

**franklin**  
health systems

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# “Design me a cart that I can put my laptop on.”

**Dr. Julie Ashton**  
Franklin Pediatrics

## Introduction

When I asked my mother if there were any issues at work that I could focus my senior capstone on, she told me to design a mobile cart for her laptop. The days of traditional hand written doctor notes are gone and in the world of electronic health records, or EHR, many physicians now carry around a laptop or tablet.

After looking into this idea, I quickly realized that the physical laptop was the least of her issues. Electronic health records have resulted in a variety of problems for doctors around the country. This book discusses those issues and covers the design process used to reach the proposed solution.

The name “Franklin Health Systems” pays homage to the inspiration for this project: my mother’s practice, Franklin Pediatrics - founded on Franklin Street in Morristown, NJ.

## **Mission**

To facilitate the art of medicine by creating a smart and connected suite of tools that streamline pediatric care.

## **Vision**

We will be the leading provider of pediatric workflow solutions because of our emphasis on mobility, efficiency, and adaptability.

## **Values**

At Franklin Health, we believe good health begins with a strong patient-doctor relationship. We are fully committed to providing physicians with the tools they need to practice the art of medicine in a technological world.

**We care for you,  
so you can care for them.**

### **Why?**

We believe good health begins with a strong patient/doctor relationship. Doctor's need to be able to understand their patients and patients need to be able to trust their doctor and feel cared for.

### **How?**

One way we can improve that relationship is by increasing the physician's efficiency so they can spend less time on their charts and more time with the patient.

### **What?**

With a focus on pediatric care, Franklin Health creates a smart, mobile workstation equipped with a suite of connected tools and a digital clipboard in an effort to relieve the physician of the manual data entry overload present in the existing EHR workflow.

## “The Art of Medicine”

“During our medical training we are taught to use evidence based medicine. This means using the most up to date scientific research data that has been analyzed and accepted as fact. But does this mean every patient we see fits into the evidence based medicine algorithm that we have been taught to use?

I hope not. For this would mean we would only be following half of medicine. The art of medicine is the other half, and is the most important. The art of medicine can be defined as being how we apply evidence based medicine to each and every patient we see. We are to use the evidence based algorithms solely as guidelines. Each and every patient has to be treated as an individual. As individuals they don’t all fit the evidence based medicine algorithms as perfectly as the guidelines require.

The art of medicine, the most important part of medicine, involves several components:

*Caring for patients, showing honest concern and compassion*

*Giving patient’s time, not rushing in and out of the exam clinic room, being patient with them, having a great bedside manner*

*Using the evidence based medicine algorithms as a guideline, as we apply them to each and every patient we see. Understanding that every patient is an individual who has individual circumstances that affect their lives*

*Helping every patient to acquire the best outcome they can for themselves by working with them, educating them, coming up with a mutually agreed upon plan of action*

Evidence based medicine does not teach us how to apply them to the patients we see, only the art of medicine does that. Much unlike evidence based medicine we don’t learn the art of medicine in a classroom. We learn the art of medicine by seeing patients, one by one, year after year. As new research comes out and the evidence based medicine algorithms change, hopefully we have refined our art of medicine skills to such a fine point that we have attained the stature of a wise mentor.

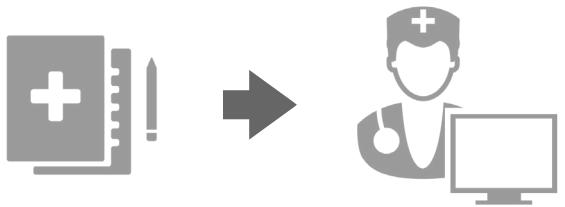
It is when we become this wise mentor who has been able to aptly combine the art of medicine with the research based evidence of medicine that we can parlay our skills to those of us who are younger, still in training and learning the skills of a medical provider.

I remember my training days and to this day I can still recall those wise mentors who played such an important role in my training. As we teach those young, up and coming medical providers let us not forgot how to teach them to use and refine their own art of medicine.”

