data collection instruments for different sectors or ensure compatibility between the reporting frameworks are actions that can facilitate the integration.
 - Conduct training needs assessment in the different sectors and map training capacities, which will help in planning future trainings with a One Health approach and understanding who the target audience should be. Conduct joint simulation exercises involving the human, animal and environmental health sectors to test response plans for zoonotic disease outbreaks.
 - Improve public awareness and strengthen community engagement, and engage with the public to inform about zoonotic disease risks and prevention measures using the One Health approach
- Explore options for pooled funding and agile working structures to prevent, prepare for and respond to zoonotic diseases
- Address environmental and climate factors: include One Health approach in climate change adaptation strategies and ensure alignment between different plans. Ensure the implementation of the plan is facilitated by the allocation of resources and the monitoring is possible by identifying measurable indicators.

Other capacities not assessed in-depth

Policy, legal and normative Instruments to implement the International Health Regulations 2005 (Capacity 1)

Luxembourg has implemented the key IHR capacities and cross-sectorial collaborations. Thanks to the size of the country that facilitates communication, some processes did not require to be formalised so far.

Recommendations

- Formalise mechanisms for intersectoral communication through the IHR NFP, as deemed necessary.
- Clarify the organisation of the IHR NFP with clear roles and responsibilities for surveillance, communication, and coordination.
- Strengthen the IHR NFP role as the central hub for coordination of public health related matters, ensuring effective collaborations with other relevant sectors as needed.

Financing (Capacity 2)

In Luxembourg, there is no contingency funding foreseen specifically for large scale virological testing for a public health emergency response. However, the Health Directorate has a nominal crisis budget and the Ministry of Finance is responsible for releasing additional budget. During the pandemic, funds from this crisis budget were readily mobilised to cover the costs related to testing and contact tracing. In addition, research has been directly funded by the Ministry of higher education and research. While a normal procedure to request extra funds requires more than three weeks, during the pandemic the approvals were faster, and extra funds were available in less than a week. This can be also facilitated by merging several budget lines in one, thus triggering simplified approval/verification process.

There are additional budget lines that are not related to crisis. While in the State Party Self-Assessment Annual Report, the country responded that there are no funds allocated to IHR implementation, during the in-country discussions it was clarified that the IHR function is observed within the Health Directorate by a dedicated staff.

Recommendations

- Maintain the one-line budget model for public health emergencies, to ensure timely allocation of resources.

Human resources (Capacity 5)

A large proportion of the health workforce is represented by commuters with residence in neighbouring countries. Luxembourg's National Health Reserve ('Réserve Sanitaire Nationale du Luxembourg') is the main mechanism to address human resource needs during public health emergencies. The National Health Reserve was established in 2020 to surge human resources during the COVID-19 pandemic. The program has undergone external review and currently, work is focused on sustaining and digitalising the recruitment and mobilisation mechanism, with a goal of establishing by 2027 a legal framework, Standard Operating Procedures, and a technical platform to manage volunteers and their training.

The National Health Reserve allows to rapidly deploy volunteer healthcare workers for a variety of tasks and includes compensation and insurance coverage for those who provide medical care. The National Health Reserve allows for rapid deployment of Health Reserve members by using a continuously updated database of workers and students from all fields. These members sign up voluntarily and benefit from annual trainings. Once dispatched on a task or mission, national labour laws apply and a compensation is provided according to contract details and recruitment style. The workers can have different profiles and backgrounds such a retired experts, unemployed persons as well as currently active workers ready to dedicate part of their time to work with the National Health Reserve.

Inclusion of workers outside of the healthcare sector is envisaged in the future. During the COVID-19 pandemic the National Health Reserve was used for contact tracing, consultation centres, vaccination centres, and call centres. After the pandemic, it has been used for smaller crises such as healthcare provision to migrants from Ukraine and support for hospitals during a surge of RSV hospitalisations.

Luxembourg's hospitals have established connections with the National Health Reserve for requesting support. It was noted that there are currently no plans to include laboratory workers in the target profiles to scale-up at this time, as this was not identified as needed. The National Health Reserve can potentially also link with the EU Health Task Force, the Global Outbreak and Response Network, and other international deployment mechanisms.

Furthermore, there is a legal provision to authorise during a crisis health professionals to conduct tasks outside their usual role. This requires the professionals to be trained for the new activity.

