COVID-19 surveillance robot: rapid innovation for public health pandemic management

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Summary

HSE-HPSC developed a COVID-19 surveillance robot to align COVID-19 data across HSE information systems and navigate the national infectious disease reporting system (CIDR) to process laboratory records, notifications and contact tracing data [1, 2].

The COVID-19 surveillance robot, is a key tool in the HSE's pandemic response. The robot delivers timely data for epidemiological reporting by the Health Protection Surveillance Centre (HPSC) to the National Public Health Emergency Team (NPHET), facilitating evidence-based decision-making for the pandemic response [3, 4].

1. Background

Due to the large-scale pandemic response, COVID-19 surveillance has been disjointed. The COVID-19 robot project required stakeholder engagement with regional HSE Departments of Public Health (DPHs), laboratories, the contact tracing system (CovidCare Tracker-CCT), and HPSC to foster a more integrated approach for COVID-19 surveillance data management [5, 6].

The HSE-HPSC reports on the epidemiology of COVID-19 in Ireland using the Computerised Infectious Disease Reporting system (CIDR) [2]. The DPHs use CIDR to process laboratory or clinical notifications, apply case definitions and input enhanced surveillance information from contact-tracing centres. On average, it takes 26 minutes per case. Typically, each DPH team has two scientists. Assuming an even geographic distribution of cases and full staffing levels, 100 daily national cases equate to 2.7hours per scientist. (400 daily cases equates to nearly 11 hours per scientist). Regional outbreaks and screening programmes create additional workloads for specific regions.

The live trial results of the COVID-19 Robot have previously been reported in the September 2020 issue of Epi-Insight, this article provides an update on the successful deployment of the robot into routine COVID-19 surveillance [1].

1.1 Aim

To rapidly design, develop and implement a robotic process automation (RPA) solution for pandemic surveillance demands, increase the timeliness of data for national COVID-19 surveillance reporting and reduce the workload of staff in the eight regional HSE Departments of Public Health.

1.2 Objective

In response to the COVID-19 pandemic, this national HSE project was developed to automate three manual sub-processes (SP) of COVID-19 case data on the Computerised Infectious Disease Reporting system (CIDR);

1. SP1, laboratory records: process COVID-19 laboratory notifications on CIDR by either linking to a current patient on the system or by creating a new patient;
2. SP2, infectious disease notifications: create an COVID-19 notification on CIDR, termed a 'CIDR event' by applying current case definitions [7];
3. SP3, contact-tracing surveillance data: update the COVID-19 notification with data collected by the contact tracing centres (CCT) i.e. information on symptoms, preexisting clinical conditions and exposures of interest requiring immediate public

health investigation to contain/limit the spread of COVID-19 (e.g. travel, mass gatherings).

2. Methodology

The Director of HSE-HPSC sponsored the COVID-19 RPA project on behalf of the HSE Public Health teams and appointed a small HPSC project team within existing resources. The project was managed and delivered by HSE-HPSC with the support of a multidisciplinary project team of scientists, analysts and developers who cooperated daily to develop the rapid solution. Key project stakeholders included the HSE-HPSC CIDR team, HSE-Departments of Public Health Surveillance Scientists, HSE-Health Business Services, HSE-Office of the Chief Information Officer, and Deloitte RPA team [8, 9, 10]. The robot was designed to operate using an agreed set of rules, which were developed through business process analyses, stakeholder engagement and technical collaboration. The methodology is summarised below, further details are outlined in Appendix 1.

2.1 Business process analysis

Multiple analyses of the first-wave of COVID-19 cases (laboratory data, case data, contact-tracing data) provided business intelligence for scenario-based data handling, informed the robot coding development and provided robot data processing reference files.

2.2 Stakeholder engagement

The HSE-HPSC designed and delivered this solution on behalf of HSE-Departments of Public Health. Stakeholder buy-in was achieved through active collaboration, two-way open communication and trust. Stakeholder ownership of the solution was fostered through bi-monthly project meetings, IT demonstrations, and the pilot/ testing phases.

2.3 Technical collaboration

A collaborative approach between key technical partners facilitated the successful innovation in a rapid timeframe; including the HSE-HBS, the Deloitte RPA team, the HSE-OoCIO and the HPSC CIDR team.