**Sharon Bahrych**  
Physician Assistant

## **01 Opportunity Assessment**

## The Switch



### Paper Charts

Doctor's notes are meant to be a personal narrative of their discussion with the patient. Hand written notes result in a more natural conversation allowing the doctor to know their patient in a very personal way and both parties can decide together the plan of action for the patient's care.

### Electronic Health Records

The Electronic Health Record (EHR) was created, among other reasons, to provide a universal version of a patient's health information that can be shared with other providers across more than one health care organization. With all the patient's health information in one central location, the EHR, in theory, provides an automated and streamlined provider workflow.

### The Switch

The American Recovery and Reinvestment Act of 2009 accelerated the implementation of EHR by providing \$19.2 billion for health information technology allocated to help hospitals and physicians' offices with the transition. Because of this act, "the percent of pediatricians, who are using EHRs, increased significantly from 58% in the 2009 survey to 79% in 2012" (Lehmann). Most private offices are part of a bigger healthcare system so they have been forced to make the switch from "old school" paper charts to EHR.

## Problems with EHR

### Why the switch?

One of the main reasons for the switch to EHR is because insurance companies want easy access to data to determine which services they will cover and the payments for those services. This leads to patient healthcare decisions being based off statistics rather than personal choice. The system is efficient for the insurance companies but not for the doctors who now have to sacrifice the art of medicine for the purpose of data collection. The failure to implement EHR in a seamless and truly beneficial manner has resulted in three main problems:

### Efficiency

Since EHR implementation, most physicians have seen a drop in their clinical productivity and feel they have reached a plateau of efficiency. Not only do physicians feel that they could see more patients in a day with paper charts, they are spending 2-3 extra hours per day completing their patients' EHR.

### Burnout

The extra hours physicians now have to work is not sustainable. Many studies show that the manual data entry overload of EHR is not only causing burnout but leading many seasoned physicians to leave practice.

### Patient Satisfaction

The scripted, dehumanizing nature of EHR is decreasing the quality of the patient / doctor relationship which is so important in the art of medicine. Patients want to feel like they matter to their physician and that they can trust them but that wish is hard to obtain if the physician is looking at a screen typing away.

## Levels of Providers

01	<b>Certified Medical Technician</b> + Minor office procedures	<b>CMT</b>
02	<b>Licensed Practical Nurse</b> + Minor office procedures	<b>LPN</b>
03	<b>Registered Nurse</b> + Medical advice over the phone + Patient education	<b>RN</b>
04	<b>Nurse Practitioner / Physician Assistant</b> + Medical advice over the phone + Patient education + Make diagnosis + Write basic prescriptions + Complete full exam	<b>NP/PA</b>
05	<b>Medical Doctor</b> + Complex patients + Hospital admissions + Prescribe controlled substances + Psycho / Social aspects to life	<b>MD</b>

\* Sees patient as a whole, not just another visit

## Levels of Access to Care

01	<b>Retail Clinic</b> (i.e. CVS) <i>Potential conflict of interest with selling their own products</i>
02	<b>Telemedicine</b> <i>Skype / call doctor</i> <i>Convenient but not always good medicine</i>
03	<b>Walk-In Urgent Care</b> <i>No appointment - open after hours</i> <i>Urgent matters short of ER</i> <i>Not personal physician - doesn't know patient</i>
04	<b>Emergency Room</b> <i>Can't turn anyone away</i>
05	<b>Private Office</b> <i>"Medical Home"</i> <i>Primary care providers</i> <i>Consistency of care provides better care</i>

### \* Patient - Doctor Relationship

The patient - doctor relationship is strongest and most important with the medical doctor in the private office, also known as the Medical Home.