Recommendations

- Continue to evaluate which skills may be lacking in public health crises and develop pools of trained personnel in those fields. Ensure pre-training and just-in-time training, particularly for competencies in public health, applied epidemiology, and disease prevention and control. Consider the efforts needed for having volunteer pools updated and trained. The ECDC Learning Portal and other existing training platforms (e.g. WHO) should be leveraged.
- Large health crises are uncommon, thus a fit-for-purpose program for human resources surge support requires a reliable assessment of potential uses and demands. This can be done for example by analysing in which situations this mechanism could have been used in the last two years. A cost-benefit analysis could also be helpful to understand how much budget and resources to allocate and where to expand partnerships.
- Understanding and assessing what type of volunteer profiles are needed in surge situations versus normal healthcare system functioning is important. Considering the limited human resources in Luxembourg and knowing that the volunteers will receive economic compensation, ensure that this mechanism does not cause issues during the management of a crisis due to competition for the same human resources.

Health service provision (Capacity 7)

At the beginning of the COVID-19 pandemic, in March 2020, a national business continuity plan was developed for healthcare continuity, encompassing hospitals, with prioritisation of urgent care, and primary care. Healthcare establishments are required to have a plan establishing the structure of security and business continuity plans for critical infrastructures, referred to as the '*plan blanc*' (white plan), and particularly adapted to public health emergency situations. Although a national reference for this plan is available, regional/ local institutions and facilities are still adapting and deciding on the implementation of the requirements defined within this framework. Simulation exercises of surge capacity in healthcare access have started again in 2024, involving several stakeholders.

During the COVID-19 pandemic, there was evident capacity to monitor hospital capacity (i.e. beds, specialised equipment, and healthcare workforce). However, the process was burdensome and was only implemented and upscaled during the peak period of the pandemic (approximately between March 2020 and March 2023). The capacity monitoring system in long-term care facilities started later than that for the hospital systems, which was due to the more complex organisation structure of individual practices in primary care and the different Ministerial scope and different national and local stakeholders for the long-term care facilities. Coordination at a national level of this monitoring process, regarding reporting of data, analysis, and support for public health decision-making needs to be documented and integrated in relevant plans. In the post-pandemic period, with the downscaling of systems and services, the current legal framework does not set a specific legal instrument that would allow hospitals, medical practices, and LTCFs to report healthcare capacity data to public health stakeholders.

Recommendations

- Consult with relevant national stakeholders to consolidate the legal instruments allowing for the monitoring of healthcare utilisation and capacity, such as hospital, primary care practices, and long-term care facilities, for public health purposes, and particularly during public health emergencies.

Risk communication and community engagement (Capacity 8)

During a national emergency, the High Commission for National Protection (HCPN) sets up a dedicated team, called 'crisis cell', with representatives from all the relevant sectors. The authorities in Luxembourg have a crisis communication strategy which is implemented when the crisis cell is activated. A communication cell is composed of experts from the communication units from relevant sectors. This structure helps to have one common message with input from the different stakeholders. Any communication related to the emergency is shared to avoid duplication or discordances. This strategy appears to have worked well in the past and to have contributed to the high trust in the health authorities by the population, an aspect highlighted during different sessions. However, the particular communication strategy is not documented nor part of a larger plan or SOP.

An organised communication with the media is in place and press conferences are a way for the government and relevant stakeholders to communicate to the population. Information is also shared via government webpages and

social media. Also, social media has been used as direct contact with the population during COVID-19 pandemic. The population of Luxembourg was provided with different channels to contact the authorities with questions related to health, such as a phone and online service under the HCPN (infocrise.lu), and a dedicated COVID19 website.

Despite this contact with the population, there is no systematic mechanism to receive feedback from the population and implement social listening regarding health messages and communications. No surveys on public perception towards the government or the management and response to crisis have been conducted.

A mobile communication system via SMS and mobile application, called LU- Alert, is available in Luxembourg to send alert messages to the population. It can be used for all hazard emergencies and the dissemination of the messages can be modulated based on the geographical location of the mobile device. The decision to launch an alert depends on the sector in charge of the response to the event. The alert consists of a brief message, usually with a link to the official webpage of the responsible entity launching the message for further information. There is no mechanism in this platform to receive feedback about the messages, alerts or information shared.

