ARTIGO ORIGINAL / *ORIGINAL ARTICLE*

Sistemas de vigilância inteligentes: implementação de tecnologia digital em unidades de cuidados continuados

Intelligent surveillance systems: implementing digital technology in long-term care facilities

/ **Diana Portela**[1,2,3,4] / **Paula Baptista**[5] / **Elvira Silva**[5] / **Pedro Almeida**[5] / **Victor Freire**[5] / **António Amorim**[5] / **Fernando Tavares**[2] / **Lucas Ribeiro**[2] / **Bernardo Gomes**[1,3] / **Hugo Monteiro**[2,3]

[1] ACES Entre o Douro e Vouga I – Feira/Arouca

[2] Planning and Study Department – North Health Regional Administration

[3] Faculty of Medicine, University of Porto, 4200-450 Porto, Portugal

[4] Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, 4200-450 Porto, Portugal

[5] Regional Coordination Control Group – North Health Regional Administration (GCR-ARS Norte)

Correspondência:
Diana Portela
Rua 1 de Maio, 45
4520-176 Santa Maria da Feira
Tel.: 00351 918829260
E-mail: di.portelasilva@gmail.com

Patrocínios:
O presente estudo não foi patrocinado por qualquer entidade.

Artigo recebido em
21/04/2022

Artigo aceite para publicação em
15/03/2023

/ Resumo

A vigilância epidemiológica requer a recolha, armazenamento e análise da informação com base em dados precisos e confiáveis, com a finalidade de recomendar medidas de melhoria contínua. O nosso objetivo foi desenvolver uma metodologia, com a adoção de tecnologias digitais, para apoiar e melhorar a integração das informações recolhidas.

Os dados foram colhidos até à saturação no âmbito de trabalhos desenvolvidos pelo Grupo de Coordenação Regional da Administração Regional do Norte de Portugal do Programa de Prevenção e Controlo da Infeção e Resistência aos Antimicrobianos. Este é um estudo qualitativo com componente de design descritivo, utilizando discussões de grupos focais. Foi dividido de acordo com os estágios do ciclo de vida da tecnologia para descrever a sua implementação.

Para cada etapa da estrutura do ciclo de vida das tecnologias digitais, foram identificadas e executadas atividades cruciais: (i) Descrição do fluxo de informações; (ii) Seleção de um sistema; (iii) Planeamento; (iv) Manutenção e avaliação. As Unidades de Cuidados Continuados foram selecionadas como áreas prioritárias de melhoria e introdução de novas ferramentas para adequar às necessidades locais.

Sistemas de informação eficientes são a base para a vigilância epidemiológica. Este trabalho respondeu aos objetivos propostos e destacou a necessidade de implementar adequadamente sistemas de informação que suportem as necessidades do utilizador. O referencial metodológico adotado neste estudo pode ser utilizado como referência para estudos baseados em situações semelhantes. Investigações futuras servirão para determinar o impacto a longo prazo desta intervenção.

Palavras-chave: Vigilância epidemiológica; Tecnologia digital; Sistemas de informação inteligentes; Desmaterialização de processos; Avaliação de tecnologia em saúde

/ Abstract

Epidemiological surveillance requires management by gathering, storage and analysing on accurate and reliable information. Our goal was to describe the implementation and adoption of digital technologies to support and enhance integrative care and evidence-based decision-making for epidemiological surveillance.

Data was collected at the Northern Portuguese Regional Administration Coordination Group of the Program for the Prevention and Control of Infection and Antimicrobial Resistance until saturation. This is a qualitative study with a descriptive design component using focus group discussions. It was divided in accordance with technology lifecycle stages to describe implementation of digital technology. Crucial activities were identified and executed for each framework step (i) Description on information flow; (ii) Selecting a system; (iii) Planning; (iv) Maintenance and evolution. Continuous Integrated Care Units was selected as a priority area for improvement and introducing new tools to tailor the local needs. Efficient information systems are the cornerstone for infectious disease surveillance. Our work met the proposed aims and highlighted the necessity to adequately implement information systems that meet user needs. The methodological framework adopted in this study could be used as a reference for studies relying on similar situations. Future research will be required to determine the impact of such intervention.

