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SCOPE-IS

D3.2 Report on early warning system inputs and outputs

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Change Log

Version	Date	Author	Description of Changes	Reference Section
1.0	20. 5. 2025	Project Team	First final version of the document	-

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Overview of Abbreviations Used

CDR – Central Data Repository

EWS – Early Warning System

ISIN – Infectious Diseases Information System

RPHA – Regional Public Health Authority (in Czech: KHS)

MoH – Ministry of Health of the Czech Republic

GP – General Practitioner (in Czech: PL)

RestAPI – Standard for automated data exchange between information systems

NIPH – National Institute of Public Health (in Czech: SZÚ)

IHIS CR – Institute of Health Information and Statistics of the Czech Republic (in Czech: ÚZIS ČR)

Executive Summary

This document describes the proposed configuration of reports and the visualization platform within the early warning system for infectious disease surveillance under the SCOPE IS project in the Czech Republic. The aim is to define and describe the general requirements and parameters of the displayed data for different user groups, taking into account their competencies and needs, which will be further specified and adapted based on the results of the pilot phase.

Processing of personal data within the planned activities of the SCOPE IS project is subject to the Project's Data Protection Policy, which is available in full on the project website (https://scopeis.uzis.cz/en/outputs/).

1 Introduction

The early warning system for infectious diseases is one of the key tools that enables timely identification, analysis, and appropriate response to emerging public health threats. Within the SCOPE IS project, an integrated platform will be developed that connects various data sources and enables their effective visualization and interpretation via a dashboard.

This document focuses on specifying the output component of the system—namely, the design of reports intended for different types of users with varying levels of remit, decision-making authority, and professional focus.

2 System Inputs

To enable effective data handling within the system, a differentiated display of parameters is designed for individual users based on their role in the system, level of involvement, and access rights. This approach will help protect sensitive information while also simplifying and clarifying the user interface.

Emphasis is placed on ensuring the quality and completeness of data through validation mechanisms, control rules, and compliance with personal data protection legislation, including data anonymization where relevant.

2.1 Data Sources

Data will be automatically transmitted via RestAPI based on reports from general practitioners, inpatient care providers, and laboratories. Upon receipt by the system, the records (reports) will be stored and subsequently processed with respect to user access permissions.

2.2 Data Collection and Validation

The system will be designed to enable automated real-time data acquisition through integration with information systems of healthcare providers and laboratories. In justified cases, manual data entry by authorized users will also be permitted, particularly when there is a need to complete or modify the data. Data quality will be ensured through automated control mechanisms that will detect inconsistencies, missing information, or suspicious values. An integral part of the system will also be data anonymization, which will ensure compliance with personal data protection legislation and allow for a safe use of data for analytical and public purposes.

3 Data Processing

The effective functioning of the early warning system requires well-designed data processing and analysis that enables the timely detection of changes in the epidemiological situation. The system design therefore includes a combination of methods for monitoring, modelling and predicting the spread of infectious diseases, as well as alert mechanisms based on defined criteria. These tools aim to support informed decision-making, strengthen preparedness, and accelerate the response of public health authorities to potential threats.

3.1 Analytical Methods

Within the proposed early warning system and infectious disease surveillance, the use of a combination of analytical approaches is being considered. These approaches will enable the timely identification of threats, monitoring of the epidemiological situation, and support decision-making at the public health level. The methods will be further defined based on available data, the specifics of individual diagnoses, computational capacities, and the needs of the system's target users.

3.1.1 Trend Analysis

The use of both basic and advanced methods for monitoring temporal and geographical trends in the occurrence of infectious diseases is planned.

The aim is to:

- identify changes in incidence over time (increasing or decreasing trends),
- monitor seasonal fluctuations,
- detect regional differences and transmission patterns.

This type of analysis will provide a fundamental basis for assessing the development of the epidemiological situation.

3.1.2 Anomaly Detection

The introduction of tools for automated detection of deviations from the usual state is being considered — for example, sudden increases in case numbers, spatial clusters, or changes in the demographic structure of cases.