# EHR Experience Survey Results

## 2-3 hours extra per day

*46.70% of doctors spend at least 2 extra hours a day completing their patients' electronic record.*

## Plateau of Efficiency

*75% of doctors feel they will not get any quicker with EHR no matter how comfortable they get with it.*

## Paper Charts > EHR

*70% of doctors feel they could see more patients in a day with paper charts than EHR.*

## Dissatisfaction

*43.40% of doctors are either somewhat or very dissatisfied with EHR.*

*15% are neither satisfied nor dissatisfied.*

## Unintuitive

*85% of doctors find the current EHR system to be unintuitive.*

## Cumbersome

*80% of doctors find the current EHR system to be cumbersome.*

## Illogical

*60% of doctors find the current EHR system to be illogical.*

## Excessive Clicking

*85% of doctors find the current EHR system to contain excessive clicking.*

# What are the physicians saying?

## Efficiency

"I'm sick of scrolling down page by page; sick of checking off a million little boxes. All the time spent on medical documentation cuts down on physician efficiency."

**Dr. Lloyd Minor**  
Dean, Stanford Medical School

## Burnout

"54% of physicians reported at least one symptom of burnout. A higher risk of burnout is linked to frustrations with the data-entry workload of EHRs."

*Mayo Clinic Study*

## Patient Satisfaction

"This has resulted in decreased and lower quality face time due to the need to look at a screen. The end result is either a rushed visit, with attendant patient and doctor dissatisfaction, risk for errors, omissions and/or inevitable delays in the office patient flow as I try to catch up. I often take the patient care path and leave dictation and charting for home in the evenings."

**Dr. Jerome Seid**  
St. John Hospital

## Productivity

"Over the last three months, since EHR implementation, my clinical productivity — my ability to take care of patients — has dropped by about a third. People's health is endangered."

**Marie-Elizabeth Ramas**  
Mercy Medical Center Mount Shasta

## Excessive Clicking

"I cannot stand the 400 clicks it takes to finish a patient visit. Processes are set up for data collection for other users- like billing or research- but not set up for a natural flow of an office visit."

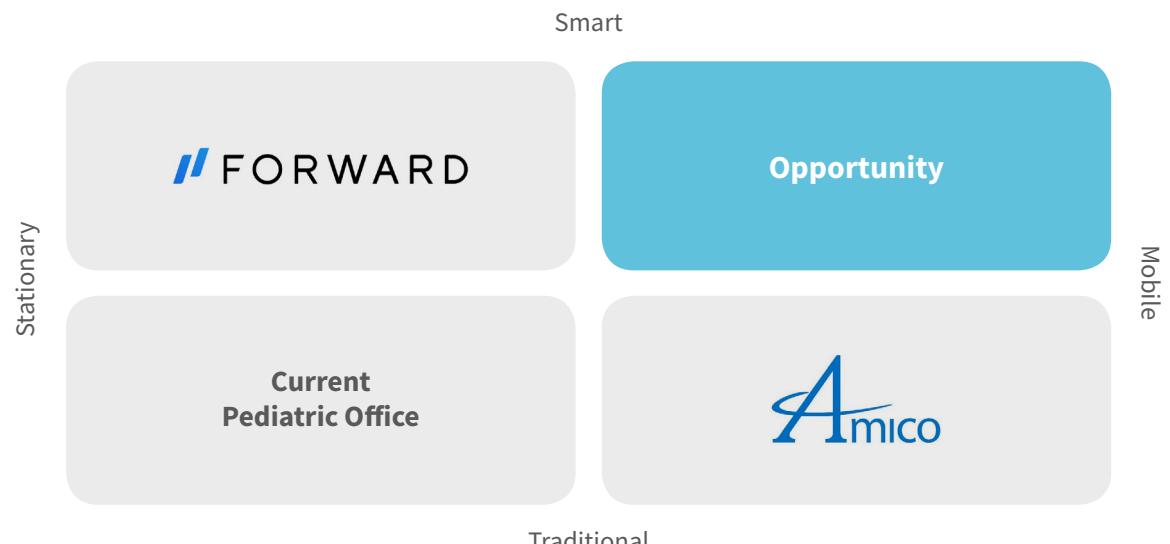
**Dr. Corinne Lehmann**  
Cincinnati Children's

## Mobility

"I'm juggling my laptop, mouse, and otoscope / ophthalmoscope heads so inevitably something always falls to the floor (usually my mouse) as I make my 'grand entrance' into the exam room. Then I have to find a place to put the laptop (but away from little curious, sticky hands) so that I can face the parent and/or patient."