Keywords: *Epidemiological surveillance; Digital technology; Intelligent information systems; Dematerialization process; Health technology assessment*

/ Introduction

Infection prevention and antimicrobial resistance (AMR) are among the most serious public health threats today.[1] The Regional Coordination Group (GCR) of the Program for the Prevention and Control of Infection and Antimicrobial Resistance (PPCIRA) in the North region coordinates the Local Coordinating Groups (GCL) and the Local Supervisors (RL) of Hospitals, Health Centres Clusters (ACeS) and Long-Term Care Facilities (UCCI). For each level of care, a plan was established that includes training and consultancy, monitoring and evaluation in pre-defined areas of expertise, namely Basic Infection Control Precautions (PBCI) and monitoring of antibiotic prescriptions. The mission of the CGR-PPCIRA is to implement a structured and multidisciplinary approach to address the prevention and control of healthcare-associated infection (HAI) and the responsible use of antimicrobials.

Epidemiological surveillance (ES) of HAI (namely urinary tract infection (UTI), respiratory tract infection (RTI) and skin Infections) requires management by gathering, storage and analysing accurate and reliable information. However, some health care units are not properly prepared to respond to epidemiological surveillance. For instance, both digital and paper records are kept which leads to communication inefficiencies and delays responding to potential outbreaks. Moreover, there is lack of efficient communication between Hospitals, ACeS and UCCI reporting AMR intervention (either in health promotion, prevention, or communication). This is particularly relevant in the quality of clinical practice. Similarly, manual recording of information on the national platforms highlights difficulties in reporting timely information at regional and national level generating potential delays and gaps in the reported clinical information.[2]

Digital technologies are growing rapidly and have the potential to shape the quality of delivered care by enabling information sharing, communication, collaboration, and coordination between care providers. Systemic change is required to create an environment allowing the deployment of new technologies and also promoting new attitudes among citizens, patients and professionals.[3] A reliable decision support system should be fed with online and real-time data, hence the need for the processes dematerialization that should be implemented in the PPCIRA

registry system where timely information is particularly of high value.[4] Hospitals are implementing new tools and work methodologies on top of organic changes in these circumstances.

Digital transformation and dematerialization in the HAI epidemiological surveillance have the potential to impact its efficiency inducing improvements of the working team operational flow increasing the quality of healthcare provided to the patient. Furthermore, several studies indicate that the use of digital information system leads to a more complete and accurate data.[5]

UCCI in Portugal meets the definitions of long-term care facilities and skilled nursing facilities. These facilities provide a variety of services both medical and personal care to people who are unable to live independently. Others provide health services for people leaving the hospitals but still needing medical and nurse support.[8] UCCI are healthcare institutions which receive especially chronic, fragile, and dependent patients. They are divided by length of stay into convalescent units (hospitalization ≤ 3 month), medium-term (hospitalization ≤ 9 months) and long-term (hospitalization ≤ 3 years) units. In the northern region there is also a palliative care unit. The structure of each unit is based on 24-hour nursing care with most institutions lacking a full-time doctor and displaying high turnover of healthcare professionals which may contribute to insecurity and absence of safety culture.

Based on experts acknowledgement, until 2019, GCR-PPCIRA had been working mainly with public institutions, namely 25 Hospitals and 24 ACeS. Recently, GCR-PPCIRA started working with UCCI (more than 100 private units) and initiated data collection for surveillance. The last Point Prevalence Survey-HALT3 conducted by European Centre for Diseases Prevention and Control (ECDC)[6] revealed large antibiotic consumption and UTI, RTI and skin Infections (ulcers in particular) incidence in UCCI.[7]

This work results from the goal of reducing paper-based information and combines the need for an efficient way of registering and retrieving timely and accurate information for decision support. Thus, we describe the implementation and adoption of digital technologies to support and enhance integrative care on UCCI and clinical decision-making for ES by the GCR-PPCIRA.

