
Software Requirements Specification



for

Thousand Smiles Digital Charts Patient Registration and Routing

Version 1.2

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Revision History

Name	Date	Reason For Changes	Version
Syd Logan	05/20/2015	Original	0.9 Draft
Syd Logan	02/15/2016	Incorporate feedback on prioritizing patients in the routing slip	1.0
Syd Logan	02/15/2016	Push HIV/AIDs lower in the med history, parents become agitated when they encounter that question	1.1
Syd Logan	03/20/2016	Incorporate comments from Dr. Lebovits	1.2

1. Introduction

1.1 Purpose

The purpose of this document is to outline the basic requirements associated with the Thousand Smiles Digital Chart registration and patient search functionality. Other documents define requirements for the various stations a patient may visit at the clinic (e.g., Dental, ENT, Audiology, Surgery Screening) and the hospital (e.g., patient intake, surgery, recovery and discharge).

1.2 Document Conventions

There are no specific conventions associated with this document.

1.3 Intended Audience and Reading Suggestions

The intended audience includes:

Thousand Smiles Board Members: Board members should read this document to become familiar with the overall overall scope of registration in the digital charts project. This knowledge may prove helpful as background when evaluating logistics and expenditures associated with the implementation of the system, e.g., equipment purchases.

Design Team: The user experience design for the system is based on the requirements defined in this document.

Implementation Team: This document spells out requirements which guide the implementation of the system. It is not intended to be a design document, rather it spells out the requirements that a design must follow to be considered valid.

Users: This document must be read and approved by the end user(s) of the system. This document will likely go through some number of revisions towards eventual approval. If asked to review, comment on, or approve this document, please read the document critically and identify any omissions, errors, and changes so that they can be dealt with.

1.4 Product Scope

The following sections briefly summarize the scope of the system. Detailed requirements for each will be presented later in this document.

1.4.1 Registration

The system must support registration functions. Such functions allow users to perform the following functions:

- search for patients in the database
- add new patients to the database
- update the registration data for existing patients (patients that are already in the database from a previous clinic)
- maintain an active/inactive status for patients

- view attendance data for one or more clinics in a specified date range
- view attendance data for a specific patient, for one or more clinics in a specified date range
- report the status of the current clinic in terms of patients registered (e.g., display a patient list and count of patients)

1.4.2 Patient Photographs

The registration system is used to obtain and maintain a photograph of the patient (headshot) that is used for identification during search and chart usage. A headshot should be taken at the time of registration and it replaces any headshot that was taken at a prior clinic. The headshot should be displayed along with any search results to aid in patient identification.

Photographs required by specialists (such as surgery screening) are maintained separately from the headshot, and are not a part of the registration system.

1.4.3 Medical History

A medical history is to be obtained at the time a patient is registered.

- As with the patient registration data, this data is entered by a volunteer or the patient
- The user interface and data must support both English and Spanish language
- The medical history is general, intended to be useful to all specialists providing care. Additional medical history tied to a specific specialty, e.g, ENT or Audiology, is defined in that speciality's requirements document.

1.4.4 Routing Slip

The system must support routing slip functions. The routing slip is a plan for a patient's current and future visits to a clinic, and the care to be received. The routing slip is part of the information used to decide where in the clinic the patient should go as the clinic progresses. It is also used to determine what stations are to be visited when the patient returns at some future clinic.

- The routing slip must list all stations (ENT, x-ray, etc.) in the clinic that a patient can visit
- For each item in the list, the routing slip must allow the user to add comments or specify the care that should be given, as needed.
- For each item in the list, the routing slip must allow the user to notate the date or time when the care should be provided. Possible choices include:
 - Current clinic
 - Future clinic (3 months, 6 months, 9 months, 12 months)
 - Specific clinic date (month, year)
- The routing slip is mutable; during a clinic visit, items in the routing slip for a patient can be added to or removed from the routing slip as the patient visits stations and the condition of the patient, and required treatment, become apparent.

1.4.5 Routing Functions

Because the system has a complete picture of the clinic resources:

- the list of patients registered at the clinic
- the routing slip
- the state of various stations like ENT (idle, busy, etc.)

it should be possible for the system to perform the task of patient routing during the clinic. This will be described in detail below.

2. Example Routing Scenario

The following scenario should illustrate the basic operation of the registration and routing system. Following this section are detailed requirements for each of the concepts introduced below.

