Connecticut Department of Public Health

ContaCT—Connecticut's Integrated COVID-19 Contact Tracing Solution

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Award Category: Cross-Boundary Collaboration and Partnerships

Executive Summary:

The COVID-19 pandemic is an unprecedented public health emergency which required an extensive, coordinated response to mitigate the impacts and minimize societal impacts including the closing of schools and businesses and overburdening the healthcare system. Contact tracing is a core mitigation strategy during outbreaks of infectious disease which involves interviewing infected individuals to identify close contacts and communicate public health recommendations related to isolation and quarantine to limit the spread of illness in the community. Additionally, cases and contacts undergo daily monitoring during their isolation or quarantine window in order assure adherence to recommendations and identify new onset of illness.

Previously in Connecticut, contact tracing for vaccine preventable diseases, such as measles, was primarily accomplished using a paper-based interviews process with spreadsheets to manage cases and their associated contacts. It was determined that these antiquated methods were not sufficient to manage an emerging pandemic and an enterprise system was needed to: manage the volume of anticipated cases/contacts; integrate with existing surveillance systems; facilitate real-time information sharing among public health partners, and automate case/contact interviews or monitoring to improve efficiency.

> *"Contact tracing is a critical part of the public health response to COVID-19. Any effort to supplement that program could be a crucial step in stopping the spread of the virus. If even one person is in touch with a contact tracer and discusses their contacts for the last 14 days, it could result in a chain reaction that stops dozens or more from getting infected."*
> *-Dr. Deidre Gifford, Acting Commissioner DPH*

To achieve these goals the Connecticut Department of Public Health (CTDPH) developed and implemented a supporting software application, ContaCT. This is a cloud-hosted enterprise Microsoft CRM application. During May 2020 Connecticut deployed Microsoft's At Risk Identification Alerting System (ARIAS) was launched to rapidly support states' pandemic response efforts. The Connecticut development team undertook an extensive customization on this base product, and iterative development in 2-3 weeks sprints to create the ContaCT application that meets the Connecticut requirements. This ongoing Agile development process allowed us to incrementally roll out functionality as it was demanded and address shifting priorities and business functional needs.

During November 2020 CTDPH integrated the [Google/Apple's Exposure Notification Express (ENx) Mobile application](#) with ContaCT; branded for our state as "COVID Alert CT". The application facilitates proximity-based Bluetooth notifications on Apple and Android smartphones to supplement traditional contact tracing efforts. The ContaCT system has been instrumental in allowing CTDPH to facilitate and ensure compliance with statewide requirements in an equitable manner which engages all key stakeholders and ensures the highest possible outreach rates with residents who have tested positive.

Idea:

Contact tracing is a key infectious disease mitigation strategy to interrupt disease transmission. Individuals that are infected with a disease (cases) are interviewed to identify close contacts, so that these contacts can be notified of their potential exposure and advised to quarantine. During March 2020, CTDPH conducted contact tracing for individuals who tested positive for SARS-Cov-2, the virus responsible for COVID-19. However, as case counts increased during the first wave of the pandemic this

approach rapidly became unsustainable as widespread transmission occurred statewide and the state began to close schools and businesses to slow transmission and preserve healthcare infrastructure.

During April-July 2020, the Office of the Governor established the Reopen Connecticut Workgroup to advise the state on its reopening strategy. One of the recommendations of this committee was the establishment of a statewide contact tracing system. They determined the business requirements of a statewide enterprise contact tracing platform with appropriate software to which included:

1) Rapid Delivery—the selected application needed to be launched statewide within 2 weeks of selection
2) Dual Reporting—Connecticut reportable diseases are dually reportable from test providers to both CTDPH and the Local Health Department where a case resides so the application must support role-based permissions and record sharing based on jurisdiction
3) Automation—the application must include automated data collection from constituents via text or emailed links, to improve the efficiency of interviews and/or daily monitoring assessments
4) Privacy—the application needed to maintain privacy and HIPAA-level data security for protected health information as mandated by state statutes and regulations
5) Flexibility/Scalability—the scale/scope of the COVID-19 pandemic were unknown, and the application needed the flexibility to meet emerging business requirements and expanding or shrinking use as infection rates change
6) Distributed Workforce—the application needed to be able to support users from a large, distributed, remote workforce with both on-shore and offshore participants.
7) Integration—this application needed to integrate with other existing state data systems including the Connecticut Electronic Disease Surveillance System(CTEDSS), which receives electronic disease reports from laboratories and providers, as the ongoing CTDPH disease surveillance repository containing the source of all reported tests.

