



TDS Team News

THE LATEST FOR TDS TEAM MEMBERS | February 2023

FEATURED STORY

FastFax Uses Machine Learning to Triage Urgent Patient Referrals

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Stanford Health Care receives a high volume of patient referrals, resulting in continued challenges in timely access to care. While there exists an online referral portal, we typically receive around 4,000 faxes per day, most of which relate to referrals from non-Stanford affiliated community providers.

Approximately 10% of referrals are marked as urgent by the referring provider. Under the existing workflow, incoming faxes need to be read manually by a member of the referrals management team in the Enterprise Contact Center (ECC) and urgent referrals are mixed in with routine referrals into the same

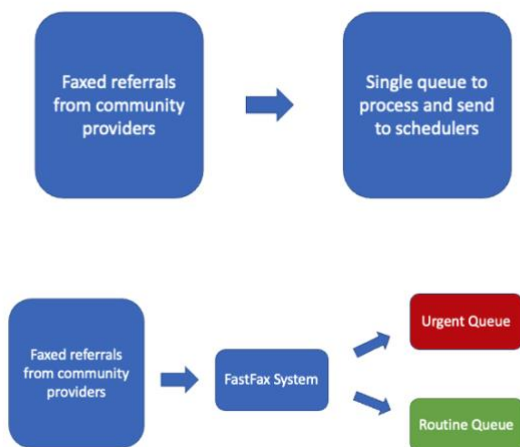


queue, leading to potential delays in those referrals being processed and sent to the clinical schedulers.

The Origins of FastFax

The Stanford Emerging Applications Lab (SEAL) partnered with the TDS Revenue Cycle Team, Integration Services, and the ECC referral management team to explore developing and testing a machine learning (ML) and image processing enabled technology called “FastFax” to address this bottleneck.

FastFax was originally developed by Stanford faculty Dr. Amit Kaushal, Clinical Associate Professor of Medicine and Adjunct Professor of Bioengineering, as a freely available solution for the Contra Costa



Top: Before FastFax. Bottom: Using FastFax to direct referrals into urgent and routine queues.

Public Health Department, which was receiving high volumes of faxed COVID case reports during the height of the pandemic. The system consists of an image pre-processor feeding a machine learning (ML) classifier that recognizes when an “urgent” checkbox is checked on a standardized PDF fax cover sheet, and moves faxes deemed urgent by the system into a different queue for expedited processing.

Dr. Kaushal reached out to SEAL to explore the possibility of repurposing this capability for Stanford Health Care. Recognizing the potential to repurpose this tool for the use case around referrals processing, SEAL partnered with TDS and the ECC to design

and build a workable solution that fit the specific needs of the ECC referrals management team and perform a limited pilot to understand how such a capability would impact the referral processing workflow in a live operational environment.

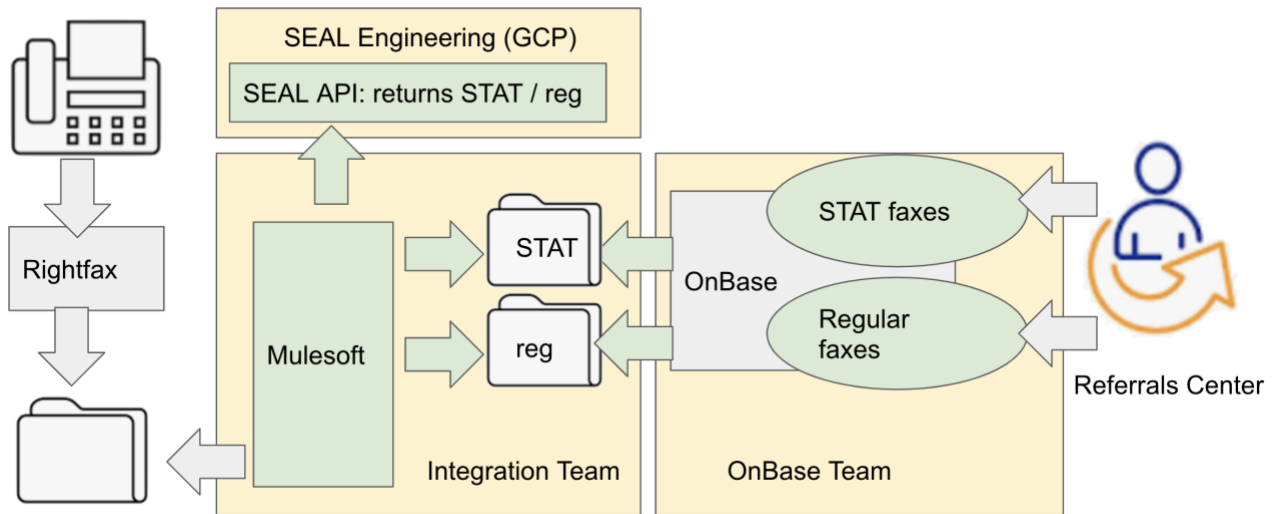
Building and implementing FastFax as an “emerging application”

Once ARB approval was obtained in September 2022, the TDS software developers affiliated with SEAL and Research Technology worked closely with the IT Revenue Cycle team, Integration Services, and the ECC to tune and validate the original FastFax ML model on a dataset of SHC fax referral cover sheets, design a new ML enabled workflow, and create an integration architecture to support this system.