2.4 Development timeline

The rapid development of the innovative COVID-19 surveillance robot began in April and went live in August after testing, a live pilot, and a hyper-care phase. Subsequent development for surge capacity occurred between September and December, with expansion to 42 virtual robots functioning automatically.

3. Results

The successful degree of automation achieved and its impact is measured through the average time to process a case, total cases processed by the robot and the time-saving benefit to public health departments.

1. Successful Integration: The Robot aligned COVID-19 surveillance data across HSE information systems.
2. Successful time-saving result: The robot operates quicker than a human, 3.3minutes compared to 26minutes. Therefore, based on a case-load of 100 daily cases, the robot saves 38hours. (400 cases, saves 151 hours)
3. The ability to operate outside of core hours and currently operates for 22 hours per day: to maximise its benefit. This reduces overtime and out of hours work by the regional scientists, resulting in overtime cost-savings for the HSE.
4. Successful degree of automation: The robot processed greater than 80% of cases just like a human. The remaining 20% are flagged by the robot for human processing as per the agreed robot business rules. The Public Health teams review and investigate these cases on a daily basis. (Figure 1).

Figure 1: COVID-19 daily case data: CIDR events created by human/ robot (SP2)

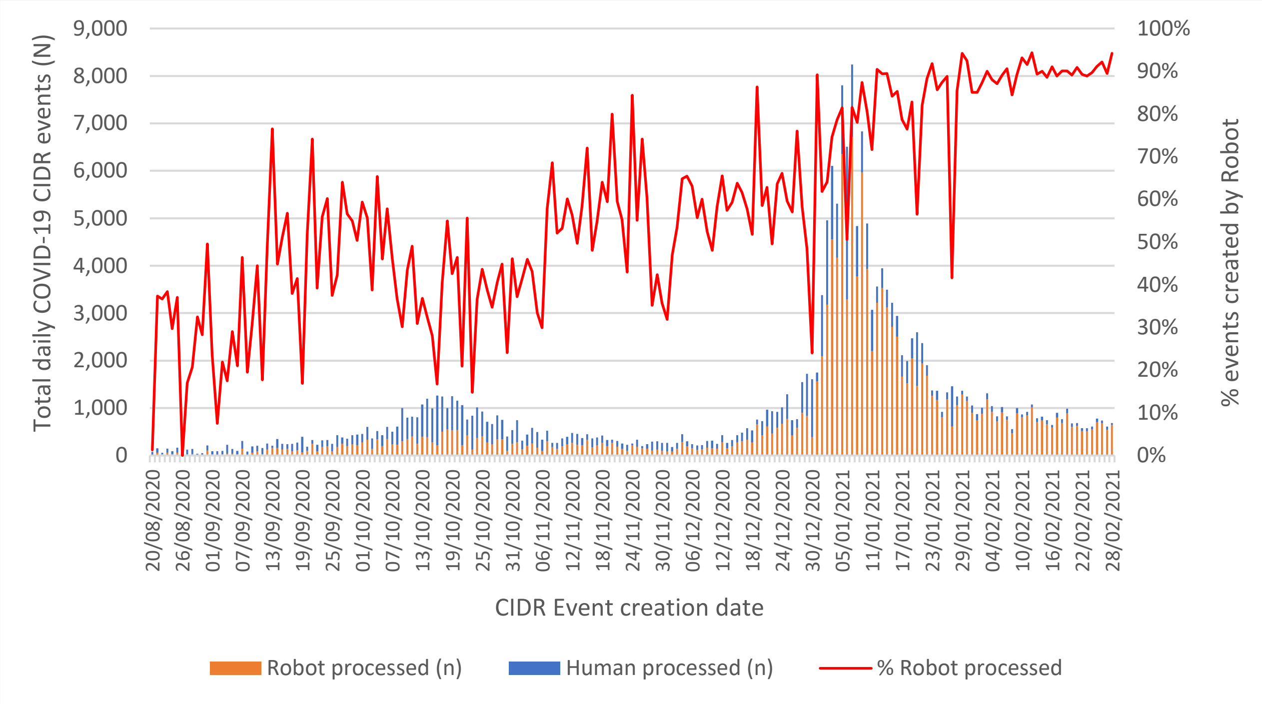

Figure 1 displays the time-saving benefits of the robot processing COVID-19 case data. The daily robot capacity has increased to account for processing of 94.2% of COVID-19 cases created on CIDR, latest data 28/02/2021.