/ Methods

This study was divided in four parts, in accordance with technology lifecycle stages to describe implementation of digital technology for integrative surveillance of PPCIRA (figure 1).

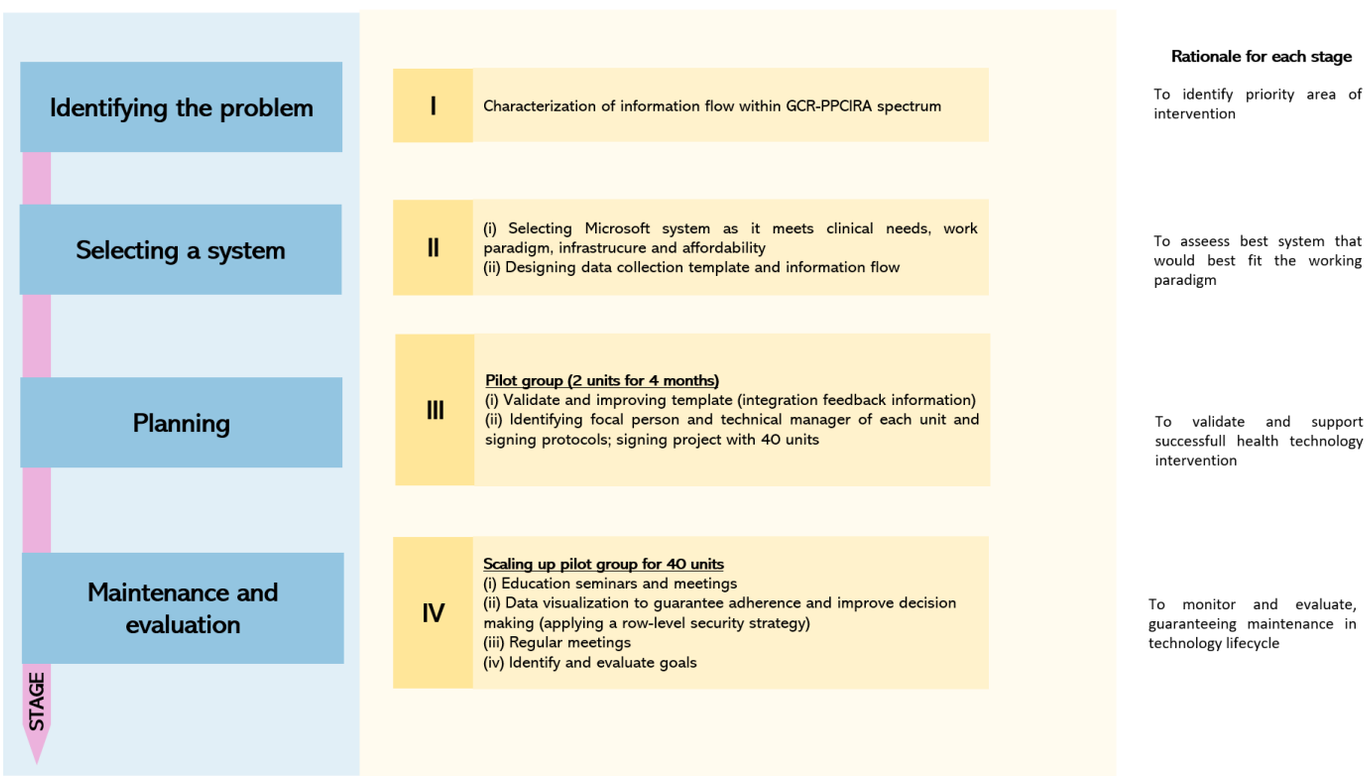

Figure 1 – Description of protocol implementation

/ Data collection and analysis

This study has an explorative qualitative component with a descriptive design using focus group discussions. Data collection for this study was performed during 2020 and encompassed two different methods, namely preliminary analysis, and group discussions. The preliminary analysis consisted of identifying the institutions involved in the PPCIRA jurisdiction followed by characterization of the circuit information within the institutions system. This data was used to identify key problems for the implementation and adoption of health information technology. To this end, we identified the indicators used at national level and applied a backwards approach to track back the origins of such data at regional level. Respondents were selected mainly through a method of judgment sampling within the Regional Administration office and occasionally by snowball sampling. Data collection was conducted until the saturation. Researchers confirmed the existence of a source, a target and the form of communication used through data collection process after theoretical saturation of the data collection was reached for each of the elicited flows. Diagrams were found an adequate method to depict and summarize the findings.