A daily press review referring to national and international threats is shared internally with the staff from the Ministry of Health. However, there is no systematic or automated media monitoring.

Luxembourg has no systematic approach to identify misinformation and disinformation and there is no structured approach to infodemic management.

Some activities are in place to address the specific needs of certain communities, such as providing information in different languages or ensuring the commuters also receive key messages related to health emergencies. However, there are some hard-to-reach populations that might be more reluctant to adhere to the advice provided by the health authorities. Before the COVID-19 pandemic, there was limited work done to identify and address the specific needs of these groups of population. The pandemic was an opportunity to identify some of these groups and build trust, especially with key representatives from the communities, so as to address their needs in order to protect their health. These now established links were successfully used during subsequent health emergencies such as the mpox outbreaks. There are currently a few projects, with different stakeholders, to better understand socioeconomic and cultural aspects that can affect populations' health in the country.

Recommendations

- Document the risk communication, community engagement and infodemic management (RCCE-IM) strategy, especially in the context of the revision and update of plans. We suggest adding the RCCE-IM aspects to the generic preparedness and response plan that is under development. The HCPN is also in the process of developing a crisis management plan that should include an RCCE-IM component.
- Ensure the RCCE-IM strategy includes specific actions targeting the particularities of Luxembourg, such as the large number of commuters. We also encourage working closely with national authorities from neighbouring countries. Actions such as monitoring media and social media from neighbouring countries could help in understanding and complementing the messages commuters are receiving in their country of origin.
- In between crises, develop activities to promote the engagement of different communities, especially those identified as vulnerable or hard-to-reach populations. Build trust and connect with key stakeholders that can engage during emergencies and help in the response in their communities.
- Develop social listening and behavioural and social science to receive feedback from the population about the messages shared. This will help in understanding the limitations of the shared messages and in identifying knowledge gaps and reasons for not following recommendations.
- Implement a more structured approach to infodemic management in the area related to health.
- Encourage training activities about risk communication, community engagement and infodemic management, for communication experts and experts in field of preparedness and response.

Points of Entry and border health (Capacity 9)

Luxembourg has designated three Points of Entry: the Luxairport international airport at Findel, the Bettembourg CFL train station, and the Merttert river port. The activities of the train station and river port are limited to freight only. Luxembourg is unique in having the vast majority of its international traffic generated by daily work commuters, with 230 000 people entering the country by road or train daily, and 10 000 by air. The majority of Luxairport's five million yearly passengers originate from within the European Union.

The international airport is the only designated Point of Entry that implements routine core capacities under International Health Regulations, is integrated into the national surveillance system, and has a public health emergency contingency plan. The latter focuses on biological hazards only. Threats of non-biological origin are managed through other response mechanisms, including the national chemical, biological, radiological or nuclear (CBRN) plan. The other two designated Points of Entry are so far considered at lower risk for threats to health, but are nevertheless potential introduction points for vectors for infectious diseases due to container shipping.

Luxembourg has instruments to share travel-related health data, as shown during the COVID-19 pandemic and a recent measles outbreak. The Sanitary Inspection Division of the Health Directorate holds a key role for implementing vector surveillance, assessment of potentially infected passengers, and contact tracing. The Sanitary

Inspection does not maintain a permanent presence at the airport but has pre-positioned equipment necessary for emergency response. Timely information exchange between the Sanitary Inspection and the airport authorities and actors is therefore paramount and fostered through the national aviation facilitation committee.

During the PHEPA visit the Sanitary Inspection Division presented their entomological (mosquitoes and eggs) surveillance and integrated environmental DNA monitoring, including at the airport and the Bettembourg CFL train station. The Sanitary Inspection plans to integrate the Mertert river port into its entomological surveillance strategy. There is a surveillance protocol for mosquitoes and a Standard Operating Procedure. A vector map application has been developed and vector surveillance data will be integrated within the SORMAS environmental Module. There is regular communication between the Sanitary Inspection, authorities and the public, and annual reports are produced.

Recommendations

- Implement entomological surveillance at the Mertert river port, as planned.
- Include management of non-biological hazards in plans and procedures for Points of Entry.
- Continue and reinforce the national aviation facilitation committee to share best practices and formalise actions.

