

# Project Report - Swiss Digital Infection Prevention Platform

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## 1. Executive Summary

The Federal Office of Public Health (FOPH) mandated Swissnoso to examine the feasibility, acceptability, and requirements of a unified, comprehensive digital solution for the surveillance of healthcare-associated Infections (HAI) and further Infection Prevention and Control (IPC) functionalities ('Vorprojekt'). The authors conducted the project, and Swissnoso approved the current report.

The project addressed the following work packages:

- a) the feasibility of implementing a Swiss Digital Infection Prevention Platform (**IPC Platform**)
- b) the definition of necessary technical requirements;
- c) the legal requirements;
- d) the opportunities for interoperability with other projects in the Swiss healthcare system;
- e) the evaluation of commercially available software solutions.<sup>1</sup>

**Ad a)** – To assess the **feasibility** of a digital **IPC Platform**, we conducted interviews IPC experts and IT experts from ten Swiss hospitals. Additionally, all **Swiss acute care hospitals** were invited to participate in a written survey, and interviews were conducted with selected Electronic Health Records (EHR) systems providers. The investigations revealed that the level of automation in IPC units in hospitals is generally low. The concept of a national **IPC Platform** met broad approval. While few hospitals already have specific IPC software solutions, most rely heavily on manual work. Requests for nationally defined Application Programming Interfaces (API) for data exchange were often voiced, and semantic standards and standards for data exchange emerged as crucial components. We also understood from the multiple exchanges that Swiss IPC teams are saturated with manual data entry for Swissnoso surveillance modules. Hospitals are under financial pressure and are reluctant to support additional surveillance activities. They only consent to additional surveillance and monitoring modules if the workload for data management would be reduced.

**Ad b)** – We established the basic **requirements** for the **IPC Platform** supported by multiple interactions with experts, including Bern University of Applied Sciences (BFH) and commercial providers (see below under e)). The optimal design of the **IPC Platform** emerged to be a two-pronged approach consisting of a Swissnoso-hosted, central Digital Infection Prevention and Control IPC Datacenter (**IPC Datacenter**) and Hospital-based Digital IP Toolkits (**IPC Toolkit**). As alternatives to the IPC Toolkit, hospitals will be able to submit data manually or via an application programming interface (API) if they renounce of automated algorithms and further software modules included in the **IPC Toolkit**.

**Ad c)** – As a basis for **legal clarification** with the Federal Data Protection and Information Commissioner (EDÖB), we established a description of current and planned Swissnoso IPC digital solutions ready for submission.

**Ad d)** – To evaluate opportunities for **interoperability** with other projects in the Swiss healthcare system, we approached relevant stakeholders, including the Swiss Personalized Health Network (SPHN), DigiSanté, the Federal Quality Commission (EQK), ANQ, ANRESIS, and eHealth Suisse.

**Ad e)** – We identified available **commercial software solutions** covering the anticipated platform functionalities. Among 23 evaluated software providers, we identified three solutions covering the core requirements. They feature semi- or fully automated HAI surveillance and further IPC functionalities such as

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<sup>1</sup> The last work package (e) constituted an additional activity not primarily included in the project since it was instrumental in learning about real-world applications (ad a) and requirements (ad b).

isolation, outbreak management, and multi-drug resistant organisms (MDRO) monitoring. These software solutions are already implemented in various countries at reasonable cost. It will facilitate the work of IPC teams decisively and free time for their presence in the units to support intervention programs. We were particularly convinced by platforms that allow the hospital to choose how they transmit data to the **IPC Datacenter**:

1. Hospitals host the proposed **IPC Toolkit** linked to the national **IPC Datacenter**
2. Hospitals transmit the data via a predefined **application programming interface (API)**
3. Hospitals continue with **manual data entry** in web forms.

**We recommend:**

1. To pursue a **two-pronged approach** with hospital-based **IPC Toolkits** and a Swissnoso-powered national **IPC Datacenter**, while still offering alternatives for data transmission via webform or API
2. To acquire a **commercially available IPC software** solution instead of building a new solution
3. To enforce **semantic and data exchange standards** in Swiss healthcare data systems through national initiatives (e.g., DigiSanté)
4. To consider **synergies with co-existing projects** (e.g., ANRESIS) to control costs
5. To finalise the clarification of the **legal framework**

**For a second project phase in 2024, we propose:**

1. To further **evaluate the 3 identified commercial software** solutions, including visits to user hospitals and national authorities
2. To assess **costs**, develop a business model, and identify potential funding sources
3. To further explore **synergies** with other projects and outline timelines and pathways to interoperability to control costs
4. To co-develop the roadmap for the **integration** of existing and planned surveillance modules and potential bridging solutions
5. To pursue the clarification of **legal requirements** with the Federal Data Protection and Information Commissioner (EDÖB)

## 2. Mandate

The Federal Office of Public Health (FOPH) mandated Swissnoso with the project “Swissnoso digital infection prevention platform (SwissnosoDIPP)” (Verfügung 142006169 / 332.11-90/40), dated August 8, 2023.

The project aimed to analyse the feasibility of a new platform for the surveillance of healthcare-associated (HAI) infections in Switzerland and to define its requirements. The following four works packages (WP) were addressed.

**WP 1:** Survey to identify hospital need and the feasibility of the strategy

**WP 2:** Specification of requirements and evaluation of data security aspects

**WP3:** Evaluation of legal aspects

**WP4:** Interoperability with other ongoing projects in Switzerland

The evaluation of commercially available software was not planned initially. However, we recognised during the project how helpful this evaluation was to establish the requirements.

### 3. Aim of the report

This report summarizes the results of the four work packages and the evaluation of commercially available software for IPC surveillance platforms, formulates recommendations, and suggests further in-depth evaluations.

### 4. Background

Annually, between 6% and 8% of patients admitted to hospitals in Switzerland experience healthcare-associated infections (HAIs). Research indicates that a substantial number of these infections could be prevented by meticulously implementing and observing evidence-based preventative strategies. The surveillance of HAIs and adherence to infection prevention measures in hospitals is the basis to monitor the success of interventions. Swissnoso succeeded in implementing surveillance of HAIs and initiated several intervention modules to decrease the incidence of HAIs, mainly by relying on manual data entry. In response to this challenge of high workload, Swissnoso is dedicated to advancing digital solutions tailored for Swiss healthcare facilities, aiming to enhance local infection prevention efforts. This includes the automation of HAI surveillance for conditions like catheter-associated urinary tract infections and monitoring compliance with preventive practices such as timely and correct antibiotic prophylaxis before surgical interventions. Additionally, Swissnoso's initiatives extend to the detection and management of outbreaks and the management of patients under isolation precautions.

Historically, Swissnoso has developed various tools to facilitate HAI surveillance and monitor adherence to prevention protocols. Over time, this has led to a diverse portfolio of modules, each designed as a standalone IT solution for data collection and prevention measures. While this growth reflects Swissnoso's commitment to addressing the multifaceted nature of infection prevention, it also highlights the need for a more integrated approach to effectively manage and streamline these critical efforts.