We aimed to further implement and adopt health information technology to improve communication, decision making and outbreak surveillance with UCCI institutions as a case study. We identified key activities to design project implementation and address all four technology lifecycle stages (figure 1).[9]

/ Ethics

There was no need for an ethical committee approval as we did not collect data on individual patients. The study was conducted in accordance with privacy and data protection principles and regulations.

/ Results

Identification – Description on information flow

Figure 2 displays the organic structure and information used for PPCIRA. We identified nine different clinical purposes for data collection by using different dimensions data for surveillance through health indicators. We tracked back information from

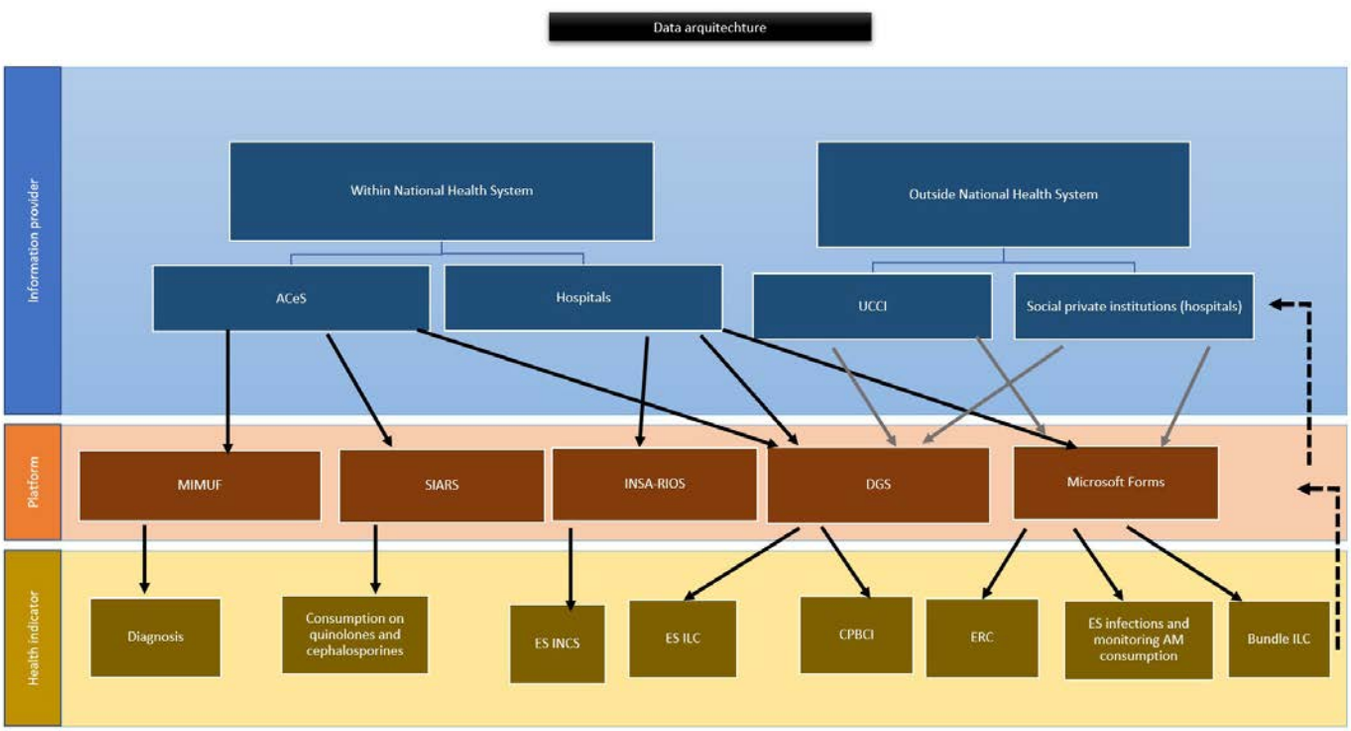

Figure 2 – Description of information architecture in infrastructures involved within GCRPPCIRA; Legend – MIMUF – Information and monitoring module for functional units; SIARS – Regional Health Administration monitoring system; INSA-RIOS – Ricardo Jorge National Institute – Health Information and Observation Networks ; DGS – General Directorate of Health; INCS –Nosocomial bloodstream infections ; PBCI – Basic precaution of infection control; ERC – Carbapenem-resistant Enterobacteriaceae; ES – Epidemiological surveillance; AMR – Antimicrobial resistance ; ILC – Surgical site infection.

those indicators to five different platforms. Only data collected through *Microsoft Forms* by hospitals was available at individual level (meaning not aggregated data). Only the Regional Health Administration monitoring system (SIARS) was directly available at regional level to identified users. Remaining platforms required a unique user to access data which was not made available on real-time by the national entity. No metadata was made available for users. Data was collected at national level from four groups of defined institutions: two within National Health System and two outside National Health System.

UCCI was selected as a priority area for improvement through mapping of existing local processes and after HALT 3 results.

Selecting a system

We built a consensus decision within the regional group to mitigate implementation technology risks failures addressing a specific functionality process, namely the hard-copy paper process. Implementation of the health technology information system undertook a strategic planning through a technology lifecycle management framework. For each stage we identified paramount activities described in figure 1. We appraised the best resource available once the need for a technological system was established. Microsoft platform was the available technology already used by health professionals satisfying the local needs considering clinical needs, work paradigm, ethics and legal infrastructure and affordability. Consensus was met as engagement by UCCI professionals was a high priority for effectively implementing dematerialization process.