To set the stage, Thousand Smiles clinics typically are two days in duration. The first day is devoted to screening patients for surgeries which take place on the following day at a local hospital. The first day of the clinic is also used to provide general dentistry and orthodontic care to patients.

Generally, there are two classes of patient seen by Thousand Smiles:

- dental only patients are usually only seen once by Thousand Smiles, and only receive general dental services.
- cleft patients are ones who are screened for, and receive surgery to repair clefts and related issues, including orthodontics.

There is a third class of patient that is best described as “unknown”. This patient category represents the minority of patients that arrive at registration and are difficult for registration personnel to classify as dental or cleft. This will be discussed in the detailed requirements, later in this document.

This section describes the flow of four hypothetical patients through the screening process on day one of a two day clinic.

- Patient 1 is a prior surgery patient who is returning to our clinic for orthodontic care. This patient was last seen 6 months ago, and was asked by the orthodontic team to return to the clinic in 6 months.
- Patient 2 is an 8 month old child who has not yet been seen, and has an obvious cleft.
- Patient 3 is dental-only patient that was bused in from a partner organization for general dental services.
- Patient 4 is similar to patient 2, a cleft infant.

In the morning, the above patients arrive at the clinic location in Ensenada, and are directed to the park just north of the building. There, approximately a half dozen bilingual volunteers, each with 2 or 3 larger screen tablets (8 or 9 inch in diameter) with rear facing cameras and wireless connections back to a server located in the main building await.

The patients arrive in the following order: patient 2 (8 month cleft), patient 3 (dental only), patient 1 (ortho), and patient 4 (cleft infant).

Patient 2 (8 month old, cleft) is the first to arrive. While likely that the patient is a first time patient, this is not guaranteed – it could well be the case that the child visited at age 2 months and had to be turned away from the clinic due to a fever or some other issue that prevented care being given.

The parents are queried about this, they respond that they heard about this clinic 2 months ago and that this is their first visit. The volunteer asks the parents to provide the name of the child (father last name, child first name, month and year of birth) and enters this data into the search screen, and touches the search button. The tablet returns 4 or 5 closely matched names, along with head shots – but none match the birthdate and it is clear that the patient is in fact new.

The volunteer asks if the parents are able to read and write Spanish and if they are comfortable using a tablet. The father, which is carrying a smartphone, and answers affirmatively. The tablet is switched to Spanish language mode, the volunteer clicks the “add new patient” button, and the father enters in basic information about the patient (name, gender, DOB, address). The father, when

all this information is entered, clicks a button to submit the data, a screen displays asking the father to confirm the information, and the father clicks another button to confirm. The tablet then displays, also in Spanish, a general medical history form. Once the medical history is complete and submitted, the father hands the tablet back to the volunteer, who then uses the tablet to take a headshot of the patient. Finally, a routing slip is displayed for the volunteer. Because the patient is an obvious cleft patient, the volunteer clicks the “cleft” checkbox on the screen. Clicking this checkbox causes the following three items to be added to the routing slip: ENT, Audiology, and Surgery Screening. At this point the patient is registered for the clinic and a runner escorts the patient and her parents directly to a staging area, where they are asked to wait until called. This staging area is manned by volunteers who ensure that patients are not allowed to enter the clinic until they are called upon.

Patient 3, a dental only patient, is the next to arrive. She is put through the same process as was the cleft patient (patient 1) – a negative search of the database was performed, and a new patient record was created. Because the parents are illiterate, the information for the patient, as well as the medical history, were entered by a volunteer who verbally questioned the parents in order to obtain the needed information. The volunteer clicked the “dental only” checkbox on the routing slip for this patient.

Patient 1 is the next to arrive and be processed. A search based on name and DOB returned four close matches, and one exact match. The volunteer uses the headshots displayed to confirm that the patient was located in the database. The parents of the patient are handed the tablet, and they verbally confirm that their child is one of those displayed in the search results. The same screens that were used by patients 2 and 3 are displayed for this patient. The patient information screen is pre-filled with the data obtained at the last clinic visited by the patient. The parents edit this information to update their e-mail address and phone number, which has changed. The medical history form also contains information taken from the previous clinic, except for certain questions that are time-sensitive (for example, “does the child currently have a cold?” needs to be answered each clinic). Once these forms are submitted, a new headshot of the child is taken, which replaces the headshot from the previous clinic. Finally, the routing slip is displayed. It is pre-filled with “ortho” already selected, because the orthodontist had recorded in the digital chart the return to clinic instructions for this clinic. The patient is, like all the others, escorted by a runner directly to the staging area.