This module is intended to support the early identification of unusual events and serve as a trigger for epidemiological investigation.

3.1.3 Predictive Modelling

For the purpose of forecasting the spread of infectious diseases, the use of predictive models will be considered, based on:

- historical and current incidence data,
- population structure and behaviour,
- characteristics of pathogens.

The models may employ both traditional approaches (e.g., SIR/SEIR model, regression analysis, ARIMA) and modern machine learning techniques. The goal is to estimate future trends in incidence and support strategic planning.

3.2 Alert and Notification System

One of the key components of the early warning system is the ability to automatically alert responsible entities about potential risks associated with the occurrence of infectious diseases. The system will be designed to enable rapid, targeted, and user-tailored notifications through multiple communication channels. This will support a swift response and effective coordination among public health stakeholders.

3.2.1 Threshold-Based Alerts

The system will be equipped with a module for automatic generation of alerts when predefined threshold values are exceeded.

These limits may be established:

- based on historical averages (e.g., weekly incidence compared to the median of the past 5 years),
- as an absolute number of cases per unit of time within a specific geographic area (e.g., 10 cases in a district within 24 hours),
- based on the age distribution of cases (e.g., more than 3 cases in a class/group of students).

Exceeding the defined thresholds will trigger an automated alert process, which will vary depending on the severity and type of event.

3.2.2 Multichannel Communication

To ensure fast and reliable dissemination of alerts, multiple communication channels will be utilized:

- Email notifications: automatic messages with an overview of events
- Internal system notifications: directly within the system's user interface, for example upon login.

The communication architecture will be designed with an emphasis on scalability and interoperability with other national and European systems.

4 System Outputs

The proposed system will generate various types of outputs intended for different target groups — ranging from rapid internal alerts to public visualizations. The design includes both detailed analytical reports for experts and aggregated information for the public or decision-makers. The structure and content of the outputs will be refined during the pilot phase, with the goal of ensuring maximum usefulness and clarity of data for end users.

4.1 Report Types

Based on the current design phase of the system, the following types of outputs have been defined to reflect the anticipated needs of individual users within the early warning system. This design will be further pilot-tested and potentially adjusted based on user feedback during the trial operation.

The report types and their presentation methods listed below represent a working draft of the system's output structure.

The system will generate several types of outputs tailored to different target groups (e.g., epidemiologists, other staff of RPHA, government and municipal employees, the public) and purposes (EWS, routine reporting in ISIN). Outputs will be created with regard to the level of involvement and competencies of individual users and will vary in scope and detail.

4.1.1 Infectious Diseases Information System (ISIN)

Description:

Overview of cases created in ISIN that have passed validation by the RPHA (in Czech: KHS).

Content:

- Case status
- Case type (confirmed, probable, possible)
- Temporal and geographic distribution

Users:

Staff of RPHA, National Institute of Public Health (NIPH) (in Czech: SZÚ), Ministry of Health (MoH), access according to user roles

Access method:

Internal ISIN interface

4.1.2 Early Warning System (EWS) in ISIN

Description:

Rapid outputs from raw data before validation, combining information from EWS, CDR (Central Data Repository), and other systems.

Content:

- Number of new records
- Temporal trends
- Regional distribution
- Detection of anomalies (threshold exceedances)

Users:

Specialist staff of RPHA, National Institute of Public Health (NIPH) (in Czech: SZÚ), Ministry of Health (MoH), access according to user roles

Access method:

Internal dashboards, notification system

4.1.3 Mailing – Early Warning Alerts

Description:

Automated email messages in case predefined threshold values are exceeded.

Content:

- Event summary
- Time and location of detection
- Type of disease

Users:

RPHA, NIPH, selected institutions according to configuration

Access method:

Email, notifications customizable based on user roles

4.1.4 Dashboard in Power BI

Description:

An interactive analytical tool for real-time monitoring of the situation and generating overview analyses.