The current structure faces the following challenges:

- **Lacunary data on the effect and evolution of the NOSO Strategy:** Isolated data management and storage solutions for each Swissnoso surveillance and intervention module preclude a holistic view of the prevention efforts and outcomes across Swiss hospitals. Swissnoso and FOPH must be able to shape their promotion based on dependable data.
- **Manual workload:** The current surveillance systems require a high manual workload at the hospital level. Even if the possibility exists to upload part of the data electronically, it is rarely used due to technical and practical challenges. In addition, it is not always a top priority of the local hospital IT department. Moreover, Swiss hospitals grapple internally with many poorly interconnected databases.
- **Data entry delay:** The high manual workload and data quality loops often lead to a substantial delay in data entry.

- **Delayed and unspecific feedback:** Data cleaning and manual calculations at the national level further increase the feedback of results, and specific feedback for different professional groups (physicians, nurses, management) does not exist. This jeopardises the motivational and quality improvement effect of the costly surveillance and monitoring activity.
- **Maintenance:** For every module, Swissnoso has a different IT system and provider, which complicates digital interaction, maintenance, and further development.
- **Standardisation and interoperability:** There is hardly any standardisation between the systems. Interoperability is very limited. In 2022, Swissnoso decided to work only with IT systems that support the FHIR standard for data exchange. A FHIR implementation guide has been made available for catheter-associated urinary tract infections (CAUTI) by Swissnoso; further guides are planned.

Swissnoso is addressing these challenges with the new **IPC Platform**. The **IPC Platform** will integrate an **IPC Toolkit** to be locally hosted within each hospital's security perimeters with an **IPC Datacenter** hosting the national database. The **IPC Platform's** innovative design is set to significantly enhance HAI prevention efforts across Switzerland. It is future-oriented and will allow the application of modern analytical technologies such as artificial intelligence. Swissnoso is committed to seamless integration within Switzerland's health technology landscape, utilising existing infrastructure, adhering to commonly used data definitions, and meeting international standards. Furthermore, Swissnoso prioritises collaboration with stakeholders in the healthcare sector to ensure the **IPC Platform's** success and sustainability.

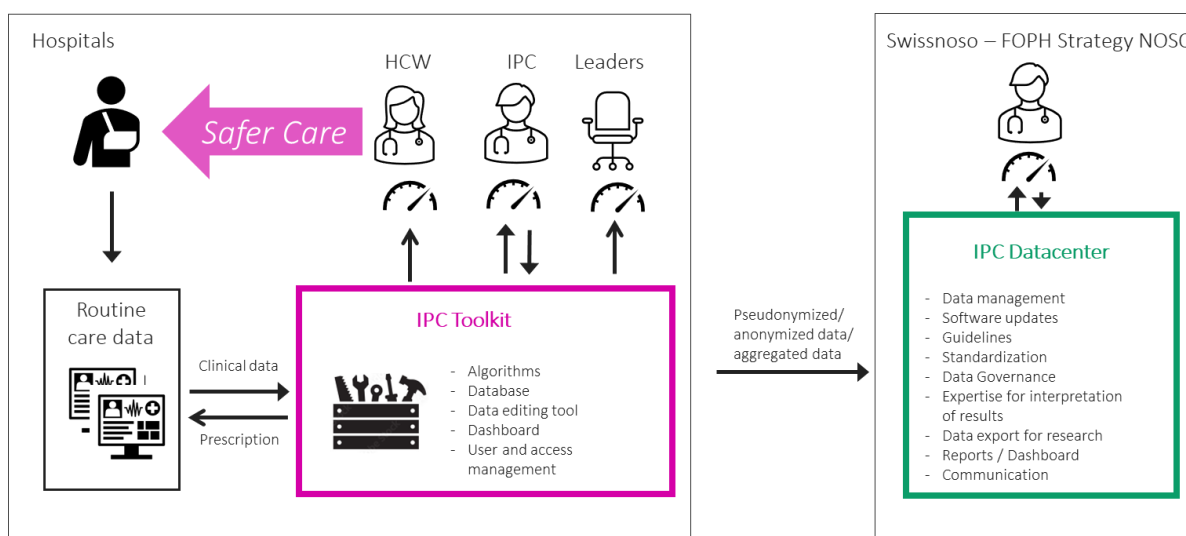


Figure 1. The illustration shows the planned IT infrastructure of the **IPC Platform**. The centrepiece is a software package provided to the hospitals, the **IPC Toolkit**. A dashboard allows monitoring of healthcare-associated infections locally at the hospital. Depending on the data protection regulations and the hospital's preferences anonymized or aggregated routine healthcare data is sent to the national **IPC Datacenter**.

The **IPC Toolkit** will be a software suite designed to run locally within hospitals' security perimeters. This software will enhance IPC efforts by enabling semi- and fully automated surveillance of HAI. Additionally, it will support typical tasks of the hospitals' IPC teams, such as managing multi-drug resistant organisms (MDROs), isolation precaution protocols, and contact tracing.

The near-real-time feedback design of the **IPC Toolkit** will allow for immediate feedback to IPC teams, healthcare professionals, and hospital management through tailored dashboard functionalities. The hosting within hospital security perimeters will allow the inclusion of patient names and contact information, which is necessary for clinical utility. The potential for integration with electronic health records (EHR) promises to streamline care delivery further, offering a seamless blend into existing healthcare workflows. Additionally, it paves the way for direct patient engagement, enabling self-reporting of symptoms or healthcare visits akin to the established patient-reported outcomes measures (PROMs) in the Swissnoso surgical site infection surveillance module.

Through a strategy of continuously deploying, the system ensures that hospitals benefit from the latest developments in algorithmic approaches and benchmarking standards.

On a national scale, the **IPC Datacenter** aggregates data, generating insightful reports and facilitating benchmarking, research, and broader applications. This central application processes data on a national level creates reports on the progress of the FOPH Strategy NOSO and provides data for benchmarking, research, and further use.

The introduction of the Platform signifies Swissnoso's commitment to minimising manual tasks in IPC teams, offering the opportunity to invest freed-up resources in intervention programs to reduce HAI. This tool would position FOPH and Swissnoso as beacons for innovation in the Swiss health sector, potentially serving as a best-practice model for HAI surveillance and prevention beyond Swiss borders.

## 5. Feasibility of implementing an IPC Platform in Swiss hospitals

### 5.1 Aim

We aimed to assess the feasibility and acceptance of the envisioned **IPC Platform**. Therefore, we contacted IPC and IT units in Swiss hospitals to learn more about their requirements and needs.

### 5.2 Procedure

We collected data on the status and potential of digitalisation in the IPC in two ways: semi-structured interviews and a written questionnaire with open-ended questions. In addition, semi-structured interviews were conducted with vendors of EHR systems to understand how they assess the feasibility of our approach.

#### *Semi-structured interviews with hospitals*

Semi-structured interviews were conducted with 10 carefully selected hospitals, ensuring a diverse representation of Swiss tertiary care hospitals. Hospitals were asked to include at least one representative from the IPC department and a high-ranking IT professional in the discussions. On the Swissnoso side, an IPC expert (Prof. Hugo Sax), an epidemiologist (Dr. Alexandra Scherrer) and an IT specialist (Francois von Kaenel) took part. The same questions were asked in the written survey (see below).