Finally, patient 4 (another new cleft patient) arrives, and is processed exactly as was patient 2. This patient, and the family members, are also escorted to the staging area.

As all of the above was happening, a large screen TV in the clinic (as well as all tablets in the clinic on the proper screen) were being updated. The display shows how many patients are registered, as well as counts for the various patient classifications (dental only, new cleft, ortho). These counts are updated in realtime as patients are registered in the park. As patients arrive at the staging area, they are “checked in”. The display also shows the number of patients that are currently in the staging area waiting to be called.

The display also shows the status of the various stations in the clinic (each dental and ortho chair, ENT, audiology, x-ray, and surgery screening). Next to each is displayed various information. The status of the station is displayed as being either unmanned, waiting, or busy. If the station is busy, the name and ID number of the patient being seen at the station is displayed. When waiting, the patient name and ID number of the *next patient to be called* is displayed. If the station is unmanned, then no patient or specialist name is displayed for the station.

Resuming the narrative, assume at this point patients 1 through 4 are checked in to the staging area, and that ortho, dental, surgery screening, speech, and audiology stations are waiting. Also, assume that ENT is unmanned, that there are 2 ortho chairs manned and waiting, and that there are 5 dental

chairs, also manned and waiting. The system, knowing that patients 1 through 4 are checked into the staging area, and knowing their routing slip contents, is able to schedule the following, in order:

- patient 2's name and ID is displayed next to speech
- patient 3's name and ID is displayed next to dental chair 1
- patient 1's name and ID is displayed next to ortho chair 1
- patient 4's name and ID is displayed next to audiology

Notice that the above assignments took into consideration the routing slip that was pre-filled at registration time, and the order in which the patients arrived at the staging area.

Runners, who are monitoring the screens, see the above changes. The runners call the patients by ID and name, and take them to the stations indicated on the screen.

Patient 2 arrives at speech. The speech specialist uses her tablet to look at the routing display to identify which patient this is. She clicks a button to accept the patient. The TV monitor immediately changes the status of speech station to busy. The name and ID of the patient continue to display next to the speech station on the screen.

Similarly, dental chair 1, ortho chair 1, and audiology all check in their patients, and the display is updated to indicate that these stations are now busy.

Next to each station that is busy, a timer updates in realtime, indicating how long that patient has been at the station receiving care. Similarly, timers display how long a station has been waiting, and how long unmanned stations have been unmanned. All of this data is recorded in the database and is used to report an efficiency score for the clinic, and for individual stations. The efficiency score basically grades how efficient a clinic is processing patients, based on how many patients are seen, their average wait times, how busy or inactive various stations are, etc.

While these stations are busy, additional patients are processed in the park by registration and arrive at the staging area, in the following order:

- patient 5, returning cleft, routing slip indicates surgery screening for bone graft
- patient 6, dental only
- patient 7, dental only
- patient 8, returning cleft, routing slip indicates orthodontic
- patient 9, returning cleft, routing slip indicates orthodontic
- patient 10, returning cleft, routing slip indicates audiology

Patients 5, 6, 7, and 8, upon being checked into staging, and escorted to surgery screening, dental chair 2, dental chair 3, and ortho chair 2, respectively, immediately upon being checked into staging as these resources are currently are all in the waiting state. Patient 9 and 10, however, remain in the staging area, because there are only 2 ortho chairs, and both are busy, and audiology is also busy.

Audiology is the first to complete work, and patient 4 is checked out of ortho. The state of audiology station moves to “waiting” on the displays. A runner escorts patient 4 back to the staging area. Patient 10's name and ID are displayed next to audiology. A runner sees this, calls patient 10, escorts her to audiology. Patient 10 is checked into audiology, and the state of audiology on the displays is marked as “busy”.

Audiology begins examining patient 10, and determines that registration made an incorrect assessment of the patient – the patient is actually dental-only, not cleft. Audiology updates the routing slip to correct the error. The patient is checked out of audiology, and escorted back to the staging area. Audiology station is displayed as “waiting” on the screens, and the name and ID of

patient 2, the cleft patient currently being seen by speech, is displayed as the next patient to be seen by audiology, because there is currently no other non-ortho cleft patient registered for the clinic. The screen also makes it clear that patient 2 cannot yet be called because she is currently being seen by speech.