The Data Subcommittee first reviewed internal data systems and determined that there were no applications in use within the state, that could feasibly be configured to meet these business requirements. The subcommittee then met with five vendors with Commercial off The Shelf (COTS) contact tracing applications to evaluate their product offering. The Microsoft Dynamics ARIAS application was selected for implementation based on meeting all key business requirements, particularly a commitment to a two-week implementation timeframe. This application will focus on the ContaCT implementation period during May 1, 2020-April 30, 2021.

Implementation:

The ContaCT system is an implementation of Microsoft ARIAS/Dynamics, an enterprise customer relationship management (CRM) system that was leveraged to support case management and contact tracing for public health authorities as a disaster response initiative. Leveraging an engagement with Microsoft development team, CTDPH launched ContaCT on May 24, 2020 and scaled up to statewide adoption by June 1, 2020. The initial launch was based on a need to stand up a minimal viable product to support statewide contact tracing. Data security and privacy were a key consideration and ContaCT was cloud hosted in the state's Azure GCC environment. Application access was managed via the state's Azure AD in the Tenant. Standard Multi Factor authentication was used to validate users and populate the Teams and security groups. Application-level permissions were granted to individual users based on

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jurisdictional assignments and required access in accordance with state statutes and regulations. Individual permissions for authenticated users in the application are governed by Business Units (geographic areas) and roles (functional permissions) and controlled by the User administration team.

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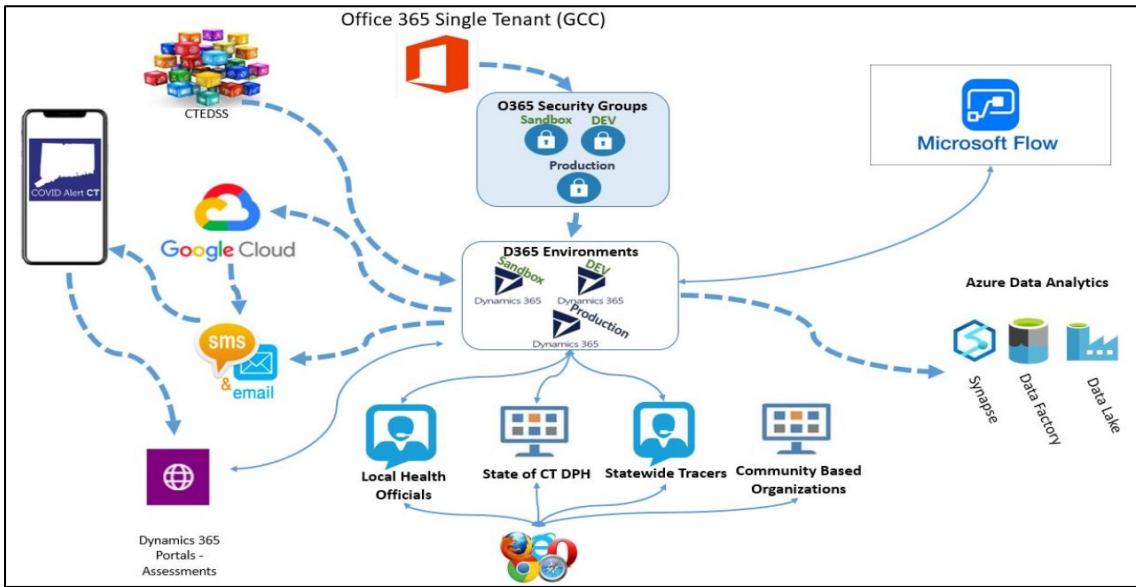
Microsoft Flow automates the processes of ContaCT integrating external data streams and processes, managing internal application business processes, and providing a bidirectional communication protocol with users, applications, and constituents. Connecticut's DPH has mandated reporting of test results from providers and testing Labs to our statewide system of record, CTEDSS for all reportable disease findings, including COVID; positive SARS-CoV-2 results are transferred to ContaCT using an hourly automated process.

Contact tracers use these data, managed by internal data views, to call all eligible infected or exposed residents within the system. As data are updated in the system, priorities are adjusted to surface the most urgent cases for priority interactions. ContaCT is also integrated with Twilio and O365 email servers and Dynamics 365 Portal to allow constituents to directly report their health information to complete the daily monitoring requirements and increase efficiencies of staff by facilitating automated data collection directly from constituents. Users of the State of Connecticut's ContaCT application are provided access to their data using a secure data portal. Azure Data Factory is used to update the data multiple times a day from the data store (MS Dynamics) into an Azure Synapse database. Subsets of the data are then provided for after action analysis and reporting based on permissions defined in the application.