#### *Semi-structured interviews with EHR vendors*

We have contacted vendors of the most frequently used EHR in Switzerland and were able to schedule interviews. We asked the EHR vendors, in particular, about the feasibility of the **IPC Platform** and what challenges they see.

#### *Written questionnaire for acute care hospitals*

A qualitative questionnaire was designed in SurveyMonkey® in three national languages (French, Italian and German). Before distribution, the questionnaire was tested in two pilot hospitals. 128 acute care hospitals across Switzerland were invited to complete the final version of the questionnaire. The survey aimed to

capture insights into the digitalisation landscape of IPC departments. The questionnaire consisted of the following open-ended questions (see Appendix 1):

- What software solutions does your hospital currently use or plan to use for various IPC tasks (e.g., surveillance, isolation management, contact tracing)? What is the level of automation?
- Which IPC tasks could benefit the most from a highly automated software solution (e.g., surveillance, isolation management, contact tracing, others)?
- Can the IT department in your hospital extract data from clinical and laboratory information systems and make it available to other systems (e.g., via Data Warehouse)?
- Does your hospital adhere to international standards for data coding (e.g., LOINC, SNOMED-CT, FHIR)? If yes, for which types of data?
- Clinical data is to be transmitted to Swissnoso's national data centre for national surveillance of HAI infections. Assuming data privacy and security are ensured, are your hospital's acceptable encryption levels for data transmission nominal (unencrypted), pseudonymised (key retained within the hospital), anonymised (no re-identification key), or aggregated?
- What digital tools do you envision for future IPC practices? What are the key functionalities of these tools?

The questionnaire was accompanied by a cover letter and a fictitious article in the internal hospital newspaper to explain the vision of Swissnoso's digitalisation initiative to the participants (see Appendix 2). Hospitals that had not responded by the closing date received a reminder letter to encourage completing the questionnaire.

The qualitative data from the survey responses underwent a thorough and systematic analysis. After carefully reading the raw data, recurring themes, patterns and key concepts within the provided data were identified. A coding system was then established to categorise and summarise the data. The data was analysed for patterns to identify differences between hospital types, sizes, and geographical locations. Statements that were considered particularly noteworthy were highlighted in the analysis and placed in a broader context.

### **5.3 Results**

#### *Response rate*

Ten of the 11 (91%) invited hospitals participated in the interview.

We have contacted 5 EHR vendors, 4 of them (80%) participated in interviews. These four vendors have an estimated market coverage of 42% among Swiss hospitals.

The written questionnaire was sent to 128 hospitals, of which 43 responded (33.6%). The response rate was particularly good for tertiary hospitals (52.2%, see Figure 2).

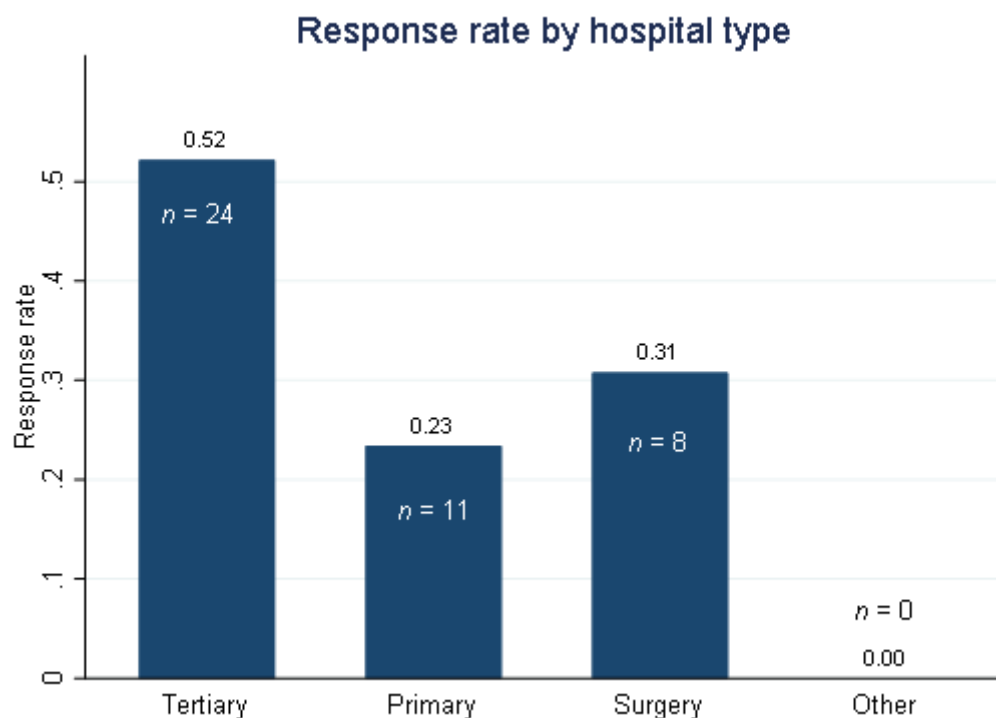


Figure 2: Response rate and number of responses by hospital type. The hospital type "Surgery" refers to hospitals with predominantly surgical or orthopaedic focus.

#### IPC software in Swiss hospitals and level of automation

The analysis of the use of software in the IPC departments revealed a mix of electronic and manual systems. Many hospitals have a low level of automation in their IPC processes. Manual data entry is common, with some automated data extraction and reporting in place.

The areas where automation is most advanced are tracking patients with multi-drug resistant organisms (MDRO) and monitoring patient movements for isolation management. Localisation and movement data are often in an administrative system such as Opale, SAP, or other Enterprise Resource Planning (ERP) systems. Some of these systems are connected to EHR systems and can trigger alerts. Excel spreadsheets are widely used to manage IPC tasks, often requiring manual updates.

HAI surveillance is often done manually by screening patient records. Catheter-associated urinary tract infection (CAUTI) surveillance is the most automated. Hospitals with a high degree of automation use technical solutions integrated into their EHR systems (e.g. M-KIS, Soarian, Epic Bugsy) or invest in in-house developments. Several hospitals plan to introduce new EHR systems or specific IPC software solutions, which indicates an interest in improving digitalisation.

Regarding data visualisation tools, QlikSense® is the most frequently mentioned, with some hospitals also employing Microsoft PowerBI.