At this point, a new surgery screening patient is checked into staging (patient 11). Because audiology is waiting, and patient 2 is currently in speech, patient 2 is replaced by patient 11 as the next patient to see audiology. The runners notice this change and escort patient 11 to audiology.

Note that ENT during this time was unmanned. Had ENT been manned, patient 11 might have been sent there by the system given that both ENT and audiology were idle at the same time. We could define a heuristic in the system that favors selecting one station over the other in this case; such a heuristic might be based on the expected or recorded wait times for either station, or based on the average time it takes for either specialist to process a child. A simple heuristic that would work in the absence of such data might be to randomly select among the available stations.

Next, dental chair 1 completes work on patient 3. She had a filling, which is recorded in her chart, and does not need to return to the clinic. The patient is checked out using the tablet computer, by the dentist. When the dentist checks the patient out, he or she is asked if there is a return to clinic needed for the patient. The dentist not record a return to clinic for patient 3. The patient is escorted to arts and crafts. The routing slip for the patient is complete, the displays show the count of “completed” patients, and patient 3 will no longer be assigned to a station by the system for this clinic.

Next, ortho chair 1 finishes work on patient 1. the orthodontist checks out patient 1, and adds a return to clinic date for 6 months. The patient departs the clinic. The display indicates one more “completed” patient.

Assume patient 1 returns in 3 months. When he or she is registered at the park, registration will notice that the patient was not due until 6 months. The patient can be then sent home, or if the patient or parent indicate the need for care cannot wait another 3 months (for example, the patient is suffering from something that affects his or her care, or there was damage to an appliance, etc.) the patient can be registered. The orthodontist will also, once the patient is checked in at a chair, notice the discrepancy and be able to address it. Hopefully, the return to clinic notation will help us better manage patients who simply show up too soon for care, allowing us to turn them away in the case there is no justification for seeing them early.

Note that in all cases, the assessment of a patient at registration, the existence of a “return to clinic” directive in the system for a patient, and the availability of the various stations in the clinic, along with the arrival times of a patient, were sufficient for the system to be able design a routing strategy that kept resources busy, minimized wait times, and followed the care plan appropriate for the classification of the patient made at registration time. Note also that the routing slip was be updated as it was in once case by a specialist, and that the system adapted to the changed update, which affected the routing of the patient during the rest of the clinic. The point is that such a system effectively allows us to eliminate the ‘hub’ as it is currently defined, replacing it with a computer based patient routing system.

3. Requirement Details

3.1 Registration

The registration component of the Thousand Smiles digital chart maintains the basic data about patients, data that is independent of the care being provided to the patient, and of interest to all specialists in the clinic. Generally speaking, data about a patient that is not related to a medical specialty (e.g., ENT, audiology, etc.) should be considered registration data. This data includes the following:

3.1.1 Basic Patient Information

Basic information includes name, gender, DOB, contact information for the patient and family, as well as demographics.

- Patient ID (generated by the system, unique for each patient)
- Patient name (father last, mother last, middle, first)
- Patient address
 - Street address
 - City
 - Colony
 - State
- Patient contact information
 - Phone numbers (primary, cell, other)
 - e-mail
- Patient gender
- Patient date of birth
- Patient location of birth
- Residence history (if different than location of birth during pregnancy)
 - City
 - Colony
 - State
 - Dates (if known)
- Parent information. For each parent:
 - Name (father last, mother last, middle, first)
 - Contact information
- Responsible party (optional, only if not mother and/father)
 - Name (father last, mother last, middle, first)
 - Contact information (e-mail, phone)

3.1.2 Medical History

The medical history is general in nature. The purpose of the medical history is to identify to all clinic personnel the general state of the patient at the time the patient is registered. Such information allows the clinic to be aware of potential issues that might affect the safety of the patient and personnel, and the care that can be given to the child. For example, a child with a cold or fever might be turned away because of the risk of infection or the inability to perform a surgery on the child in the case of cleft. This data also helps specialists determine diagnosis and care.

Note that the medical history taken at registration is general - it is not an aggregation of medical history specific to an area of care such as ENT or audiology. Additional, speciality-specific medical history, if any, would be stored in the portion of the chart dedicated to the speciality (e.g., ENT), and obtained at the time care is given.