Planning

We further designed a digital form with intended data collection indicators. The result template is available in table 1. It includes 3 sections (i) to identify the UCCI, (ii) to record denominators – patients' days, antibiotic days, catheter days and pressure ulcer days; and (iii) to record and characterize HAI or antibiotic prescription. This form was designed within experts at regional level and was tested and adopted by 2 UCCI units as a pilot group. During a 4-month period the forms were iteratively improved based on the pilot group feedback.

Before amplification of the project for other units we presented the preliminary results. The discussion occurred within one day in two separate meetings where we split the focus people for each meeting based on alphabetic order of respective UCCI name. This group discussion gave stakeholders the chance to explain their thoughts and experiences. We further nominated a focal point professional within each UCCI unit before scaling up. The focal point committed to report to the regional level through the available technology.

Maintenance and evolution

We distributed the forms within all focal points and allowed a monthly try-out for validation and identification of constraints. During this time, we also trained users allowing them to practice 'hands-on' to simulate the actual working environment as closer to reality as possible. Furthermore, training also aimed to empower professionals to correctly identify infections according to the infection criteria based on the HALT 3 technical manual and to properly address antibiotic therapy, treatment of UTI, ITR and pressure ulcer infections.

To properly evaluate the project in long-term we identified key goals, namely (a) decrease incidence of target infections; (b) increase antibiotic free days; (c) decrease the duration of treatment; and (d) decrease UTI related to catheter which will be used for monitor impact and determine health gains. We studied adherence in the units that initially subscribed to the project to identify representativeness. During the implementation process we monitored uptake through timely data collection. As we increase data volume and complexity static data visualizations can be limited in the quantity and type of information they provide. We built a dynamic representation to address this concern by making any statistical and data analysis interactive and available to both users and servers. To implement such technology and making it available for each participating unit we implemented a row-level security approach. The findings and outcomes are presented as themes in figure 3.