In the original system, RightFax, the fax intake system, connected directly to OnBase, the fax processing system, in a single intake queue. Integration Services injected a custom-built MuleSoft connector between RightFax and OnBase; the new connector monitors the RightFax queue, sends each new incoming fax to the SEAL API running on Google Cloud for evaluation, then uses the results

of the API call to determine which of two OnBase queues, urgent or routine, to place the incoming fax.

Fast Fax Architecture



Designing and evaluating the pilot

The FastFax system went live in December 2022, just three months after ARB approval, as part of a six-month pilot intended to evaluate whether to leave the system in place until a more comprehensive solution can be deployed as well as extract operational and technical insights that will be useful for a vendor search.

The system was integrated as part of standard work for the SHC referral management team to aid in processing all incoming faxed referrals at SHC. Since go live, the system has processed 26,921 faxed referrals, of which 2,332 were marked as “urgent” by the referring provider (8.7%).

We discovered that a significant number of urgent referrals (42%) use a fax cover sheet format that is different from what the FastFax system was trained on, so were unable to be recognized by the system. Excluding those faxes, of the 1,352 urgent faxes with the standard fax cover sheet, 1,059 were classified by FastFax into the urgent queue (recall = 78%). A total of 1,290 faxes were classified by FastFax into the urgent queue, of which 231 were non-urgent faxes (false positive rate = 18%, precision = 82%). The average referral processing time for faxes in the urgent queue was 38 minutes, versus 152 minutes in the routine queue (4x faster).

It turns out that a surprisingly high percentage of incoming referral faxes use either older versions of SHC’s referral form, or forms of their own devising, such as those used by email (or other endpoint) to fax solutions. Providers will even simply scrawl “Urgent” across the document rather than ticking the supplied checkbox on the form. The machine learning model we use is limited to recognizing checkmarks in known locations on a form, and has to be trained separately on each form. Given that there is not only a wide range of non-standard forms in active use but also a certain degree of non-

compliance, using handwritten notes rather than filling out the form as indicated, the Revenue Cycle team has launched a vendor search for a more robust solution, but in the meantime FastFax will likely continue to operate, as it does afford some relief from this ongoing problem, and initial feedback from the referral management team has been positive and has not revealed any problems with usability.

The new system benefits both the referrals triage team, in that they are now able to promptly process many urgent referral faxes, and also indirectly benefits the patients in question, as their referral process is now being expedited at this step. Furthermore, we demonstrate that a low cost internally developed automated machine-learning (ML) system, when strategically targeted at an organizational bottleneck, can yield significant time savings when scaled across all of enterprise faxed referrals.



Need Assistance?

Physician Helpline: 866-742-4811

Referral Request Form

(Items with ** are required for processing)

Fax To: 650-320-9443 or Submit online using prism

Radiology Referrals / Orders: Use Form: <https://stanfordhealthcare.org/imaging>

Patient Information		Reason for Referral	
If Medical Records Cover Sheet is included, Patient information can be left blank		Priority: Routine <input type="checkbox"/> Medically Urgent <input type="checkbox"/>	
Name (First, Middle, Last)** Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female		If Medically Urgent, please describe:	
Date of Birth**		Diagnosis/ICD 10**	
Phone # ** Secondary Contact #		Clinic / Specialty Requested**	
Address**		Physician Requested Location Requested	
City** Zip Code** State		If Requested Physician is Unavailable, Can Patient be seen by another provider? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Contact Referring Provider	
Interpreter Needed? Yes <input type="checkbox"/> No <input type="checkbox"/> Preferred Language:		<input type="checkbox"/> Consultation <input type="checkbox"/> 2 nd Opinion <input type="checkbox"/> Procedure <input type="checkbox"/> Other	

Referring Provider Information

Referring Provider Name**	PCP Name
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The application of an agile, collaborative development process with front-line operators enabled the discovery of nuanced insights into pain points and key levers, and formation of lasting partnerships with operational stakeholders. At an academic medical center with a highly innovative workforce,

this “grassroots” approach to innovation can elevate the voices of front-line clinicians and staff, which is critical to driving and sustaining organizational transformation.

This project has been a real showcase of the benefits of TDS unification. Research Technology contributed expertise in machine learning model development and deployment and collaborated seamlessly with both Revenue Cycle and Integration Services to design, deploy and operate a solution to a problem primarily affecting Revenue Cycle, going from ideation to operation in just a matter of months. Research Technology was thrilled to be able to materially contribute to a project whose primary impact is on clinical care.

Thanks and recognitions

We would like to acknowledge the contributions of **Silvia Ramirez** and the Enterprise Contact Center Referrals Management team, **Mandy Singh** from the PMO, **Vikrant Singh** from Revenue Cycle, **Krishna Jasti** from Integration Services, and **Joseph Pallas** from Research Technology, without whose efforts this project would not have been possible. SEAL is sponsored by **Dr. Christopher Sharp**, Chief Medical Information Officer and the **Digital Healthcare Integration Team**.