- Is the patient experiencing pain?
- Is the patient taking any medications? If so, specify.
- Has a history of cancer?
- Has epilepsy?
- Has tuberculosis?
- Is having trouble eating?
- General health (good, poor)
- Anemic?
- Congenital heart defect?
- Hemophiliac?
- Is having trouble speaking?
- Any ear problems?
- Cleft?
- Any dental problems?
- Has a cold?
- Has asthma?
- Has diabetes?
- Has hepatitis?
- Is having trouble hearing?
- Any other ear concerns: pain, itching, drainage, deformity, pressure?
- Prior ear surgery
- Height (in cm)
- Weight (in kg)
- Medicinal allergies? Specify.
- Latex allergy?
- Other allergies? Specify.
- Has HIV/AIDS?
- Other conditions? Specify.

3.1.3 Headshot

The headshot of the patient is taken at the time the patient is registered. The headshot is used for identifying the patient in the system; when faced with ambiguities related to patient name (e.g., there might be several patients in the database with names that are similar), a good headshot will aid in correct identification of the patient.

The headshot needs to include the entire head and neck, and nothing more.

The tablets in the park used for registration will be equipped with rear facing cameras. The software should provide a button or screen that directs the volunteer to take a headshot. The volunteer must be able to retake as many headshots as needed to get a satisfactory result before saving the headshot in the database.

3.1.4 Category

Patients fall into one of several categories:

- Dental-only patients. These patients are typically new patients that do not have cleft, and require general dental services such as fillings and extractions.
- New cleft patients. Often infant, but possibly older. These patients are candidates for surgery screening, ENT, Audiology, and speech. Depending on the screening and medical history, they may have surgeries performed on the second day of the clinic. These patients will not have any data in the system, will not appear in search results.

- Returning cleft patients, non-orthodontics. These patients have been seen at a prior clinic and were asked to return for follow-up care that is not related to orthodontics. Such care might include additional surgeries, or delivery and application of a hearing aid, etc.
- Return cleft patients, orthodontics. These patients have been seen at a prior clinic and were asked to return for orthodontic care.
- Unknown. The patient does not fall into any of the above categories, or the correct category is not evident to personnel at registration. In response, registration personnel have decided to not turn away the patient. The patient is similar to a new cleft patient but the category of unknown alerts personnel to the fact that the situation is not clear.

3.2 Registering Patients

Registration data is gathered upon arrival of the patient on the day of the clinic. The plan is for registration to occur in the park adjacent to the clinic building in Ensenada. Tablets will be used to obtain the registration data. The tablets can be configured for either Spanish or English speakers. The tablets should have a simple way to toggle from Spanish to English (preferably without requiring the user to leave the current screen, this will support situations where the patient might be Spanish speaking and the volunteer is English speaking and they are working together to complete input). It is up to the person who manages the activities related to registration how best to organize the data gathering. For example, there might be multiple stations, one that performs patient search and entering of initial data and the assignment of an ID number, and other stations that perform tasks such as gathering medical history information once the patient has been initially registered.

3.2.1 Searching for a patient at time of registration

The first step in the process of registration involves searching the system for the patient. This step is critical for two reasons:

1. Failing to find an existing patient will consume additional time needed to re-enter patient data that is already present in the database, thus slowing the overall process of registering patients for the clinic
2. If an existing patient is not found in a search and is registered as a new patient, this will result in a duplicate record in the database for that patient. This duplicate will not be linked to any data that was gathered for the patient at earlier clinics, including (but not limited to):
 - Surgery history
 - Return to clinic instructions
 - Clinical photos, x-rays, etc..

Thus, it is important for the search function to be accurate and easy to use.

The system must provide a search screen that accepts the minimum amount of data required (last and first name, gender, date of birth, etc..) to enable the system to search for and identify patients in the database. The volunteer will enter as much data as needed to accurately search the database. Generally, the less data that is entered as search parameters, the more patients that will be returned by the search. Example: if only the gender is entered, then all patients matching that gender will be returned in the search results. Generally, the system should favor searches based on the patient providing a patient ID. Failing that, last name, first name, gender, and date of birth are good search parameters for the system to support.

If the search yields positive results, the volunteer should be able to choose from one of two methods to view these results. The first method is a list of names, gender, date of birth, last clinic

visit date for the patients that match. Each result should include a headshot as a thumbnail. Clicking on the thumbnail would enlarge the headshot to aid in viewing. Alternately, the system should display a list of headshots for all of the matching patients. Clicking or selecting a headshot will display the name, gender, data of birth, and last clinic visit date for the selected headshot. The volunteer should be able to choose which method is appropriate for the situation, and should be able to toggle between the two.