The project's success prompted the expansion to 42 robots, supported by a multi-robot environment. Further expanding the solution's surge capacity has strengthened the pandemic resource. The current operational schedule and capacity are outlined in Appendix 2.

4. Conclusion

Through compassionate collaboration, the RPA successfully delivered a fit-for-purpose public health data management resource that successfully integrated into public health surveillance, removed administrative burdens, increased the timeliness of data and empowered scientists to focus on higher value work.

The COVID-19 surveillance robot successfully;

- relieved the administrative burden of COVID-19 surveillance, enabling scientists to focus on vital epidemiological analyses, outbreak investigations and reporting.
- streamlined surveillance across HSE information systems.
- saved the underfunded public health system from being unable to cope with the pandemic caseload.
- provides NPHET with an up-to-date epidemiological view of the pandemic, facilitating national governmental recommendations.

4.1 Future innovation development

The COVID-19 surveillance robot;

- This project introduced the HSE-Public Health teams to the benefits of robotic processing for infectious disease surveillance. The knowledge gained during the project can be used to extend the robotic solution to other notifiable diseases.
- The multidisciplinary project team structure and the active stakeholder engagement methodology employed can be utilised as a basis for a national surveillance data management team, fostering a collaborative approach.
- A change management process is in place to monitor changes made to the CCT/CIDR for impact on robot code. Change requests include stakeholder engagement, business process analysis such as meta-dataset cross-referencing, robot coding development, testing and hyper-care phases to make the changes 'live'. A change request is currently underway to process vaccination data and laboratory sequencing data for variants of concern.
- A HSE-HBS RPA Centre of Excellence has recently been established to support RPA initiatives across the health sector [8].

5. Acknowledgements

The project was led by Julie Arnott and Niamh Sneyd (HSE-HPSC) on behalf of the scientists in the HSE-Departments of Public Health, in consultation with and supported by Deloitte, HSE-Health Business Services and the HSE-Office of the Chief Information Officer.

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Appendix 1: Methodology specifications

I. Business process analysis

Multiple analyses of the first-wave of COVID-19 cases (laboratory, notifications, contact-tracing) informed the robot coding development, providing business intelligence and robot reference files:

1. SP1, laboratory records:
   - All COVID-19 laboratory records were analysed and data quality anomalies/ issues were explored with all laboratory-based surveillance scientists nationwide, trouble-shooting scenarios of data quality issues or data time delays and identifying collaborative solutions.

2. SP2, infectious disease notifications:
   A full COVID-19 case dataset (N=22,000+) was analysed to develop two robot reference files based on:
   - Community Care Area (CCA) mapping: each CCA was geographically mapped by county and HSE Area, providing a list of addresses where geographical exceptions occur (e.g. Tipperary South/ North) for the robot to allocate the CCA automatically.
   - Patient type mapping: all patient types identified by the primary laboratory referrer were analysed, providing a list of codes for the robot to generate the 'patient type' automatically (i.e. GP patient, A&E, Inpatient, ICU etc).

3. SP3, contact-tracing surveillance data:
   - the CCT system was analysed by undertaking contact-tracing training to understand the system and stakeholder engagement. The meta-datasets and case forms of both CIDR and the CCT systems were analysed and cross-referenced to develop the robot code.
   - A full extract of positive patient assessments on the contact tracing system (CCT) were analysed (N=15,849). The resulting report highlighted data quality issues that would require robot data management rules, i.e. scenarios of missing data or data discrepancies.

II. Stakeholder engagement

The HSE-HPSC designed and delivered this solution on behalf of HSE-Departments of Public Health. Stakeholder buy-in was achieved through collaboration, communication and trust.