#### IPC tasks that could benefit from automation

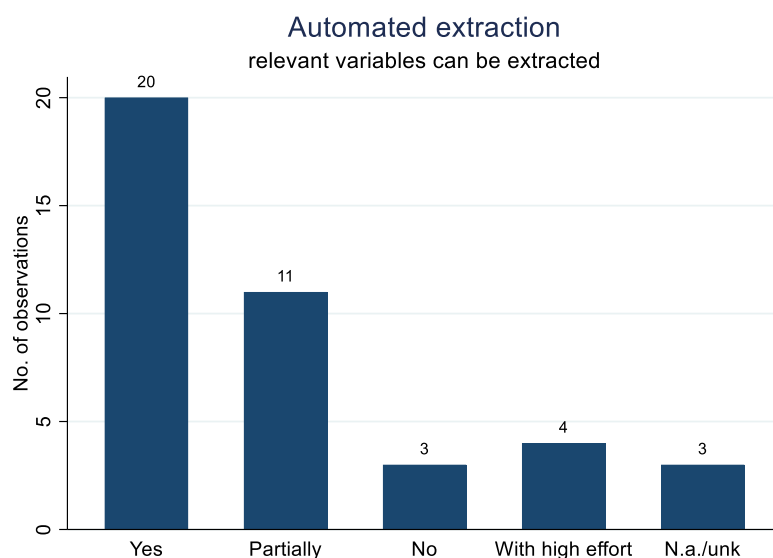
A whole range of different tasks was mentioned that could benefit from improved digital IPC tools: 1) the semi- and fully automated surveillance of MDRO, bacteraemia, *C. difficile*, CAUTI, surgical site infections (SSI)

and other HAI; 2) automated notifications on laboratory results and alerts for microbiological findings (today some hospitals still receive microbiological results from the laboratories by email); 3) semi- or fully-automated contact tracing and isolation management triggered by laboratory results; and 4) tools for managing and monitoring antibiotic use (antimicrobial stewardship). In summary, all systems that reduce manual workload and free resources to be invested for preventive measures are welcome. There is no clear prioritisation of a specific task.

### *Extraction of Clinical and Laboratory Information*

Several hospitals confirm that their IT department can fully extract and provide the requested data, including demographics, hospitalisation, laboratory, microbiology, interventions, medication, radiology data, and localisation and movement of the patients (Figure 3). Other hospitals can provide only part of the requested data. Some hospitals have external laboratory services, making the extraction of laboratory data not directly possible within the hospital's system. Other hospitals have a data warehouse, allowing easy extraction of the requested data. For some hospitals, however, the effort needed for data extraction is high. A few hospitals report either not having the capability for data extraction or with very limited capability that, in addition, is confined to certain types of data. Several hospitals report on planned or ongoing data projects that will make the information in the EHR systems more easily accessible in future.

Some of the EHR system vendors point out that they use a standardised data model in all hospitals, which simplifies data extraction. Others have a separate data model for each hospital, which increases the effort required for extraction accordingly.



*Figure 3: The hospitals capability to extract the relevant data for the automation of different infection prevention and control (IPC) tasks.*

### Use of international standards

The open-ended question about the use of international standards for the coding of data and the data exchange was poorly answered. Some hospitals use international standards such as [LOINC](#) or [SNOMED-CT](#) (Figure 4). Formats such as [HL7](#), [FHIR](#) or [DICOM](#) were mentioned for the data exchange. Although standards are not yet widespread in Swiss hospitals, projects for introducing international standards such as LOINC, SNOMED-CT, [OpenEHR](#) or FHIR for data exchange were mentioned several times. For the EHR vendors with their own IPC module, publishing a standard application programming interface (API) definition is particularly important. Ideally, it is specified by the government, e.g., as a formidable task of the federal DigiSanté initiative.

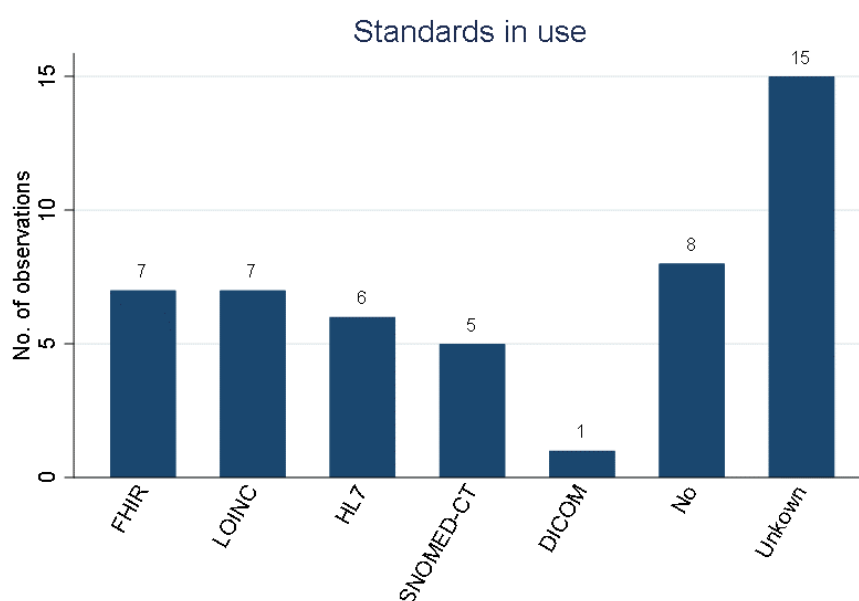


Figure 4: The use of data and data transfer standards in Swiss hospitals.

### Acceptable level of anonymisation for the data transfer to the IPC Datacenter

The majority of hospitals find it appropriate to send pseudonymised data to the [IPC Datacenter](#). This means that data is coded with a key to allow the hospital to re-identify the patient if necessary (Figure 5). A few hospitals prefer fully anonymised data, where re-identification is not possible. Some hospitals refrain from making a clear statement and mention that they will follow the legal requirements. It is worth noting that the legal requirements vary from canton to canton.

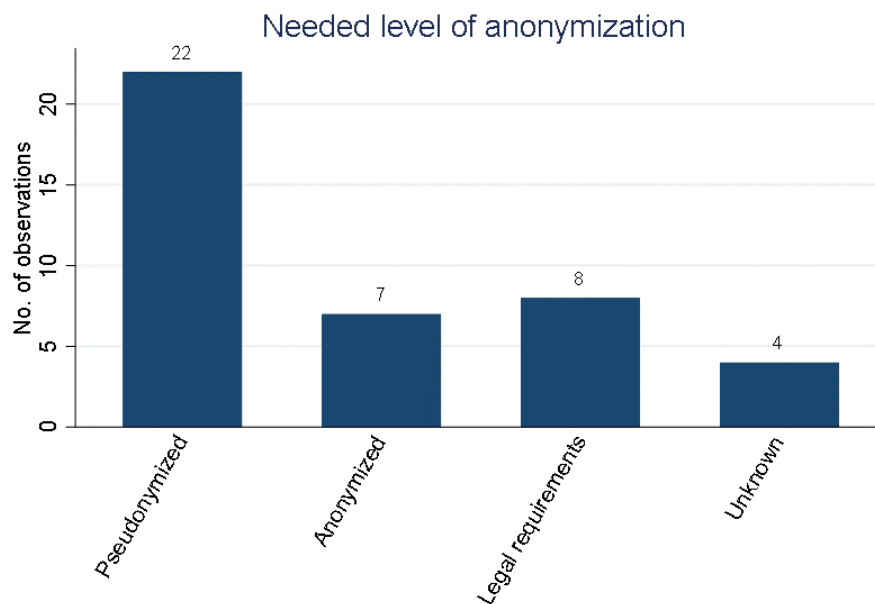


Figure 5: Acceptable level of data encryption. The category “Legal requirements” refers to hospitals that refrained to make a clear statement and mentioned to follow the legal requirements.