3.2.2 Duplicates

The system shall employ a search heuristic that minimizes the chance of search misses due to mistyped search parameters. Possible ways to solve this are (but not limited to):

- use of SQL “LIKE” searches in the backend
- autocomplete: as the user types in characters, search results are queried in realtime and updated dynamically in the user interface. For example, when searching for a male patient, all males are displayed, when typing the letter 'A' associated with a male patient named “Alejandro”, all males with first name starting with the letter 'A' will be displayed.
- Case-insensitive searches

3.2.3 Registering a new patient

New patients are patients that did not result in a match at search time. The search results screen must provide a button which is labeled “Add New Patient” should no matches be found. Clicking this button results in the display of the following screens, in order:

- Basic patient data – used to enter basic information about the patient
- Medical History – used to enter the general medical history
- Category – used to select one of the four possible categories
- Headshot – used to take and save a patient headshot
- Summary – displays an overview of the above screens. This screen should be shown to the patient for confirmation. It also displays the patient's ID number. The screen should provide a way to return to any of the prior registration screens to allow for correction of data found to be in error.

Each of the above screens should provide a toggle that allows the language to be changed from English to Spanish, and vice-versa.

Once the above screens are entered, the patient is escorted by a runner to the staging area.

3.2.4 Register an existing patient

Should a search identify an existing patient, the same screens that were used for new patients are displayed in order to allow for updates. The screens will be pre-filled with information that was gathered for the patient the last time the patient was registered for the clinic. The system must require that a new headshot to be taken before registration is complete.

3.3 Routing

The system should automate the routing of patients through the clinic during the Friday screenings. Section 2 of this document presents a hypothetical clinic and illustrates the basic idea. This section specifies the requirements and operation in more detail.

3.3.1 Concepts

The routing software is responsible for placing patients at various stations (staging area, dental chair, ortho chair, xray, surgery screening, ent, audiology, and speech). These stations can be viewed as resources that the clinic provides. Such resources are busy, waiting, or unmanned. Which stations a patient must visit is determined by the category of the patient:

- Dental-only patients require use of a dental chair and x-ray
- Ortho patients require the use of an ortho chair and x-ray
- New cleft and “unknown” patients require use of ENT, Audiology, Speech, and surgery screening stations
- Returning cleft patients require the same resources as a new cleft patient (ENT, and likely audio and speech)

Each station, as mentioned, can be in one of the following states:

- Waiting – a specialist is at the station and ready to accept some number of patients
- Busy – the station is occupied by one or more patients and unable to be scheduled
- Unmanned – the station is down, or unmanned, and unable to be scheduled

Each patient, as well, has a state:

- Waiting – the patient is sitting in the staging area, waiting to be called
- Busy – the patient is at a station receiving care

In addition, the patient has the following attributes:

- Time waiting – the amount of time since the patient was registered or last seen by a station.

3.3.2 Waiting Areas

Each station may provide its own waiting area. In these cases, the number of seats that a station provides is considered when deciding if a station is available or not. For dental, which at this point in time does not have its own staging area, the number of empty dental chairs defines how many patients can be sent to dental at a given point in time by the system. For ENT, which does have its own staging area, availability is defined by the number of ENT staging area seats that are empty. Each staging area seat is considered a resource in the case of ENT.

For example, assume ENT has 4 seats in its staging area. Thus, at the start of the clinic, 4 patients can be sent to the ENT staging area.

Assume these 4 staging area seats are filled, and that ENT pulls 2 of these patients from the staging area to be seen. The result will be that 2 seats become available. At this point, 2 new patients that need to see ENT patients and who are waiting in the general staging area can be sent to ENT to fill these two staging area seats.

In the case that a station like ENT provides a staging area, the resource is a seat in the staging area. In the case of dental, a resource is a dental chair. The system needs to allow someone at the clinic to modify the number of resources available at each station to match staffing, seating, and equipment levels.

3.3.3 Use of Medical History in Routing

The medical history should be used to determine a suggested routing for a patient. For example, if the patient has hearing/ear issues identified on the routing slip, the system should include ENT in

the routing that is generated for the patient. To support this, each specialist overseeing a station to which a patient can be routed should be given user interface that allows the specialist to mark which items in the medical history pertain to patients that they do (or do not) wish the system to use as a trigger for making a routing decision to the specific station. For example, ENT would be expected to mark items in the medical history related to the ear, such as “ear pain”, as items that should cause a patient to be routed to ENT.