**Dr. Elizabeth Panzner**  
Union Pediatric Medical Group

# Competitive Landscape



## Opportunity

A smart, mobile pediatric workflow solution is the next evolution in primary health care. With medical records now being digital, it only makes sense that the tools physicians use follow suit. Smart tools that can communicate with each other and the EHR platform as a whole would relieve the doctor of most of the manual data entry required to complete a chart.

It is time to leave the days of dead batteries, missing tools, and countless hours of documentation behind us. Today's physicians need a mobile, efficient, and adaptable workspace and technology needs to be implemented into the pediatric office in an unobtrusive manner.



## Forward

Forward is a 24/7 membership based primary care provider. Using state of the art technology, members can build a 3D model of their body and analyze body composition, measure resting metabolic rate, and create an ECG. Members can spend 60 minutes with their doctor reviewing real-time blood tests, discussing their medical history, and setting their preventive plan. Forward is smart and innovative but stationary, expensive and not ideal for a pediatric office.



## Current Pediatric Office

The current pediatric office is in high demand of a technological upgrade as the traditional doctor's office is not designed for the recent implementation of EHR. With the introduction of the computer into their toolbox, physicians are now turning their back to the patient in order to take their notes. The traditional tools also need an upgrade in order to integrate smoothly with the EHR so the doctor doesn't have to manually input all of the patients' data.



## Amico Hummingbird

Since EHR implementation, physicians have been on the market for a mobile solution to help carry all of their tools and more specifically their laptop or tablet. The Amico Hummingbird is a cordless medical workstation that recharges in each exam room as it travels through the halls of the office/hospital. This workstation is great reference for mobility but it is still lacking a lot of features needed to offer a wholistic, connected experience.

## Solution Requirements

Mobile | Efficient | Unobtrusive

## Problem Statement

How might we streamline and make more efficient the pediatric workflow so physicians can spend less time on their charts, and more time with their patients?