#### Desired digital tools for the future

The demand for instruments for the automated surveillance of HAI stands out clearly in the responses, in particular, the semi-automated surveillance of SSI (Figure 6). There is also a strong desire for tools that provide reporting capabilities and dashboards for real-time monitoring of IPC-relevant indicators (e.g., epidemic outbreaks). Hospitals with a low level of automation of IPC tasks require the automatic transmission of microbiologically relevant findings. In some cases, the IPC receives this information as a PDF by email, which makes the further processing of this data difficult. In general, hospitals are looking for tools that can automate workflows to streamline infection surveillance and infection prevention and control measures.

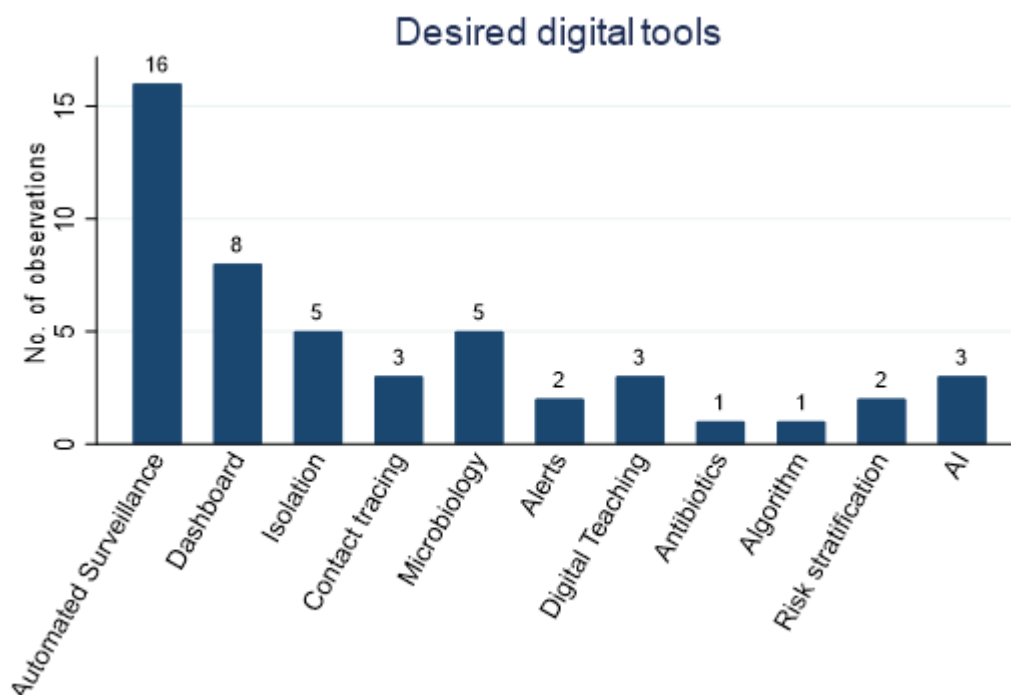


Figure 6: Desired digital tools for IPC (as extracted from free-text answers)

#### Integration of the IPC Toolkit in the local EHR system

The integration of the **IPC Toolkit** into the local EHR system is considered important so that users do not have to open different systems. The simplest suggested solution is to create a subpage with a weblink to the **IPC Toolkit**. The integration into the EHR is only sought if there is no pre-existing IPC tool in the EHR.

#### 5.4 Discussion

The generally positive attitude of hospitals and EHR vendors towards Swissnoso's planned digitization initiative underlines the recognition of the potential benefits, even if the specific interests of the individual institutions differ. Hospitals with advanced internal digital processes and sophisticated IPC software systems express interest in automated data transmission to a unified national platform rather than in new local IPC software. Ideally, standardised, regulatory-defined APIs could pressure EHR vendors to make the clinical data available in a specific format. Hospitals with lower levels of digitalisation express high interest in IPC software to optimise their processes and reduce the workload in the IPC department.

The reported low level of automation in HAI surveillance aligns with findings from [Swissnoso's Point Prevalence Study](#). Surprisingly, no dominant IPC-specific software is in use in Switzerland; those mentioned are often modules provided by EHR vendors rather than standalone solutions. This could indicate that the commercially available digital tools in the IPC departments are not being fully utilised.

A crucial success factor for a national data platform is data extraction from different hospital systems. While not all hospitals can extract relevant data, there has been a marked shift, particularly among those evaluating new EHR systems, emphasising the importance of availability and standardisation of clinical data.

Some hospitals that mention the financial aspect of the **IPC Platform** as a decisive factor are only willing to invest in data extraction and software maintenance if this demonstrably leads to improved treatment quality

or savings in personnel costs. Therefore, the focus of the new **IPC Platform** should go beyond surveillance and support various IPC activities to achieve broader support from hospitals.

Legal clarification for the national **IPC Platform** will be unavoidable. Among other things, which data may be collected, in what form, and at what level of anonymisation must yet be clarified.

Participants emphasised the importance of the solution fitting into the broader federal digital transformation efforts, with interoperability at the core.

Close collaboration with the EHR vendors should be sought. Some of them showed strong interest in collaboration and are even interested in supporting the platform's product development.

The study's strength is that it provides a comprehensive overview of digitalisation in IPC departments; despite the challenging nature of the questionnaire covering multiple disciplines, the response rate of 33% is remarkable. However, the study is limited by a predominantly larger hospital sample, which could lead to some bias, although it is recognised that larger IPC departments will benefit most from digitalisation.

In summary, the digitalisation of IPC activities in Switzerland faces substantial gaps, with limited automation and a significant reliance on manual data entry. While the potential for improvement is recognised, accessibility and standardisation of routine care data remain key challenges. Not all hospitals may be initially equipped to integrate new IPC software or provide automated data for national HAI surveillance. A stepwise approach is an unavoidable solution. Technologically advanced hospitals can lead the way, while others adapt gradually. With the right digital tools, the workload in IPC departments can be reduced, and infection rates effectively lowered.

## **6. Evaluation of commercially available infection prevention and control software**

### **6.1 Aim**

Acquiring a digital Platform presents two options: building one from scratch or purchasing a commercial solution adaptable to Swiss needs through configuration. We refer to this decision as "Make or Buy." Swissnoso has systematically evaluated existing commercially available IPC software to address the "Buy" approach. We aimed to understand the functionalities of such software and to assess if the software meets the requirements set by Swissnoso and FOPH.

### **6.2 Procedure**

#### *Definition of requirements*

We identified and listed key requirements for IPC software to establish a foundation for the evaluation process. These requirements, outlined in bullet points, guided our discussions with potential vendors.. Among others, the requirements covered the following aspects (details are shown in Appendix 3):

- Content of the system (e.g. HAI surveillance modules, isolation management, contact tracing, management of MDRO)
- Compliance with regulatory requirements
- Data security
- User-friendliness
- Integration capability at the hospital

- Semantic standards and standards for data exchange
- Alerting and notifications
- Reporting and analytics
- Near-real-time monitoring
- Languages (German, French, Italian)
- Cost and licensing

### *Selection of vendors*

In our search for suitable IPC software solutions, we employed a multi-layered approach. Firstly, we conducted online searches using Google and ChatGPT to identify potential vendors. Simultaneously, we explored scientific publications that evaluated or described IPC software. Additionally, we asked IPC experts if they knew of any IPC software solutions.

