

Patient Organization for a Kidney Transplantation Management and
Decision Support System

A Technical Report submitted to the Department of Computer Science

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Natalie Zhang

Spring, 2022

Technical Project Team Members

Josie Lamp

On my honor as a University Student, I have neither given nor received unauthorized aid on this
assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Lu Feng, Department of Computer Science

Patient Organization for a Kidney Transplantation Management and Decision Support System

Natalie Zhang, Josie Lamp, Lu Feng
University of Virginia, Charlottesville, VA, USA

1 Introduction

Patients needing organ transplants can wait for more than five years for a donation in the United States (2). Transplant coordinators ensure that patients on deceased-donor waitlists receive organ donations. Communication between the coordinators and the donor's family, recipient, doctors of the patients, hospitals, medical laboratories, and surgeons is vital to a successful transplant. Considering the amount of information to track, such as test results, appointments, and waitlist updates, it may come as a surprise that this is currently being done manually. With no standardized technical system in place, the risk of human error increases, and the work for communication is prioritized over other life-saving tasks a coordinator could be doing. Thus, the kidney management system implemented focuses on visualization to assist transplant coordinators in tracking patients, ensuring that patients have completed the necessary tests and are in the condition to accept an organ donation at any point in time.

2 Related Works

There have been similar kidney management systems developed that incorporate key features, including a secure database. For example, Bircan et al. designed a similar system for healthcare professionals to track patients on the deceased-donor waitlist and ensure patients were prepared to receive an organ. Major features of the system included a search tool, an alert or reminder feature, and distributed system management permissions (1). This database system attempted to lower the high mortality rate of patients on dialysis, a procedure that continuously filters a patient's blood due to the kidneys' inability to do so, and to increase the rate of receiving a deceased donor kidney. The system would decrease the number of potential rejections due to patients not meeting the required tests and checkups necessary. Although future clinical trials need to be performed to assess the success of this system, the features created were designed considering the need for organizational information to track tests and to increase the chances of patients receiving transplants from the deceased-donor list. The technical project aims to incorporate these considerations and features.

Previously, researchers on the technical project created a conceptual kidney transplant management system for the University of Virginia (UVA) Kidney Transplant Clinic. The kidney management system will have the necessary features to address these needs (2). The main feature that is the focus of the project is the visualization of a patient waitlist. Coordinators can view the waitlisted patients they are responsible for and track their attendance in appointments ensuring that patients are following routine tests. Formatting and prioritizing the information coordinators want to view will be enhanced while allowing them to easily access more detailed information on a specific patient or test. By having automated tracking that can update information about patients immediately and providing a more comprehensive way of seeing patient data, healthcare

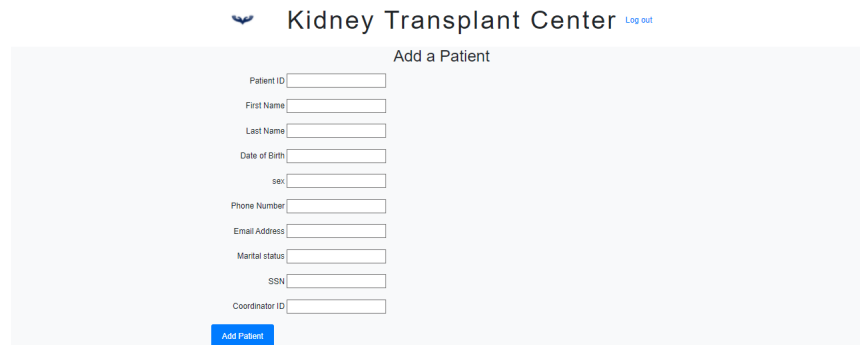
professionals can make more informed decisions on treatments, administration of testing, and waitlist decisions. Transplant coordinators can view the patients on the deceased-donor waitlists and their laboratory tests. The focus is on the coordinators' side who will be utilizing patient information as part of their jobs. The prioritization of these features was a result of feedback from stakeholders, including clinicians working at the UVA Kidney Transplant Clinic.

3 System Overview

The system was developed in Django, a python web framework. The database used is default SQLite database supplied by Django. The system had a login portal that would redirect patients, transplant coordinators, surgeons, and financial coordinators to their respective accounts. Depending on the role, each had role-based authorization to determine what type of information they could access. Patients could only look at their own information and modify themselves while transplant coordinators can see the information about their own patients. For this research, the main features developed were forms to allow transplant coordinators to add patients and tests as well as a patient waitlist.

3.1 Adding Patients

For transplant coordinators to have patients in the system, they must have a way to add them. A form was developed to allow them to add patients into the database and view them on waitlist of patients afterwards.