- Stakeholder trust was established through regional site visits, business process analysis and regular workshops.
- Active and dynamic two-way communication led to the agreement of the national overarching set of business rules and reference files that underpinned the robot development.
- These business rules were used to design and develop a robotic solution to mirror the use of the CIDR system by HSE surveillance teams, and ultimately deliver an additional virtual workforce to supplement the human resources across the HSE-Departments of Public Health
- Stakeholder trust was further strengthened through collaboration during the project's test, pilot, and trial phases. Testing was carried out on the CIDR Test system prior to implementation on the CIDR Live system during a 'hyper-care phase' with real-time supervision.
- Stakeholder ownership of the new innovation was fostered through time-efficient bi-monthly videoconferences to communicate project scope and timelines, demonstrating the robot developments, and feeding-back communications from CCT or national groups.

III. Technical collaboration

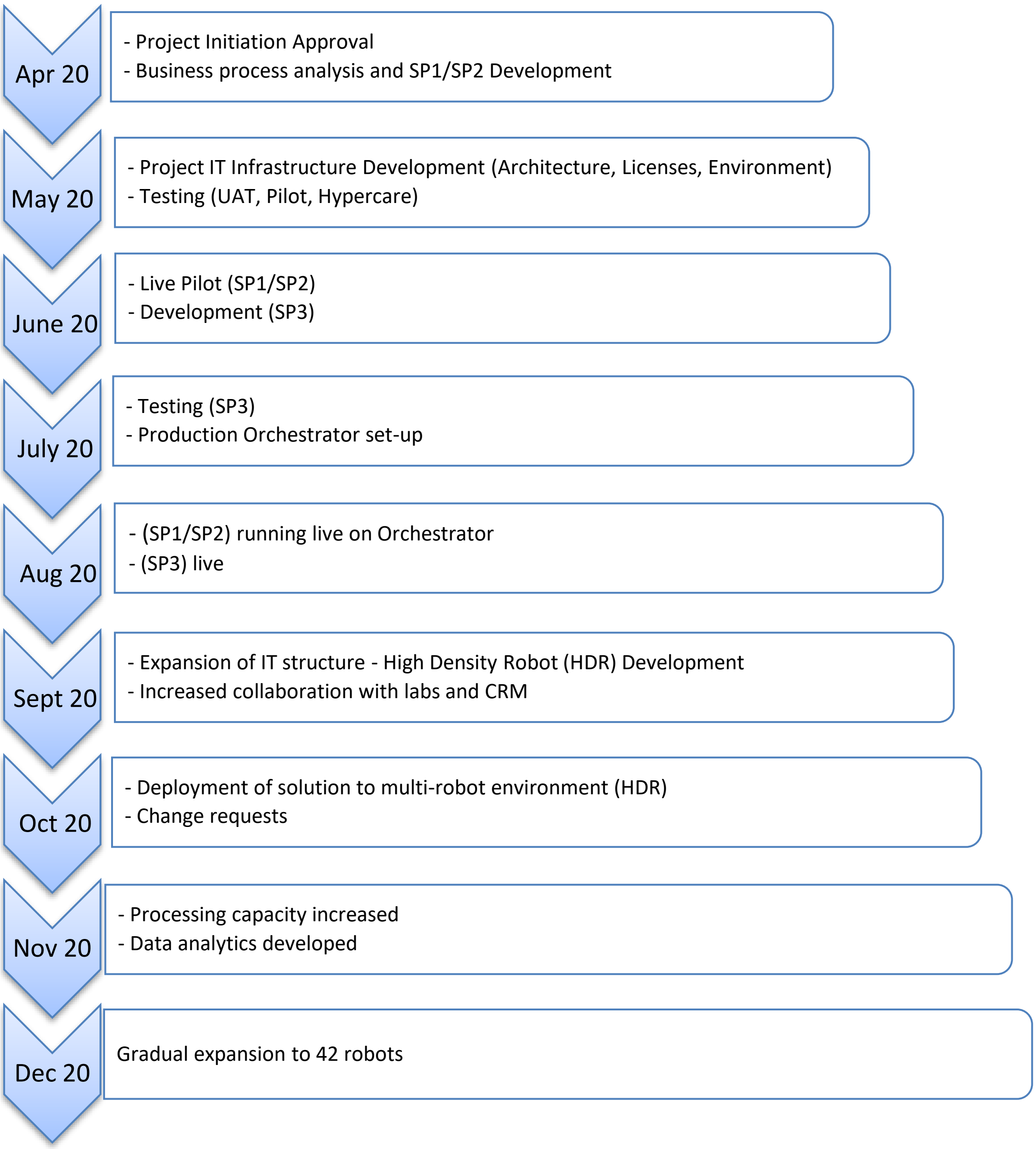
A collaborative approach between key technical partners facilitated the successful innovation in a rapid timeframe, including;