### *Vendor interactions*

In September 2023, contact with IPC software vendors was initiated through email or contact forms on their respective websites. In instances where no response was received, we followed up at least twice to ensure a comprehensive evaluation. During the first round of evaluations, mutual interest was clarified, and after expressing interest, a second round of discussions was scheduled for a detailed software demonstration.

### *Collaboration with Kantonsspital St. Gallen*

Close collaboration with the Department of Infectious Diseases and Infection Prevention of Kantonsspital St. Gallen was maintained throughout the evaluation process. This collaboration was particularly valuable as the hospital proactively sought and evaluated IPC software solutions for their hospital independently and in parallel.

## **6.3 Results**

In our search, we identified and contacted 23 providers of IPC software (see Figure 7). Of these, four were excluded because they did not respond, four were excluded because they do not offer their software in Switzerland, and a further five were excluded for various reasons, mainly due to a lack of interest in cooperation on the part of the providers or because the software did not prove to be specific to IPC needs.

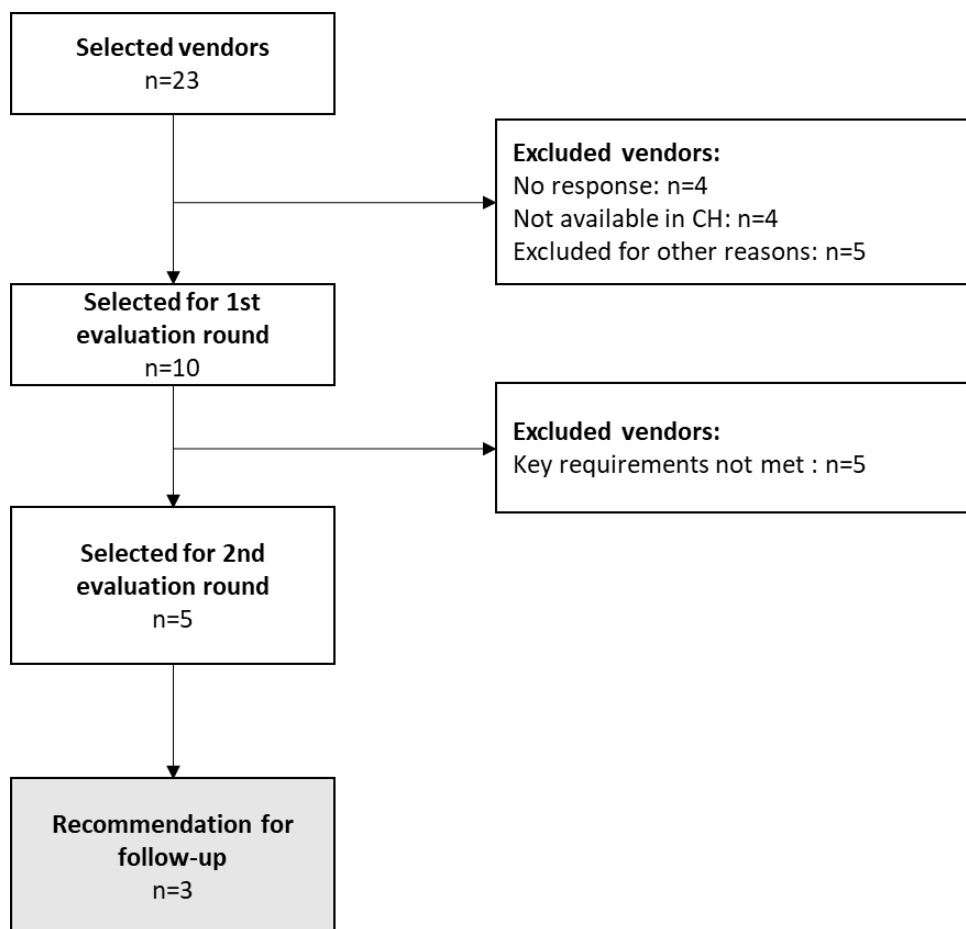


Figure 7: Overview of software evaluation.

Following the initial contacts, meetings were held with ten providers. Some were excluded from further evaluation because their technology did not meet our requirements, their software focused on quality management, or they did not fit the target group of acute-care hospitals.

More in-depth discussions were held with 5 selected providers.

*Table 1: Overview of key features of the evaluated software. Abbreviations: HAI Hospital-acquired infections, MDRD multi-drug resistant organisms.*

Vendor	Semi- and/ or fully-automated surveillance of HAI	MDRO	Isolation Management, Contact Tracing	Dashboards	Reports, Data extraction	Monitoring of Prevention Measures	Device Tracking	Central Aggregation Database
A	✓	✓	✓	✓	✓	✓	✗	✓
B	✓	✓	✓	✓	✓	✗	✗	✓
C	✓	✓	✓	✓	✓	✗	✗	✗
D	✓	✓	✓	✓	✓	✗	✗	✗
E	✓	✓	✗	✓	✓	✗	✗	✗

## 6.4 Discussion

Our investigation revealed a range of providers offering digital solutions to enhance the efficiency of IPC activities in acute care hospitals by directly extracting data from EHR and other hospital systems. Many of these systems also support semi- or fully automated surveillance on a national level.

The commercially available software systems cover a broad spectrum of requirements, with the primary challenge being system integration in the hospital. Notably, the evaluated IPC software solutions are rarely in use in Switzerland. Certain Swiss hospitals use homemade software solutions or a module integrated into the clinic information systems (e.g., EPIC Buggy).

Our research has shown that other countries collaborate with IPC software companies for efficient, timely surveillance of HAIs and, in some cases, for other infections (e.g. notifiable infections).

From the perspective of the FOPH, adopting a broader perspective is essential. The commercially available software solutions cover the surveillance of HAI and reporting of notifiable diseases or antibiotic resistance. Antibiotic stewardship features are commonly offered, but not the tracking of specific devices (e.g. endoscope). In discussions with the software providers, we have identified many potential synergies with ongoing Swiss projects such as [ANRESIS](#), [CH-SUR](#) or [DigiSanté](#).

The costs of software usually depend on the local situation in the hospitals, in particular, the effort required for system integration. Depending on the size of the hospital and the technical infrastructure, license costs are probably between 10'000 and 50'000 per hospital per year. The providers were reluctant to specify numbers, as they would have needed more details than we could provide.

Our approach had some limitations. We have not yet tested the performance of the technical solutions within a hospital and in a data centre. Further details need to be exchanged with the software providers for cost estimates.

Based on our research, we recommend following up the “Buy” rather than the “Make” approach for the Platform. There is promising software on the market, which supports efficient near-real-time surveillance of HAI. However, the project also has overlaps and synergies with other national initiatives, which should be considered in the “Make or Buy” decision.