/ Discussion

Efficient information systems are the cornerstone for infectious disease surveillance as they can timely detect outbreaks and even identify public health hazards that would have previously gone unnoticed. Hence, increased global health concerns have intensifying their digital transformation efforts in core capacities and infrastructures for the use of information systems for infectious disease surveillance (including dealing with the management, analysis and presentation of large amounts of surveillance data).[3] However, the expectations for a truly integrated epidemiological surveillance based on a communications infrastructure, data standardization and policies on data access and sharing have not yet been met.[10, 11]

Overall, our work met the proposed aims and highlighted the necessity for adequately implementing information systems that meet user's needs. An information system therefore needs to fulfil a range of requirements on a variety of levels.[3, 12, 13] It needs to ensure engagement (ultimately be usable by end-users), to be cost-effective for organizations, interoperable and to allow secondary uses of data.[13-15] In fact, successful integration of technology into complex healthcare environments requires information systems to be both fit for organizational purpose and for clinical practice. To this purpose is crucial to understand state of art of information flow in planning any intervention.[13]

TABLE 1 –TEMPLATE FOR DATA COLLECTION AND HEALTH INDICATORS FOR UCCIS		
Data collected		
ID		
Section I	Name of UCCI	
	Aim of submission	Monthly overview Epidemiological surveillance
Monthly overview		
Section II	Last date included	
	Type of LFCT	Convalescence, mean duration, long duration, palliative
	Number of beds	
	Sum of hospitalization days	
	Sum of catheter days	
	Sum of patients with pressure ulcers each day	
	Sum of patients with prescribed at least one antibiotics each day	
Epidemiological surveillance		
Section III	Patient ID	
	Age	
	Type of UCCI	Convalescence, mean duration, long duration, palliative
	Infection origin	At UCCI itself; In another UCCI; Unknown origin; No infection (for symptom control or prophylactic); Hospital
	Date of diagnosis	
	Date of prescribed antibiotic in the absent of infection	
	Type of infection	Urinary tract infection; Pneumonia; Tracheobronchitis; Clostridioidescolitis; Surgical site infection; Infected pressure ulcer
	Products for Microbiology	External, Within in LFCT
	Type of products	Urine, Respiratory secretions, Pus (Aspiration/ swab), Blood, Feces, Other
	Results from microbiology Resistant microorganisms	Sterile; Positive – Agent No known resistance, ESBL positive, Carbapenemase resistant/Carbapenemase producing, Oxacillin resistant, Resistant to 3rd generation cephalosporins, Resistant to vancomycin and/or linezolid, Multi drug resistance (MDR)
	Antibiotic treatment	Not performed, Empirical (absence of collection for microbiology or inconclusive), Directed (no change in previous empirical treatment), Directed (with change in previous empirical treatment), Prophylactic, Symptom control
	Type of antibiotic used	
	Duration	
	Results of infection	Healing, Transfer for Acute care hospital, Death