Content:

- Time trends by diagnosis and regions/districts
- Detection of outbreaks and clusters
- Comparison with previous periods
- Reporting rates by provider type (general practitioners, inpatient care, laboratories)
- Visualization of the results of predictive models (in a later phase)

Users:

RPHA, NIPH, MoH, and other users with access rights according to their level of involvement and competencies (local governments, integrated rescue services, etc.)

Access method:

Registered access (authentication)

4.1.5 Other Outputs – Open Data

Description:

Aggregated open data from ISIN and summaries for the public and the professional community.

Content:

- Weekly incidence
- Regional comparisons
- Seasonal trends
- Summaries by age group

Users:

Public, researchers, media

Access method:

NIPH website

4.2 Configuration of Outputs According to the User

The reporting system is designed to enable targeted customization of outputs for different types of users according to their roles, needs, and remit in public health. The configuration mainly varies in the form of presentation, data scope, and level of detail.

Local governments (e.g., regional and municipal authorities) will have access to clear outputs through interactive Power BI dashboards, offering easily interpretable visualizations of key indicators, geographic overviews, and trends. The goal is to support quick understanding of the local situation and health protection decision-making.

Regional Public Health Authorities RPHA (in Czech: KHS) and other expert users will be able to work not only with visualization tools but also with detailed analytical outputs directly within the ISIN system, as described above. This option allows for deeper data analysis, ad hoc filtering, custom report creation, and use for epidemiological investigations and operational decisions.

Central authorities (e.g., Ministry of Health (MoH), National Institute of Public Health NIPH (in Czech: SZÚ) will have access to comprehensive outputs for strategic management and monitoring of the situation at the national level, including the ability to compare regions, analyse temporal trends, and evaluate the effectiveness of measures.

Outputs will be tailored to the specific needs of each user group.

4.2.1 RPHA– Regional Public Health Authority (in Czech: KHS)

- Daily signal reports alerting to above-average occurrence of specific diagnoses.
- Visualizations of the geographic distribution of cases at the district and municipality levels.
- Summaries by healthcare providers to identify potential outbreaks.
- Exportable tables for further local analysis.

4.2.2 NIPH – National Institute of Public Health (in Czech: SZÚ)

- Daily signal reports alerting to an above-average incidence of specific diagnoses
- Overviews for the entire Czech Republic and its regions, with emphasis on unusual occurrences and serotypes.
- Trend monitoring over time, including seven-day and monthly averages.
- Data for preparing materials for communication with the Ministry of Health (MoH) and the public.

4.2.3 Ministry of Health of the Czech Republic (MoH)

- Strategic overviews for decision-making, crisis management, and public communication.
- Rapid identification of fluctuations at the national level.
- Reports on data availability, reporting quality, and system coverage.

4.2.4 Regional and Local Authorities

- Summary of the situation development within their jurisdiction, provided especially in cases of epidemiological deterioration, outbreak occurrence, or the need for rapid response to new threats.
- Data visualizations for communication with the public and coordination of measures.
- Reports on data availability, reporting quality, and system coverage.
- Possibility of using overview reports for meetings of crisis management team and local government authorities.

5 Proposal of Reports for Pilot Diagnoses

Following the selection of seven pilot diagnoses, chosen with regard to their epidemiological significance, transmission potential, data availability, and international surveillance obligations, a framework of basic reporting outputs has been designed. These outputs will serve as a basis for testing the system's functionality during the pilot phase and for gathering feedback from future users.

The pilot diagnoses include:

- Acute hepatitis A
- Whooping cough [pertussis]
- Enteritis, causative agent: Campylobacter
- Chickenpox [varicella]
- Mumps [parotitis epidemica]
- Salmonella enteritis
- Measles

5.1 Basic Characteristics of Reports

Flexible reporting system for monitored diagnoses with the options of varying periodicity and territorial breakdown.

5.1.1 Time Coverage

The following time coverage is considered in the design of outputs:

- **Year-round monitoring without seasonal restrictions**, enabling continuous evaluation of the development of the situation.
- **The possibility to compare with previous five years**, used to identify deviations from usual trends and fluctuations.
- **Flexible setting of the time window according to user needs**, e.g., daily, weekly, monthly, or seasonal views, tailored to specific epidemiological requirements.