To make an informed decision, we have already written a first draft for requirements (see Chapter 6). It is important that IPC experts assess the software in use in a hospital to evaluate its usability and effectiveness. The cost aspect must be clarified to conduct a cost-benefit analysis and investigate different business models.

## 7. Requirements

As our research has shown that various commercially available products support the surveillance of HAIs, we have formulated the requirements for the **IPC Platform** so that they can serve as a basis for a tender or selection of commercially available systems. We have refrained from formulating the requirements to be used as a basis for in-house development. This would require another level of detail. The document with the detailed requirements can be found in Appendix 4.A. In summary, the following requirements are covered:

- Technology and setup
- Data security and protection
- Support and training
- Updates and deployments

- Semantic standards and standards for data exchange
- Data entry process
- Algorithms for semi- and fully-automated surveillance
- General infrastructure
- Expected functionality
- Data import
- Data transfer
- Dashboards
- Identity and access management
- List of IPC activities
- Documentation

## 8. Legal assessment

We contacted the [Federal Data Protection and Information Commissioner](#) (EDÖB) to clarify the legal aspects. They asked us to submit a document describing our project, based on which an in-depth discussion can take place. Swissnoso has prepared a document describing the current surveillance activities and the planned **IPC Platform** we propose in this report (see Appendix 5.A) and is about to submit it.

We would like to clarify the following questions:

1. Can Swissnoso continue with the existing data collection and implement the planned IPC Platform?
2. Are there any other requirements from the EDÖB that have not yet been met?
3. In addition to the software physically installed within the hospital's firewall, a cloud solution is considered for the IPC Toolkit (i.e. nominative patient data of the respective hospital is stored in a cloud). What conditions have to be fulfilled for a cloud-solution (e.g. client separation, "bring your own key")? What are the requirements for data encryption?
4. Which specific cantonal data protection regulations must be taken into account?

## 9. Interoperability with other projects in the Swiss healthcare sector

In order to coordinate our efforts and to ensure interoperability with other projects, we have exchanged ideas with various institutions in the Swiss healthcare sector. We are presenting our key contacts and conclusions in the following:

### Swiss Personal Health Network (SPHN)

We have engaged in various meetings with SPHN. On a strategic level, we held a meeting with **Katrin Cramer** (Director of Personalized Health Informatics at the Swiss Institute of Bioinformatics (SIB), Director of SPHN) and **Thierry Sengstag** (Head of the Scientific Computing Centre at the University of Basel, Research-Data Strategist). Additionally, we met with **Diana Coman** (Scientific IT Services, ETH Zurich, and SIB member), who is involved in various SPHN projects. ETH Zurich offers the **Leonhard Med Secure Scientific Platform**, where health data can be securely stored. We exchanged information about semantic standards used in SPHN projects with **Sabine Oesterle** (Head of Semantic Interoperability Strategy & FAIR Data Team at SIB). The digital platforms established within the SPHN framework ([Biomed IT nodes](#)) could be utilised for the IPC Platform. Their technical infrastructure supports secure transfer and central hosting of health data. It's important to note that SPHN primarily focuses on university hospitals and other hospitals are not yet connected. SPHN can support Swissnoso in developing semantic standards within their available resources. We also had the opportunity to exchange ideas with **Prof. Adrian Egli** (Department Head, Institute for Microbiology, University of Zurich). He established the [Personalized Swiss Sepsis Study \(PSSS\)](#), supported as a Driver Project by SPHN/Personalized Health & Related Technologies ([PHRT](#)). The digital infrastructure resembles the **IPC Platform** we propose in this report (Figure 8).

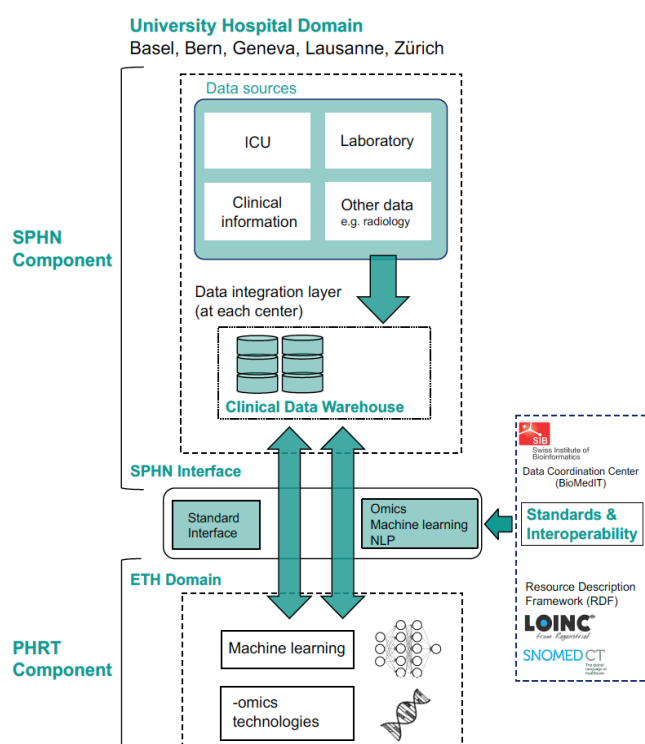


Figure 8: SPHN/PHRT framework for the Sepsis driver project. All centers locally collect data from different primary sources in clinical data warehouses. The is high interoperable and standardized following ontologies. The exchanged follows secured routes of BioMedIT to the ETH Domain for quality control and analysis (Reference: <https://sepsis-network.ch/research/the-project/>)

## DigiSanté and FOPH

On various occasions, we had the opportunity to engage with representatives from DigiSanté and the FOPH. In an early stage of our project, we presented the concept of the IPC Platform in a meeting with **Nassima Wyss-Mehira** (Vice President FOPH), **Alain Fellmann** (Head of Reporting Systems FOPH), **Céline Gardiol** (Head of Infection Control FOPH), and **Veronique Kobel** (Scientific Collaborator, FOPH). In another meeting with

Alain Fellmann, Céline Gardiol, Veronique Kobel, and **Katrin Schneider**, we were able to deepen the discussion. The primary focus was on how to integrate the surveillance of HAI into the FOPH's digital transformation strategy and what a possible funding structure might look like.

During the eHealth Summit of the Swiss Society for Medical Informatics, we also had the opportunity to exchange ideas with **Marco D'Angelo** (Deputy Director, Federal Statistical Office, Deputy Program Head DigiSanté).

Alexandra Scherrer had the opportunity to collaborate in the FOPH working group "registry (data management in the health sector)," providing a deep insight into national-level processes.

Based on discussions with the FOPH and DigiSanté, it appears crucial to us that development of the IPC Platform is well-coordinated with the authorities. The use of common semantic standards is particularly important, and there may be opportunities for synergies in the technical infrastructure. As an agile project deeply rooted in hospitals, the IPC Platform can take a pioneering role and pave the way for further initiatives.

### eHealth Suisse

We aligned our efforts with eHealth Suisse in a meeting with **Martine Bourqui** (Director), **Pero Grgic** (Scientific Collaborator), **Patrick Jolo** (Scientific Collaborator), and **Stefanie Neuenschwander** (Scientific Collaborator). eHealth Suisse can support Swissnoso in developing semantic standards.