The overall project management of ContaCT development and ongoing operations was a workstream-driven model with a single project manager and team leads related to IT, Business Processes and Data Management, Stakeholder Engagement, Health Equity, and Project Administration. System enhancements are tracked through Microsoft DevOps and development work was governed using an Iterative Project Management style in 2 or 3-week Sprint deployment cycles. This was required due to the rapidly evolving scale and scope of the pandemic and changing business requirements as the system matured and data volume increased over time. These scheduled sprints streamlined technical development and change management by pulling together key stakeholders to coordinate business

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requirement prioritization, development, testing, documentation, tracking, and deployment of all changes. In addition to contact tracing, the application suite deployed was configured to include the following functionality:

- **Case Investigation:** Contact Tracers attempt to speak with all community cases of COVID-19, so this system was leveraged to collect supplemental case investigation data. Additional fields, data collection forms, views and reports were developed in the model driven application. DPH Outbreak Investigation Team staff were provided direct system access to identify potential clusters. Cross-jurisdictional data sharing was automated to share information related to schools, daycares, and colleges, as appropriate.

- **Mobile phone based Proximity sensing:** COVID Alert CT was implemented statewide, during November 2020. This app is using Google/Apple's Exposure Notification Express (ENx), a mobile application that allows cell phones in close proximity of each other, to log Bluetooth beacon keys; key data are managed on an APHL key server. When a new Positive test notice is imported into ContaCT, through normal processes at DPH, it sends an automated, system generated SMS text message to the cellphone of record for all adult cases who tested positive. It instructs the individual to take action to activate their ENx key release, which will notify anyone listed in the proximity log on the cell phone, that they may have been exposed to COVID. Individuals who receive an alert that they have had an exposure are invited to enroll in ContaCT and instructed where to go to receive additional guidance about how to mitigate risk related to their potential exposures.

- **Community Resource Coordination (CRC):** Unmet needs may be a barrier to successful quarantine and isolation so regional CRCs were established within regional Community Based Organizations to connect individuals to services. Data identifying Unmet needs and consent are collected in the MDA or via the application Portal and automated referrals are generated through ContaCT to individual assignments to the appropriate CRCs. The CRCs can then access applicable records in ContaCT and document their more detailed needs assessment and intervention outcomes directly within the ContaCT system.

- **Community Outreach Specialists:** Targeted community outreach was implemented in eleven Connecticut communities with high social vulnerability index scores. This is designed to provide tailored education and awareness and overcome cultural barriers related to engagement. ContaCT manages these referrals based on geography, languages spoken, and other community factors to ensure that all Connecticut residents have an equitable chance to participate in ContaCT by communicating with trusted community messengers in their preferred language.

At peak capacity during the 2nd and 3rd waves of the pandemic, there were approximately 1,000 full time equivalents staffing the contact tracing operations; 900 of whom are contact tracers (paid, volunteer, and Local Health Department staff) and 43 provide Project Support Operations, 57 are analysts and technical reporting resources. Due to the critical need and urgency to deploy and to implement a timely contact tracing solution, the initial timeline from vendor selection to implementation was two weeks, which is unprecedented for a standard SDLC cycle in the State of Connecticut.

The overall cost of contact tracing from May 1, 2020 to April 30, 2021 was $16 million. The break down of this spending was:

- 63% Operational costs and temporary call center staffing for the Contact Tracers
- 35% (4.7 million) for DevOps and IT staffing including contract and the Helpdesk/command center operated by a consulting firm under contract
- 2% infrastructure and product licensing.
  - ($25,000),Azure components and metered use fees
  - ($211,293) Application licenses
  - ($5,525)Twilio text message integration service fees

The project was funded by federal cooperative agreements that were allocated for this purpose.

Impact:

The successful implementation of ContaCT provided a technological framework for contact tracing and COVID data tracking in the state of Connecticut. This ultimately resulted in the successful collaboration of key stakeholders from over 100 government, private, and community-based organizations to provide statewide, equitable contact tracing services to all individuals in Connecticut diagnosed with COVID-19 and those who came in close contact with them. Fully implementing this key public health mitigation tool and tracking processes was a dependency for the state to proceed with its "Reopen Connecticut" strategy. It significantly contributed to declining case counts and cross transmission rates by assuring that constituents were aware of the Public Health recommendations regarding quarantine and isolation. It identified barriers associated with unmet needs and tracked that they were rapidly addressed. It also retained case-level data to facilitate timely identification and investigation of suspected COVID outbreaks. The integration of multiple functions and cutting edge technologies into a single contact tracing platform, permitted a seamless experience for CT constituents to participate directly in contact tracing through a web-based user interface, provide real-time case exposure data, participate in interviews in their preferred language, and request and get connected to services to support unmet needs.