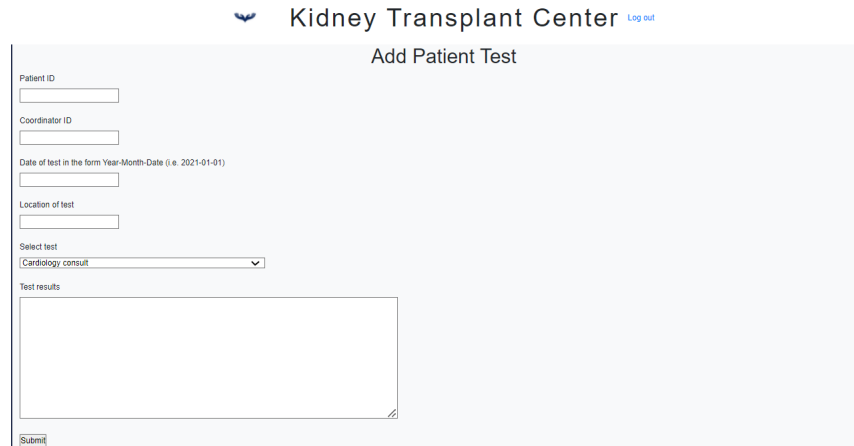
The screenshot shows a web interface for the 'Kidney Transplant Center'. At the top right, there is a 'Log out' link. The main heading is 'Add a Patient'. Below this heading is a form with the following fields: Patient ID, First Name, Last Name, Date of Birth, Sex, Phone Number, Email Address, Marital status, SSN, and Coordinator ID. Each field is represented by a text input box. At the bottom of the form is a blue button labeled 'Add Patient'.

Figure 1: Patient form to add new patients

Figure 1 shows the visual form that allows users to add patients into the system. Django forms were used to develop this form and the submit button takes in a POST request to add the patient into the database. If a transplant coordinator attempts to add a patient with the same patient identification, an error is returned without adding the patient in to the system.

3.2 Adding Tests

After creating the feature for transplant coordinators to add their patients into the system, the next feature developed was the form that added test for each patient.



The screenshot shows a web form titled "Add Patient Test" within the "Kidney Transplant Center" interface. The form includes several input fields: "Patient ID", "Coordinator ID", and "Date of test in the form Year-Month-Day (e. 2021-01-01)". There is also a "Location of test" field and a "Select test" dropdown menu currently set to "Cardiology consult". Below these fields is a large text area labeled "Test results". A "Submit" button is located at the bottom left of the form.

Figure 2: Test form to add new tests for each patient

Figure 2 provides the form, which takes in information needed about the tests. The transplant coordinator can supply the information necessary. The patient's identification and their own identification are asked to ensure that the test added will be assigned to the correct patient and documents the coordinator supplying the information. For now, the test information required is the date, location, and type of test. Notes relevant to the test result and potential future considerations are also given a space for the transplant coordinator to fill out. If the patient identification cannot be given, then an error is returned without adding the test into the database.

3.3 Patient Waitlist

The patient waitlist displays the information about patients and their respective tests from the database into a readable format for the transplant coordinator. A wireframe was first designed to determine the information a coordinator would need to see about a patient at the first glance. Figure 3 provides an overview of the design.

Patients are first prioritized by their tests due. A patient with a scheduled test late by a few days is displayed at the top of the list over other patients with on-time tests. The transplant coordinator can login and notify such patients with their contact information. Upcoming dates are displayed at the top and complete tests are at the bottom or hidden. This feature later changes so that completed tests are hidden unless the transplant coordinator clicks a button that will expand to show the recently completed tests.

There are also four icons displayed on the right of each patient to provide information and allow the transplant coordinator to edit information for each patient. In the order of the icons displayed, their meanings are the following:

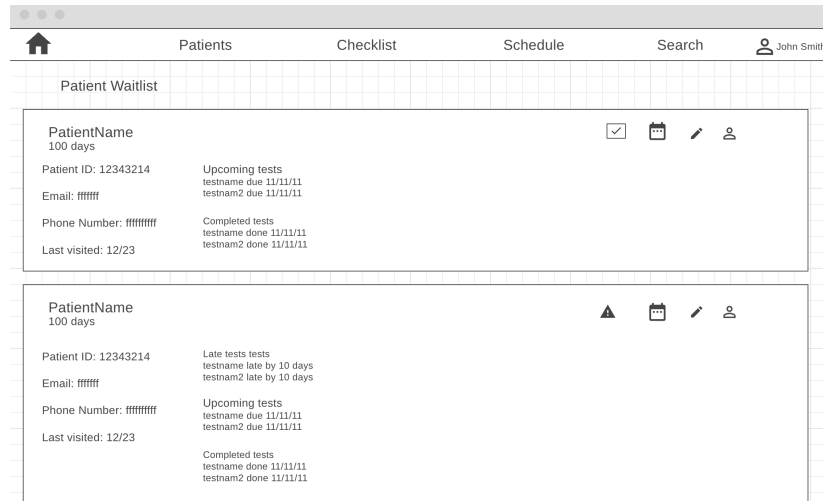


Figure 3: Wireframe outline of patients on the coordinator's view.