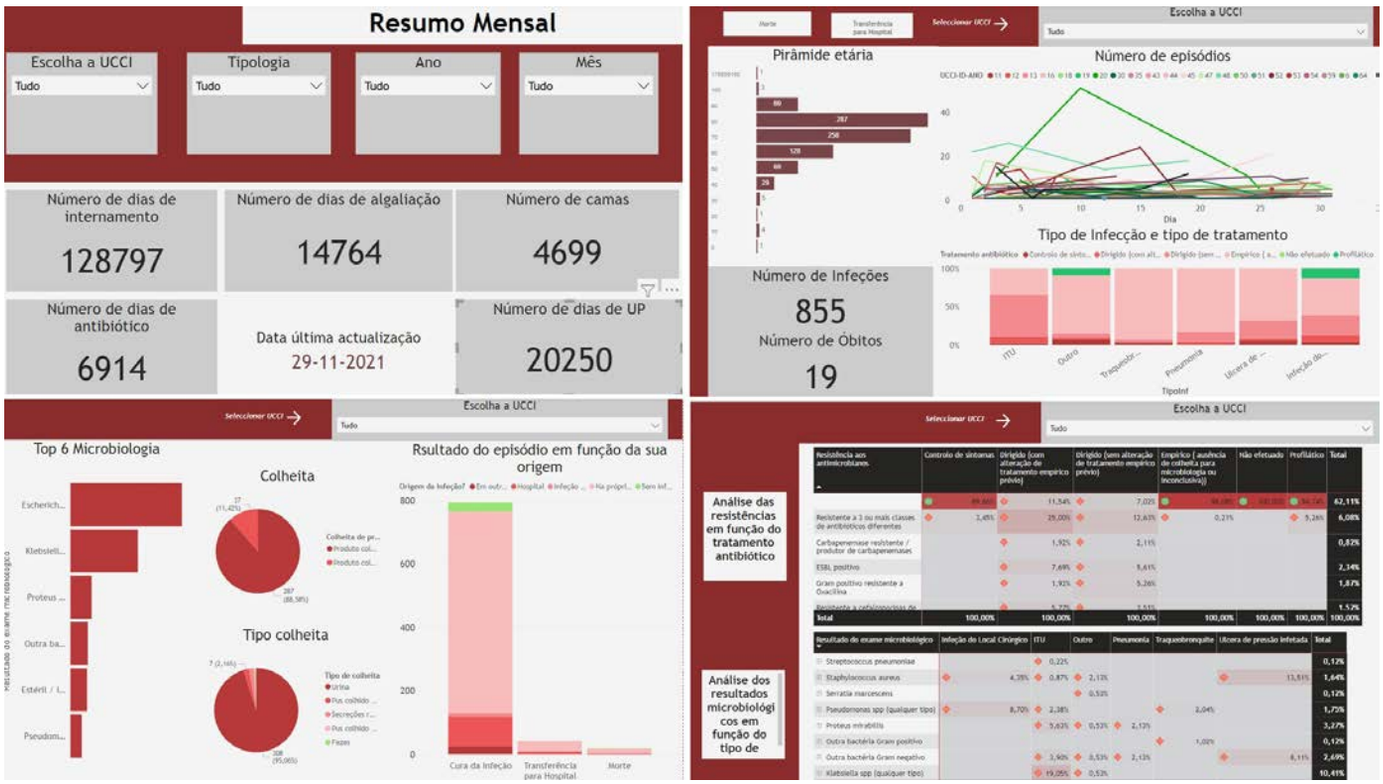

Figure 3 – Data analysis after dematerialization process in UCCI (data collected between 02/01/2021 and 29/11/2021)

As previously stated, it is of paramount importance avoiding the running of parallel systems (both paper and electronic) whenever possible as such information may be described as unstructured and may even be subjective and/or contradictory because the information is obtained in non-standardized ways. In fact, dematerialization process is a basilar step for future health technology information assessment as recently proposed by WHO.[13]

To the best of our knowledge variables concerning PPCIRA requirements in UCCI have not been previously described for risk management and surveillance. We thus designed a first template to be adopted for UCCI units which also suits the aims and purposes of GCR-PPCRIA. This is especially important for timely action in outbreaks and geospatial management within regional level.

To avoid this system becoming obsolete we should focus on following long term developments. Hence, it is essential to capture user feedback about problems that are identified and respond to it in a timely manner.[9] Moreover, it also requires regular maintenance by periodically re-visiting the technology lifecycle framework namely, by (i) evaluating implemented strategies on real-time data collection through the analysis and assessment of health reporting and information summaries;[15] and by (ii) providing formative feedback as emerging results can be incorporated in on-going implementation activity.[12, 14, 16] Future research will be required to determine the impact of such intervention in health gains, as well as the integration of digital technology in health professional's culture.

Este estudo foi realizado no Departamento de Estudos e Planeamento de Saúde da Administração Regional de Saúde do Norte, Portugal. O mesmo foi realizado sob supervisão do Dr. Fernando Tavares (ftavares@arsnorte.min-saude.pt).

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