> Constituent Feedback from Community Outreach Specialist:
> *"I called a case that was connected to CRC [Community Resource Coordination]. She is so grateful for the work we do. CRC called this morning and is connecting to services for oil as it ran out…Wanted to share how we can impact one family at a time."*

The increased integration of automation and data sharing encouraged constituent engagement. This allowed Connecticut to consistently meet their performance benchmarks for contacting COVID positive citizens and encouraging and monitoring adherence to CDC recommendations, even during times of extremely high volumes which strained capacity during the 2nd and 3rd waves of the pandemic. The ContaCT system allowed for the equitable roll-out of contact tracing statewide by giving all Connecticut residents an opportunity to participate in contact tracing and seamlessly, shift workload between contact tracers and/or teams based on changing staffing and resource constraints. Despite the very short implementation window of this project, this work led to the rapid adoption of new technologies to support the scale, scope, and complexity of this public health response. ContaCT was the first application hosted in the state's GCC Azure Cloud environment, and the first application hosted in any directly managed cloud environment. The use of the GCC Azure Cloud also leveraged the Azure AD Tenant to credential both internal and external partners and employ multi-factor authentication (MFA). With over 1,000 users, user administration access and security were key factors in maintaining the privacy and confidentiality of constituents' protected health information (PHI).

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In addition to a 3 Tier transactional application with development, testing/sandbox, and production environments, a reporting database was also established using Microsoft Data Factory. Data were maintained in a Data Lake and the Microsoft Synapse was installed to leverage AD permissions to apply data access controls. Database views were established to allow each local health departments to access it's jurisdiction-level data. After the proven success of the ContaCT reporting database, the Data Lake is being leveraged by other COVID-19 data sources, including CTEDSS (surveillance disease registry) and CT WiZ (Immunization Information System) to establish a common architecture to support cross-application COVID-19 analytics and reporting, and is being modeled as a best practice template for future statewide development projects in the Azure Cloud Environment.

ContaCT required a large initial technological investment in terms of funding and resources to rapidly respond to an unprecedented public health emergency. The actual MS Azure hosting costs of the application are only $25,000 per year. Licensing costs are based on utilization, allowing the ContaCT application to rapidly scale up or down as programmatic needs change. Many of the core features of this application will be leveraged for other infectious disease use cases utilizing the established cross-jurisdictional data security, information sharing, data management, and automated methods of data collection and constituent engagement. While current work is still focused on pandemic response, additional use cases are being explored, including incorporating ContaCT into the agency's Public Health Emergency Response Plan to be rapidly redeployed during future public health emergencies. Current operation of the ContaCT system is anticipated to continue at the current level until August 2021; it is anticipated that contact tracing will continue for an additional 6-12 months using existing ContaCT functionality and supporting a reduced workforce.

Aside from the deployment use of the ContaCT application, an ongoing architectural framework was developed and invaluable experience was gained in the use of Microsoft tools that are supported on the Azure Cloud; Data Factory, Synapse, Flow, Dynamics, and AAD user management which will be leveraged for future development efforts not only within DPH but other agencies statewide.

> ## ContaCT Success Stories:
> - Maintained use of the ContaCT system 8am-8pm, 7 days/week, 365 days/year.
> - Credentialed and managed over 1,000 users from 3 State Agencies, 65 Local Health Departments, 5 Community-Based Organizations and 30+ colleges/universities
> - Consistently met benchmarks of attempting >90% and completing >50% of case/contact interviews within 48 hours
> - Provided COVID-19 recommendations to over 191,179 Connecticut residents
> - Connected 14,248 persons with unmet needs to support services
> - Had high adoption of COVID Alert CT application with over 1.3 million cases
> - Doubled COVID ALERT CT utilization by automating case notification process to release Bluetooth keys to notify close contacts
> - Identified or investigated over 500 potential clusters in schools, day cares, sports teams and in occupational settings using ContaCT data

Additional Resources:

1. Connecticut Open Data Portal ContaCT Dashboard: https://data.ct.gov/stories/s/Contact-Tracing/3q7k-ypbp/
2. ContaCT Website: https://portal.ct.gov/Coronavirus/ContaCT
3. COVID Alert CT Website: https://portal.ct.gov/coronavirus/covidalertCT/homepage
4. ContaCT Educational and Promotional Campaign Materials: https://portal.ct.gov/Coronavirus/Resources---Contact-Tracing

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