- The icon is either a check-mark or a warning sign. A check-mark indicates that the patient is up to date on all their tests. A warning sign indicates that the patient has overdue tests and are displayed on their synopsis of information.
- When clicked on, the calendar icon brings the transplant coordinator to the patient's schedule with their upcoming appointments. This feature should be implemented after a scheduling or appointment tracker is set up.
- The pen icon allows the transplant coordinator to update any information on the specific patient or their tests. This feature should be implemented after the system is set up so that each coordinator can only see the patients that are assigned to them rather than all patients in the directory.
- The icon of the person directs the coordinator to the patient's profile page. This feature should be implemented after the profile page feature for each patient is set up.

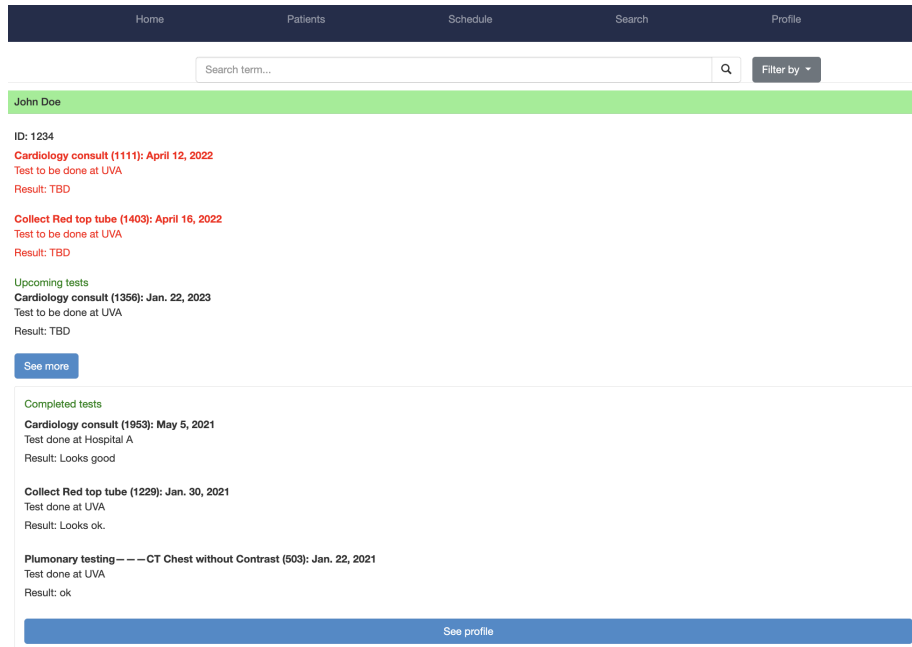


Figure 4: Patients listed for the transplant coordinator.

The patient waitlist developed has some features that are not yet implemented or different from the wireframe. Figure 4 demonstrates the patient waitlist prototype. Only patient name and identifications are displayed instead of all their contract information to reduce clutter. Tests that patients are behind on will appear in red at the top of a list of upcoming tests. Clicking the see more button expands the view of tests to show previous tests that the patient has done, displaying information such as the test type, location of the test, and notes previous inputted. The "see profile" button will later direct the transplant coordinator to the patient's profile once clicked, after the features for patient profiles is implemented.

4 Conclusion

The implementation for the waitlist presents organized information on patients for transplant coordinators after adding their information into the database. Future recommendations include creating features for scheduling and displaying appointments, searching functionality for patients, establishing different login portals for each role in the system, and personalizing patient profiles respectively. These recommendation can be subject to change based on the needs or feedback users have.

References

- [1] Hüseyin Yüce Bircan, Ümit Özçelik, Nida Uysal, Alp Demirağ, Mehmet Haberal, Development of an Information Model for Kidney Transplant Wait List, Experimental and Clinical

Transplantation: Official Journal of the Middle East Society for Organ Transplantation vol. 13 Suppl 3 2015: 58-61.

- [2] Yuxin Wu, Autumn Routt, Kunaal Sarnaik, Josephine Lamp, Lu Feng, PhD, Alp Demirag, MD. Kidney Transplantation Management and Decision Support System. In *American Transplant Congress[abstract]*. Available: <https://atcmeetingabstracts.com/abstract/kidney-transplantation-management-and-decision-support-system/>