Chemical events (Capacity 11)

The authorities in Luxembourg have a national emergency response plan dedicated to threats by substances of chemical, biological, radiological or nuclear origin (CBRN). Furthermore, the law on the organisation of civil security, the Grand-Ducal Fire and Rescue Corps, the Government National Vigilance Plan in the face of threats of terrorist actions, and other relevant s provide an overarching framework for actors involved in management of chemical events. The Grand-Ducal Fire and Rescue Corps is responsible for planning and implementing the management of pollution by nuclear, radiological, biological and chemical products, has developed accordingly standard procedures and has acquired tools like spectrometry mobile devices, mobile decontaminating unit, etc. Other actors like the police and army have other detection and identification capacity which are also usable outside an emergency response context. Municipalities are involved on a collaborative base. Hospitals are developing an own CBRN approach to improve their preparedness, including the procurement of personal protective equipment and standardised response protocols. The Laboratoire National de Santé (LNS) has the capacity to analyse chemical substances, with more capacity under development to strengthen analysis of both chemical and biological agents.

EU and cross-border collaboration play an important role in Luxembourg for matters of intoxication/poisoning. Public health and health professionals rely on expertise from the Belgian Poison Centre, and for rapid risk assessment related to chemical events, the authorities rely on expertise from neighbouring countries or the European Chemicals Agency (ECHA).

The Health Directorate is not directly involved in formal mechanisms for a rapid response to chemical events, but is working towards it, considering the expertise and knowledge needed related to the identification of chemical substances in environmental and human samples, chemical risk assessment and clinical/medical toxicology.

Recommendations

- Strengthen chemical risk assessment capacities in collaboration with experts in Luxembourg, neighbouring countries, and at EU level (e.g. ECHA).
- Describe the role of the Health Directorate and operational aspects regarding chemical hazards in the Preparedness and Response plan.
- Actively engage in EU and cross-border cooperation to test response procedures to chemical events, for instance through a simulation exercise.

Union level coordination and support functions (Capacity 13)

Luxembourg has collaboration agreements in place with neighbouring countries, particularly given the many cross-border commuting workforce.

During the COVID-19 pandemic, Luxembourg participated actively in the Health Security Committee (HSC) and used HSC Opinions for their national context. The HSC Opinions are well received as they are built on scientific advice and agreed through consensus at EU level.

Luxembourg also highlighted during the assessment visit the importance of having joint human and animal health HSC meetings to facilitate communication on topics such as avian influenza.

Recommendations

- Continue to actively participate in the HSC, through suggesting topics for discussion as well as contributing to the discussions.
- Disseminate relevant HSC information and questions, contribute to the HSC Opinions and continue using them according to the national context.

Research development and evaluations to inform and accelerate emergency preparedness (Capacity 14)

During the COVID-19 pandemic, a dedicated Taskforce of Research Luxembourg and the Health Directorate have initiated and contributed to several studies. Procedures for mobilisation of research funding, rapid site accreditation, ethical clearance and data sharing between research actors were defined and have worked well. However, for serious (cross-border) threats to health, including pandemics, the procedures do not specify how the research initiatives inform the public health authorities' activities, including for risk assessment and management.

Recommendations

- Strengthen the strategic collaboration and the coordination between the Directorate of Health and the research community, both for preparedness and response to public health emergencies.

Recovery elements (Capacity 15)

There is no recovery plan to return to baseline activities after a public health emergency, but recovery actions, including organisational changes, were undertaken ad hoc following the COVID-19 pandemic (described in detail in Capacity 16). Moreover, cascading the ECDC Recovery training to the Health Directorate was a clear indication that the value of recovery is recognised.

Since Article 7 submission, the Health Directorate has started an internal after-action review (AAR) on the COVID-19 response with an interview phase. Next steps are foreseen. In addition, the Organisation of Economic Cooperation and Development (OECD) has reviewed the response. The interview part of the AAR and OECD reports were made available for the desk review and discussed during the assessment visit.

Luxembourg is planning to develop a recovery plan and include in it the after-action review methodology to identify lessons learned, as such methodology was missing during the COVID-19 AAR.

Recommendations

- When developing the recovery plan, describe the intra- and after-action review methodology and link to related methodologies, e.g. made available by ECDC, for a consistent approach.
- In future outbreaks, consider intra-action review to improve the response while the outbreak is ongoing.