Likewise, age of patient, and prior history should be used, along with current medical history, to determine routing of a patient to a station on a per-specialty basis.

Example (Lebovits):

- a. Check with audiology to set a lowest age for a patient to be seen by them.
 - i. For example, you might program the software such that all their pts have to;
 1. Be over 1 year old, or,
 2. Have complaints of hearing loss, or
 3. Speech delay, or
 4. Be referred by ENT
 5. AND not have had an audiogram in the past 3 months
 6. ENT can refer for audio and over ride criteria 5

3.3.4 Changes Made to Routing Slip by Specialists

A specialist at any station should be able to modify the routing algorithm by assigning a priority to any item in the routing slip. For example, if ENT would like the patient to immediately be seen by speech, the ENT specialist should be able to make the child the next patient to be seen by speech by tagging the patient. This might be done by selecting the speech entry in the patient's routing slip and then marking it as urgent. The scheduler should then put this patient at the top of the list for speech. If multiple patients are marked as urgent for speech, they will be serviced in time order, e.g., the first patient that was identified as urgent for speech will go first, the second identified as urgent for speech will go second. The system should identify the patient in the UI somehow as having been marked as urgent, and notes should be entered and associated clearly with the patient so that the reason the patient was tagged as urgent are made clear to the specialist to whom the child has been routed.

Each evaluation area, (ENT, audio, etc), needs to be able to make edits in the routing of the patients. For example, ENT may see a patient who was only scheduled to see ENT. But, then ENT determines that they also need speech and ortho. Or, ENT may see a patient who has been triaged to see ENT, speech and audio. But, ENT's evaluation shows they do not need to see speech and audio, but, they need to see the dentist. ENT should be able to make those changes as they become apparent.

Similarly, ENT may, when evaluating a patient, determine that the patient needs to be seen “urgently” by Audiology and then return to ENT immediately afterwards. The software should accommodate this routing use case.

3.3.5 Return to Clinic

The system should allow the specialist to tag the patient as needing to return to the clinic either based on date (month/year) or duration (3 months, 6 months, 1 year, etc.). For example, the patient might be tagged as needing to return to see ENT in 6 months. The routing software should determine, when the patient is registered at the current clinic, if a return to clinic was made at a

prior clinic for a specific station. If so, the station should be automatically added to the routing slip for the patient by the system.

3.3.6 General Algorithm

The above sections define requirements that should be sufficient for software to automatically schedule a plan for the patient. The basic algorithm is:

while there are patients and resources available:

- 1) select an available resource
- 2) select a patient in the waiting area needing the resource and waiting the longest
- 3) assign the selected patient to the available resource

Step 2) is based on the category of the patient. For example, if the patient is ortho, and the available resource is a dental chair, that patient will not be selected for the resource. It is also based on waiting time. If the resource is a dental chair, and there are 5 patients waiting to see a dentist, the patient with the longest waiting time will be selected for that dental chair.

The waiting time is based on when a patient entered the staging/waiting area, either immediately after registration was completed, or after care was given at a station and the patient is checked out from a station where the patient has received care.

In the event there is a tie (2 or more patients with the same waiting time needing a single resource), the system chooses one of the patients based on search result order.

3.3.7 Routing Slip Display

The main screen of each tablet in the clinic (as used by runners and specialists) displays a status of the current clinic:

- list of resources in the clinic (dental chairs, stations such as ENT and xray)
- for each resource, its state:
 - busy
 - waiting
 - unmanned
 - number of patients processed
- for each resource that is busy or waiting
 - the name of the specialist manning the station
 - if busy, the name and ID of the patient
 - if busy, how long the current patient has been at the station
 - if waiting, how long the station has been waiting for the next patient to arrive
- For each patient in the waiting area:
 - number of patients waiting
 - max waiting time
 - minimum waiting time
 - average waiting time
- The total number of patients registered for the clinic
- The total number of patients that are active in the clinic
- The total number of patients that have been seen at the clinic and are “checked out”

3.3.8 Checkin and Checkout

The screen described in section 3.3.2 above can be used by a specialist to check a patient into a resource. This is done by clicking a “checkin” button that is located next to the patients' name. Similarly, the patient can be checked out by clicking a “checkout” button.