### Swiss Quality Commission (Eidgenössische Qualitätskommission, EQK)

The EQK is planning a monitoring system for the quality of services in the healthcare sector, with healthcare-associated infections (HAI) being a potential quality indicator. We engaged in discussions with **Dr. Monika Diebold** (Head of Secretariat) to explore potential synergies. The tendering process for the EQK's monitoring system is not yet complete, so many details remain open. However, there is interest in the possibility of data transfer from the IPC Platform to the EQK's monitoring system.

### Swiss National Association for Quality Development in Hospitals and Clinics (ANQ)

The [ANQ](#) supports Swissnoso in its digitalisation efforts. We exchanged ideas with **Regula Heller** and **Melanie Wicki**, who praised the concept of the IPC Platform but emphasized the importance of it not being a self-contained system. The possibility to integrate other quality indicators is important in their view.

We also engaged with project partners of ANQ. **Prof. Michael Havranek** (Research Director of the Competence Centre for Health Data Science, University of Lucerne) and the company [INMED](#) collaborated with ANQ to develop the Qlize! platform, measuring various quality indicators. For Swissnoso, a collaboration with INMED and Prof. Havranek in the area of dashboards for the IPC Datacenter is of interest. INMED expressed no interest in developing a local IPC Toolkit for hospitals, as it is not their core business. They focus on developing dashboards using QlikSense.

**Silvia Thomann** from the Bern University of Applied Sciences (BFH) is conducting the Vis(q)ual project on behalf of ANQ. The project aims to explore whether data existing in EHR systems of hospitals can be utilized for national nursing quality measurements and how they can be presented. It is a feasibility study, and no IT infrastructure for data extraction and transfer has been established yet. This project may lead to future synergies in the quality domain.

## CH-SUR

CH-SUR is the hospital-based surveillance of COVID-19 in Switzerland. We had discussions with **Jonathan Sobel** (Scientific Collaborator) from the Institute of Global Health, University of Geneva. CH-SUR utilizes [REDCap](#) for data collection. Jonathan Sobel mentioned that there is a significant manual workload related to their data collection process.

## ANRESIS

We have exchanged information with **Prof. Andreas Kronenberg**, who leads the ANRESIS project. ANRESIS collects and analyses anonymous antibiotic resistance data from a representative selection of Swiss clinical microbiology laboratories. There are synergies in the technical infrastructure with the IPC Platform, particularly in developing the dashboard for the national data centre. We have agreed to maintain regular communication.

In summary, there is a lot of movement in healthcare digitalisation in Switzerland. Many projects aim to reuse routine clinical data. Continued collaboration with the institutions mentioned above remains crucial. It is important that the IPC Platform does not become a standalone solution but can be integrated into other projects, or, at the very least, interfaces can be established for data exchange.

## 10. Discussion

The Swissnoso Digitalisation Working Group has successfully completed its evaluation of a unified digital solution for monitoring HAIs and managing IPC at both hospital and national levels. The outcomes are promising, with the proposed two-pronged **IPC Platform** receiving strong support from IPC leaders and hospital IT specialists. The concept also aligns with the success of advanced commercial solutions implemented in other countries.

The hospital-based **IPC Toolkit** component is critical, enabling real-time IPC management for individual patients and offering insights into epidemiological trends. Its advanced automation and enhanced IPC functionalities, including semi- and fully automated surveillance and monitoring, are particularly welcomed given the financial pressures on healthcare, encouraging a shift from manual data management to proactive, bedside prevention initiatives. Engaging hospitals in new Swissnoso modules would otherwise be increasingly challenging due to the additional workload required. However, a need remains to keep the option open for hospitals to submit data to the **IPC Datacenter** without mandatorily installing the **IPC Toolkit** via nationally standardised interfaces to ensure broader participation.

This **IPC Toolkit** stands out as a significant advancement in streamlining IPC tasks and, simultaneously, gathering valuable data to shape the national NOSO strategy. Successful surveillance systems in regions such as Quebec and Ireland, which offer comprehensive digital IPC solutions, highlight the potential benefits for Switzerland. The consideration of commercial software solutions suggests that creating a new system from scratch will not be necessary, with the costs for commercial options appearing manageable. However, these solutions require thorough evaluation due to the far-reaching consequences of a commitment.

We have detailed potential requirements to serve as a basis for future evaluations or tender processes, anticipating various potential outcomes (see Annex 6). Aligning with other digital health initiatives in the Swiss healthcare system offers promise but also presents challenges due to differing timelines and scopes.

For Swissnoso, advancing without delay is crucial to introduce new modules, update existing ones, and prevent an increasing diversity of emerging IPC software solutions in Swiss hospitals.

Some of the commercially available tools are very comprehensive. They would allow the establishment of common data flows with other data collections in Switzerland, such as ANRESIS, CH-SUR or ANQ quality measurements. This is a potential opportunity to acquire funds for the **IPC Platform** by leveraging synergies. The **IPC Toolkit** would be ideally positioned to deliver per-patient antibiotic consumption and enriched microbiology data via the **IPC Datacenter**.

The role of semantic and interface standards in ensuring interoperability, efficiency, and sustainability is indispensable. It is hoped that national initiatives, especially DigiSanté, will greatly contribute to achieving these objectives, supporting the development and sustainability of solutions such as ours.

In conclusion, navigating numerous challenges to create a national digital solution for IPC is challenging. Successfully achieving this would position Switzerland as a beacon of innovation in IPC practices, both at the hospital and national levels, offering a model of excellence for others to follow. This visionary effort underscores the potential to redefine standards in healthcare quality and patient safety across the country and beyond.

### 10.1 Recommendation

Based on our investigations, the Digitalisation Working Group and Swissnoso recommend:

1. To pursue a **two-pronged approach** with hospital-based **IPC Toolkits** and a Swissnoso-powered national **IPC Datacenter**, while still offering alternatives for data transmission via webform or API
2. To acquire a **commercially available IPC software** solution instead of building a new solution
3. To enforce **semantic and data exchange standards** in Swiss healthcare data systems through national initiatives (e.g., DigiSanté)
4. To consider **synergies with co-existing projects** (e.g., Anresis) to control costs
5. To finalise the clarification of the **legal framework**

### 10.2 Next steps

Given the advanced development stage of additional Swissnoso surveillance modules and the threat of a diverging evolution of the IPC software landscape across Swiss hospitals, a timely advancement of the project of a unified **IPC Platform** in Switzerland is vital.

Therefore, we propose a second project phase of evaluation with the following goals:

1. To further **evaluate the 3 identified commercial software** solutions, including visits to user hospitals and national authorities
2. To assess **costs**, develop a business model, and identify potential funding sources
3. To further explore **synergies** with other projects and outline timelines and pathways to interoperability to control costs
4. To co-develop the roadmap for the **integration** of existing and planned surveillance modules and potential bridging solutions
5. To pursue the clarification of **legal requirements** with the Federal Data Protection and Information Commissioner (EDÖB)