Actions taken to improve gaps found in the implementation of prevention, preparedness, and response plans (Capacity 16)

Some of the lessons learned from the COVID-19 response lead to important changes, including: (i) the creation of two new units at the Health Directorate (Emergency Preparedness and Response Unit, and Sanitary Risks Unit); (ii) the launching of the National Purchasing and Logistics Centre for the Health Sector Project (CNAL); and (iii) the creation of a national framework for health threats preparedness and response. Capacity building is among the priorities, and staff has been trained in managing outbreaks and R. The Health Directorate became a training site for the EPIET fellowship and there are plans to expand to the EUPHEM fellowship.

Luxembourg participated in Joint Assessment and Detection of Events (JADE) exercises in 2022, 2023 and 2024. While an after-action review is ongoing to assess the Health Directorate response to the COVID-19 pandemic and lessons learned were documented, no intra-action reviews have been conducted. Similarly, there were no simulation exercises at national level, considering the high resource demand to do so. As an alternative to a simulation exercise, the Health Directorate has conducted a scenario-based workshop on avian influenza.

There is no formal action plan yet but following the Public Health Emergency Preparedness Assessment (PHEPA) and the WHO Universal Health and Preparedness Review (UHPR), an action plan will be developed.

Recommendations

- Finalise the internal Health directorate after-action review.
- Consider a COVID-19 pandemic after-action review beyond the Health Directorate, including more stakeholders.
- Consider, prioritise and implement the recommendations from the COVID-19 after-action review and the OECD reports, as well as the recommendations from the PHEPA visit and the WHO UHPR, when developing the action plan.
- Consider table-top simulation exercises as exercise type with relatively low resource demand, to enhance preparedness and response to health emergencies.

Conclusions

The assessment was conducted in a very collaborative and effective manner, thanks to the openness and motivation of the colleagues involved from the various authorities of Luxembourg. The assessment team noted a high degree of awareness of the strengths and limitations of the preparedness and response mechanisms in the country, including clear plans to address some of the shortcomings identified during the recent pandemic. Most of the recommendations of this report are already part of such plans and should serve as guidance to further refine, prioritise and sustain key interventions.

Annex 1. List of capacities included in the assessment

Table 1A. List of capacities included in the assessment

Capacity no.	Capacity name
Capacity 1.	International Health Regulation (IHR) implementation and coordination
Capacity 2.	Financing
Capacity 3.	Laboratory
Capacity 4.	Surveillance
Capacity 5.	Human resources
Capacity 6.	Health emergency management
Capacity 7.	Health service provision
Capacity 8.	Risk communications and community engagement (RCCE)
Capacity 9.	Points of Entry (PoEs) and border health
Capacity 10.	Zoonotic diseases and threats of environmental origin, including those due to the climate
Capacity 11.	Chemical events
Capacity 12.	Antimicrobial resistance (AMR) and healthcare-associated infections
Capacity 13.	Union level coordination and support functions
Capacity 14.	Research development and evaluations to inform and accelerate emergency preparedness
Capacity 15.	Recovery elements
Capacity 16.	Actions taken to improve gaps found in the implementation of prevention, preparedness and response plans

Annex 2. Practical arrangements for the assessment process

The five capacities assessed in-depth in this cycle are:

1. Capacity 3. Laboratory
2. Capacity 4. Surveillance
3. Capacity 6. Health Emergency Management
4. Capacity 12. Antimicrobial resistance and healthcare-associated infections
5. *Capacity 10. Zoonotic diseases and threats of environmental origin, including due to the climate

*The fifth capacity has been chosen by the country and agreed with ECDC.