3.3.9 Return to Clinic

The screen described in section 3.3.2 has a button that allows the specialist to specify a “return to clinic” for the patient. The button is displayed next to the patient when the patient is busy and currently being seen by a station, and is not visible otherwise. This button leads to a screen or dialog that allows the specialist to specify the following:

- category of the patient upon return
- station the patient should visit upon return
- the date of return (e.g., 3 months, 6 months, 9 months, 1 year, 2 years)

3.4 Design and Implementation Constraints

Since we are providing the implementation for the system, there are no known constraints.

3.5 User Documentation

Documentation for the overall system, and the registration subsystem, shall be provided via YouTube videos and written documentation on the Thousand Smiles Wiki.

3.6 Assumptions and Dependencies

There are no specific assumptions or dependencies associated with the registration subsystem.

4. Other Requirements

No additional requirements have been identified for this subsystem as of now.

5. Appendices

Appendix A: To Be Determined List

<Collect a numbered list of the TBD (to be determined) references that remain in the SRS so they can be tracked to closure.>

Appendix B: Dr. Lebovits Comments - 2/29/2016

Hi Syd,

Thanks for all your work on the EMR. Certainly a daunting task.

I have read the document over and below are my comments:

2. Status of various stations:
 - a. Who enters this frequently changing information?
 - b. How do they enter it?
 - c. Will this be done by the provider, (MD, DDS, Speech therapist, etc., or, by a volunteer)?
 - d. What do you anticipate the learning curve will be for a volunteer to be able to enter this data and do so correctly and quickly?
 - e. The biggest problem with current EHRs is that the provider ends up spending too much of his/her limited patient care time entering data that is not related to evaluating and treating the patient's health problem. Because of this, less patients get seen. Please do your best to make these pt flow issues into a task done by non health provider volunteers.
 - f.
3. Criteria to consider in using the EHR as the routing hub:
 - a. Check with audiology to set a lowest age for a patient to be seen by them.
 - i. For example, you might program the software such that all their pts have to;
 1. be over 1 year old, or,
 2. Have complaints of hearing loss, or
 3. Speech delay, or
 4. Be referred by ENT
 5. AND not have had an audiogram in the past 3 months
 6. ENT can refer for audio and over ride criteria 5
4. Waiting in the general holding area, (e.g.the park), vs. waiting in the holding areas that will be right next to some of the evaluation stations, (e.g. ENT & audiology);
 - a. ENT and audiology will be upstairs and have seating for waiting patients upstairs. ENT sees patients so quickly that we need to have up to 4 patients sitting right by our clinic room, ready to come right in as soon as a patient leaves. We do not want to wait for data to placed into the system showing we have an empty chair and for a runner to notice this and then for the runner to find the patient and then bring them up to us. So, they system needs to fill our empty waiting area chairs, rather than our waiting exam chairs
5. Each evaluation area, (ENT, audio, etc), need to be able to make edits in the routing of the patients. For example, we may see a patient who was only scheduled to see us. But, we

determine that they also need speech and ortho. Or, we may see a patient who has been triaged to see us and speech and audio. But, our eval shows they do not need to see those providers. But, they need to see the dentist.

6. As I believe you took care of later in the document, ENT will need to see all pts with:
 - a. New or old cleft lips and/or cleft palates
 - b. Hearing loss
 - c. Speech problems
 - d. Any other ear concerns: pain, itching, drainage, deformity, pressure
 - e. Prior ear surgery
6. 3.1.2 Medical hx; Recommend the initial questions include:
 - a. Any ear problems?
 - b. Cleft?
 - c. Any dental problems?
7. 3.3.1 page 11
 - a. Yes, returning cleft patients will require ENT, and likely audio and speech
 - b. As noted previously, an additional station may need to be added that will designate the waiting area for ENT and Audio, such that patients will be brought from the general waiting area to this "ENT" waiting area.
 - c. Similarly, patients in this ENT waiting area may need a "state" that designates them as "ENT waiting".
8. "Urgent audio and return to ENT immediately afterwards"
 - a. Another common triage situation for an ENT patient is the following:
 - i. Pt seen by ENT and determined that they will need surgery if their audio test is abnormal. These patients are currently taken from ENT, placed in the front of the line at audio, and their chart has a note in it alerting audio to test them right away and then send them back to ENT immediately where they will be seen urgently.
 - ii. Please work this scenario into the system.