- The HSE-HBS supported the project by:
  - identifying and providing a skilled Deloitte RPA team with experience of delivering RPA solutions for HSE
  - supplying the required RPA licences.
- The Deloitte RPA team:
  - designed and developed the robotic solution using UiPath software
  - supported the testing, hypercare, implementation of the COVID-19 RPA solution
  - to increase processing capacity, implemented a high resilience / multi-robot solution
- The HSE-OoCIO teams implemented
  - the initial deployment of the technical infrastructure and virtual servers
  - the upgraded server environment and infrastructure for the high resilience solution
  - a secure COVID-19 RPA data repository for robot operational and outputs files for use by public health surveillance scientists. Access request forms are approved by the HSE-HPSC RPA Manager and submitted to HSE-OoCIO for completion.
- The HPSC CIDR team delivered:
  - business process and technical support to the RPA project team throughout the initial design and development stages
  - technical support during the testing phase, including multiple configurations of a test environment during the iterative testing process
  - business process and technical support during the hypercare and implementation phases of the initial COVID-19 RPA solution on CIDR
  - significant technical support for the planning, testing and implementation of a high resilience RPA solution
  - CIDR access management
  - Daily reporting requirements for sub-process 3

IV. Development timeline

The rapid development of the innovative COVID-19 surveillance robot began in April and went live in August after testing, a live pilot, and a hyper-care phase. Subsequent development for surge capacity occurred between September and December, with expansion to 42 virtual robots functioning automatically (Figure 2).

Figure 2: Development timeline- rapid development of the innovative surveillance robot



Appendix 2: Operational schedule and robot capacity

Figure 3 outlines the daily operational schedule: 32 robots are currently running for the majority of the day, resulting in total capacity processing figures in figure 4. This capacity can be further increased by scaling-up the operational schedule to utilise all 42 robots during the day if required for pandemic surges.

Figure 3: COVID-19 Robot, current daily operational schedule

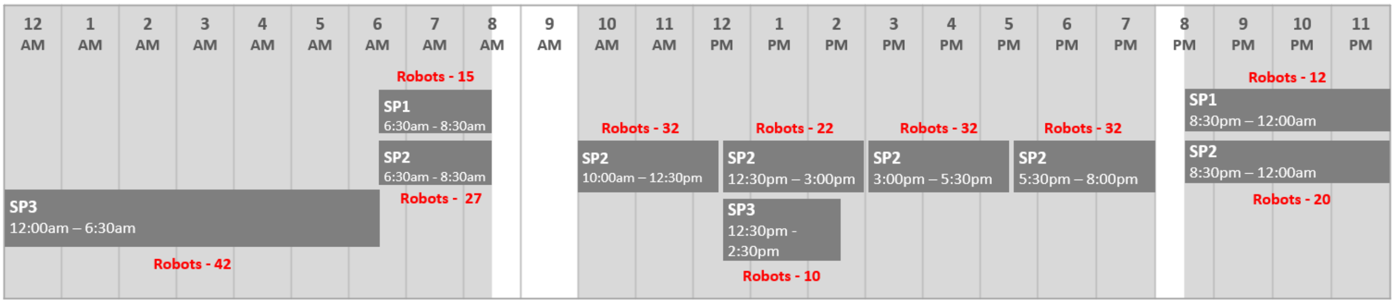


Figure 4: COVID-19 Robot, current daily capacity*

Robot Capacity* per Operating Window								
	12:00am – 6:30am	6:30am – 8:30am	10:00am – 12:30pm	12:30pm – 3:00pm	3:00pm – 5:30pm	5:30pm – 8:00pm	8:30pm – 12:00am	**TOTAL**
SP1	-	1482	-	-	-	-	2329	**3812**
SP2	-	650	1678	1137	1678	1678	1543	**8364**
SP3	10080	-	-	600	-	-	-	**10680**

* Robot capacity based on average transaction handling times as at 17/02/2021. Each Sub-process has an average transaction handling time. Transaction handling times fluctuate slightly due to IT resources e.g. network connection speed etc.