Members of the assessment team

Name	Institution (ECDC/other agencies ...)	Role in the team (team leader/expert)	Main capacities assessed
Bruno Ciancio	ECDC	Team leader	IHR, Union Level Coordination,
Daniel Palm	ECDC	Expert	Laboratory, Action plan
Luis Alves de Sousa	ECDC	Expert	Surveillance, Health Service Provision
Emmanuel Robesyn	ECDC	Expert	Health Emergency Management, Chemical events, Research
Despina Pampaka	ECDC	Expert	Health Emergency Management, Financing, PoE, Recovery elements
Adriana Romani	ECDC	Expert	Zoonotic diseases and environmental threats, RCCE,
Vivian Leung	ECDC	Expert	AMR/HAIs, Human resources
Jevgenijs Golovcuks	ECDC	Expert	Health Emergency Management, Financing
Peter Hoejskov	WHO Euro	Expert	Zoonotic diseases and environmental threats,IHR
Roman Odlozilik	DG HERA	Expert	Health Emergency Management
Velina Pendolovska	DG SANTE	Expert	Health Emergency Management, Union level coordination
Katherine Poole Lehnhoff	DG SANTE	Expert	Health Emergency Management, Union level coordination
Raphael Taravella	MS expert (France)	Expert	Health Emergency Management, PoE, Zoonotic diseases and environmental threats

National experts supporting the document sharing

The aim of this section is to facilitate the identification of the national focal point that will coordinate the implementation of the PHEPA at country level and act as ECDC contact point. Additionally, the table includes information about the national experts that will have access to the SharePoint site set up by ECDC and support the document collection and sharing with the assessment team for phase 1: the desk review. It is suggested that around 2–5 experts are involved in this task, together with the country Focal Point.

Name	Role (focal point/document sharing)
Sébastien Français	Focal Point
Anne Vergison	Focal Point
Jean-Claude Schmit	Focal Point

National experts participating to the assessment process

The table below aims at sharing the names and area of expertise of the experts from the assessed country involved in the assessment process. Please, identify one expert as coordinator per capacity.

Name	National institution	Role in the assessment (Coordinator, Expert)	Main capacity to assess
Adele Bourmaud	Laboratoire national de santé	Expert	11
Alessandro Fiorani	Directorate of Health	Coordinator	2
Alexandre Mzabi	Directorate of Health	Coordinator	7 12
An van Nieuwenhuysse	Laboratoire national de santé	Expert	11
Anne Vergison	Directorate of Health	Coordinator	1 4 9 10 16
Caroline Coner	Directorate of Health	Expert	12
Catherine Ragimbeau	Laboratoire national de santé	Expert	3 10
Charles Benoy	Centre hospitalier neuro psychiatrique	Expert	14
Charles Betz	Directorate of Health	Coordinator	1 13 14
Claire Angelsberg	Ministry of Health and Social Insurance	Expert	5
Corinna Ernst	Directorate of Health	Expert	4 8 10 15
Dritan Bejko	Directorate of Health	Expert	4
Engy Ali	Directorate of Health	Expert	7
Enzo Delvecchio	Directorate of Health	Coordinator	6 7 15 16
Etienne Ehmann	Directorate of Health	Coordinator	6 9 11 15 16
Felix Wildschutz	Luxembourg Veterinary and Food Administration	Expert	12
Francesca Poloni	Directorate of Health	Expert	12
Francoise Liners	Ministry of Economy	Expert	14
Frank Glodt	Luxembourg Institute of Health	Expert	14
Guy Bley	High Commission For National Protection	Expert	6
Héloïse Ury	Directorate of Health	Coordinator	5
Henri Michel Cauchie	Luxembourg Institute of Science and Technology	Expert	10

Name	National institution	Role in the assessment (Coordinator, Expert)	Main capacity to assess
Isabelle Gras Bourigault	Directorate of Health	Expert	6
Jean-Jacques Stelmes	Directorate of Health	Expert	7
Jean-Paul Freichel	Ministry of Health and Social Insurance	Expert	5 7
Jean-Philippe Arié	Luxinnovation	Expert	14
Joël Mossong	Directorate of Health	Coordinator	3 4 14
Julien Darmian	Directorate of Health	Expert	12
Kirstin Khonyongwa	Laboratoire national de santé	Expert	4
Laurence Wurth	Directorate of Health	Expert	10
Léa Martel	Directorate of Health	Expert	5
Lisa Noesen	Ministry of Health and Social Insurance	Expert	5
Lucie Godfroid	Ministry of Health and Social Insurance	Coordinator	1
Manon Gantenbein	Luxembourg Institute of Health	Expert	14
Marc Schmit	Directorate of Health	Expert	6
Monique Perrin	Laboratoire national de santé	Expert	12
Monique Putz	High Commission For National Protection	Expert	8
Murielle Weydert	Directorate of Health	Expert	12
Myriam Heirendt	High Commission For National Protection	Expert	6
Patrick Hoffman	Directorate of Health	Coordinator	4 9
Patrick Majerus	High Commission For National Protection	Expert	6
Paul Wilmes	University of Luxembourg	Expert	14
Pauline Hublart	Directorate of Health	Expert	6
Philippe Turc	Fédération des Hôpitaux Luxembourgeois	Expert	7
Radu Duca	Laboratoire national de santé	Expert	11
Rafaela Schober	Directorate of Health	Coordinator	3 4 10
Romain Martin	Ministry of Research and Higher Education	Expert	14
Sam Glodt	Directorate of Health	Coordinator	8
Sean Sapcariu	National Research Fund	Expert	14
Sébastien Français	Directorate of Health	Coordinator	6 13 15 16
Sibel Berger	Laboratoire national de santé	Expert	3
Sonja Thill	Ministry of Environment	Expert	12
Stéphanie Conter	Ministry of Health and Social Insurance	Expert	12
Stéphanie Saleh	Directorate of Health	Expert	12
Sylvain Vitali	Fédération des Hôpitaux Luxembourgeois	Expert	7