5.1.2 Proposal of Data Structure for Pilot Monitoring of Selected Diagnoses

Reports for the pilot diagnoses will focus on key epidemiological indicators that enable comprehensive monitoring of the situation over time and across regions. The proposed structure supports both quick orientation and deeper data analyses and visualizations.

<u>The proposed set of outputs includes:</u>

- **Total number of cases** – a basic overview of the burden of the given disease in the population regardless of age or location.
- **Number of cases by age groups and sex** – distribution of cases into predefined age categories and by sex, allowing monitoring of the impact on different age cohorts (e.g., children, seniors) and identification of potential differences between males and females.
- **Regional distribution of cases:**
  - Number of cases in individual regions, including detailed breakdowns by age categories.
  - Number of cases in districts, also broken down by age.
- **Number of hospitalizations**, including severity, categorized by both age and regions, providing insight into the severity of disease progression in various populations and areas.

- **Number of deaths** related to the disease – an indicator of severity and potential public health impact.
- **Number of complications**, recorded by age groups, allowing evaluation of how often the disease leads to further health deterioration.

Graphical part of reports:

- **Trends over time** (including comparisons with the past 5 years).
- **Cartographic outputs** (cartograms by regions and districts).
- **Relative values** (e.g., incidence per 100,000 inhabitants, changes over time).

Specifics of processing and availability:

- Option for **ad hoc reports** based on current needs.
- Combination of **automated and manual processing** depending on the output type.
- **Remote access** to data storage and outputs for authorized users.
- **Flexible frequency** of output generation according to the current epidemiological situation (e.g., daily, weekly, monthly).

Monitored analytical parameters:

- **Absolute numbers** of cases, hospitalizations, and deaths.
- **Relative morbidity** in relation to the population size.
- **Week-to-week changes** and dynamics of spread.
- **Cumulative data** for a defined period.
- **Geographic differences** and localization of occurrence.

6 Expected Benefits and Impacts of the Proposed System

The implementation of the early warning system offers a potentially wide range of benefits across all levels of public health. At this stage, key areas have been identified where the system can significantly support the work of professionals and institutions. These benefits will be further validated and elaborated during the pilot phase.

6.1 Decision-Making Support

Rapidly accessible, visualized, and analysed information will provide support for both operational and strategic decisions in the field of public health protection.

Notifications and signal reports will facilitate a prompt response to emerging outbreaks and other threats.

Predictive models will enable the planning of targeted interventions even before an infection spreads on a larger scale.

6.2 Improved Communication and Collaboration

Sharing data in a unified environment will strengthen cooperation between key institutions, such as Regional Public Health Authorities (RPHI, in Czech: KHS), the National Institute of Public Health (NIPH, in Czech: SZÚ), and the Ministry of Health (MoH).

Standardized outputs will ensure a uniform interpretation of data and provide a basis for coordinated action.

Visualization tools such as dashboards will support effective communication with the public and media through clear charts and maps.

6.3 Strengthening Surveillance and Public Health

Both detailed and aggregated outputs will enable targeted interventions at the local level without the need for broad, population-wide measures.

In the long term, the system can significantly contribute to enhancing the resilience of the public health system and preparedness for new internal and cross-border threats.

7 Conclusion

This document presents the proposed structure of reports and outputs for the planned early warning system and infectious disease surveillance. The aim of the proposal is to develop effective tools for the collection, processing, analysis, and distribution of information that will support rapid response and informed decision-making in the field of public health protection.

The proposed types of outputs, methods of presentation, and the notification system have been designed with consideration for the needs of various target user groups. At this stage of development, this is a working proposal that will be further verified and refined during the pilot phase. Practical testing will allow the assessment of their benefits, clarity, and usability in a real-world environment.

The outputs and functionalities of the system will be continuously adapted based on the received feedback. The result will be a robust and flexible tool for the early detection and monitoring of infectious threats, enhancing the ability of the public health system to respond to both current and future challenges.