Name	National institution	Role in the assessment (Coordinator, Expert)	Main capacity to assess
Telma Velez	Directorate of Health	Expert	10
Tom Dentzer	Laboratoire national de santé	Expert	3 4
Ute Aurbach	Laboratoire national de santé	Expert	3 12
Valérie Binder	Directorate of Health	Coordinator	6 12
virginie Martinet	Directorate of Health	Expert	12
Yolanda Pires	Directorate of Health	Expert	15

Agenda for the in-country visit

	Monday	Tuesday	Wednesday	Thursday	Friday		
08:30							
08:45	Welcome & Registration	Registration	Registration	Registration			
09:00							
09:15	Opening Remarks (country)	C.2 Finance, C.5 human Resources and C.7 Health Service Provision	Breakout room 1 - C.3 Laboratory	Breakout room 2 - C.6 Health Emergency Management - planning, IMS, risk profiling, PHSM	Breakout room 1 - C.12 AMR/HAls	Breakout room 2 - C.6 Health Emergency Management - Medical Counter Measures	Breakout room 3 - C.10 Zoonotic diseases and threats of environmental origin, including those due to the climate
09:30	Overview and key aspects of the assessment process (ECDC)						
09:45	Overview of the country + public health structure.						
10:00							
10:15		Break	Break	Break	Registration		
10:30							
10:45							
11:00	Break	C.9 PoE and C.11 Chemical events	Breakout room 1 - C.3 Laboratory	Breakout room 2 - C.6 Health Emergency Management - planning, IMS, risk profiling, PHSM	Breakout room 1 - C.12 AMR/HAls	Breakout room 2 - C.6 Health Emergency Management - Medical Counter Measures	Breakout room 3 - C.10 Zoonotic diseases and threats of environmental origin, including those due to the climate
11:15							
11:30	Assessment of Cross-Cutting Aspects - Scenario based discussion						
11:45							
12:00		Lunch	Lunch	Lunch	Main findings, conclusions, recommendations and next steps (ECDC presentation and discussion with Country)		
12:15							
12:30							
12:45	Lunch	Lunch	Lunch	Lunch	Lunch		
13:00							
13:15							
13:30							
13:45	Assessment of Cross-Cutting Aspects - Scenario based discussion	C.8 RCCE	Breakout room 1 - C.4 Surveillance	Breakout room 2 - C.7 Health Emergency Management - planning, IMS, risk profiling, PHSM	Buffer for further in-depth discussion	Wrap-up session	Debrief on the ECDC assessment process (structure, preparation, organization)
14:00							
14:15							
14:30	C.1 IHR and C.13 Union level coordination						
14:45		Break	Break	Break	Concluding remarks (country)		
15:00	Break						
15:15							
15:30							
15:45							
16:00	C.1 IHR and C.13 Union level coordination	C.14 Research	Breakout room 1 - C.4 Surveillance	Breakout room 2 - C.7 Health Emergency Management - planning, IMS, risk profiling, PHSM	C.15 Recovery and C.16 Action plan		
16:15							
16:30							
16:45							
17:00	Wrap-up Day 1 (ECDC together with country)		Wrap-up Day 3 (ECDC together with country)				
17:15							
17:30							

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of the European Union