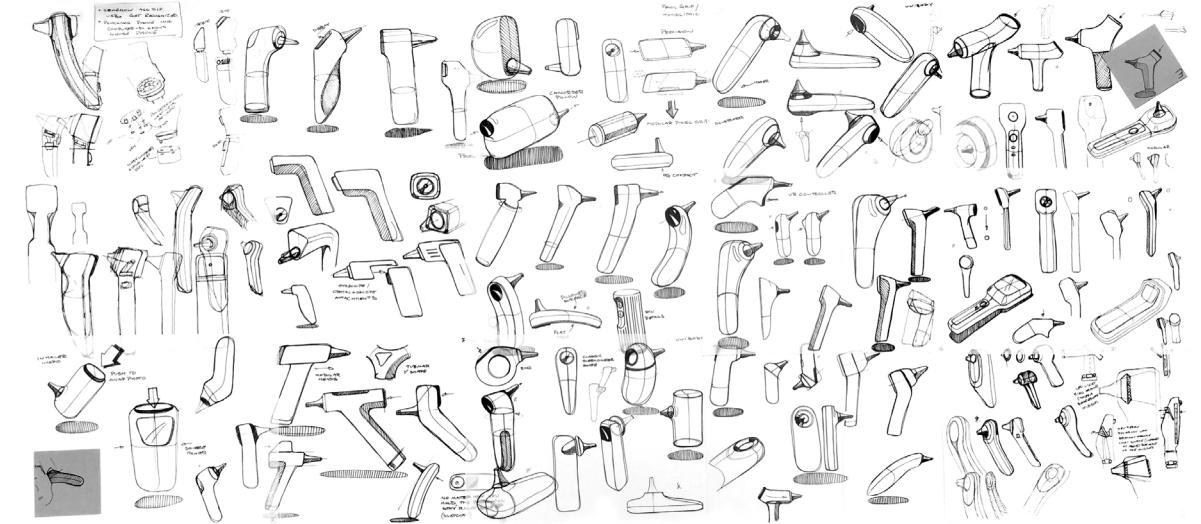
## 02 Design Development

## Inspiration



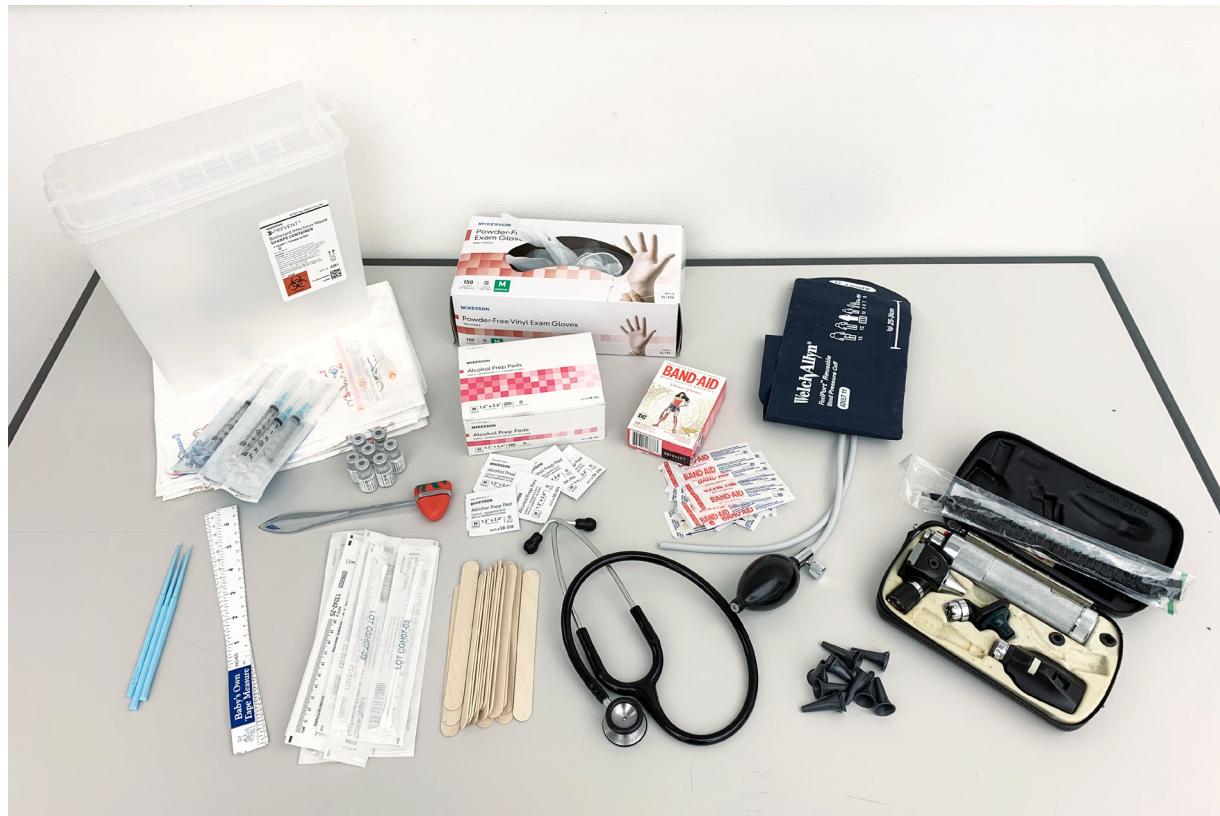
These products should feel like precision instruments that physicians can trust but at the same time, because they live in a pediatric office, they need to feel approachable and comforting to young patients.

## Tool Sketch Development

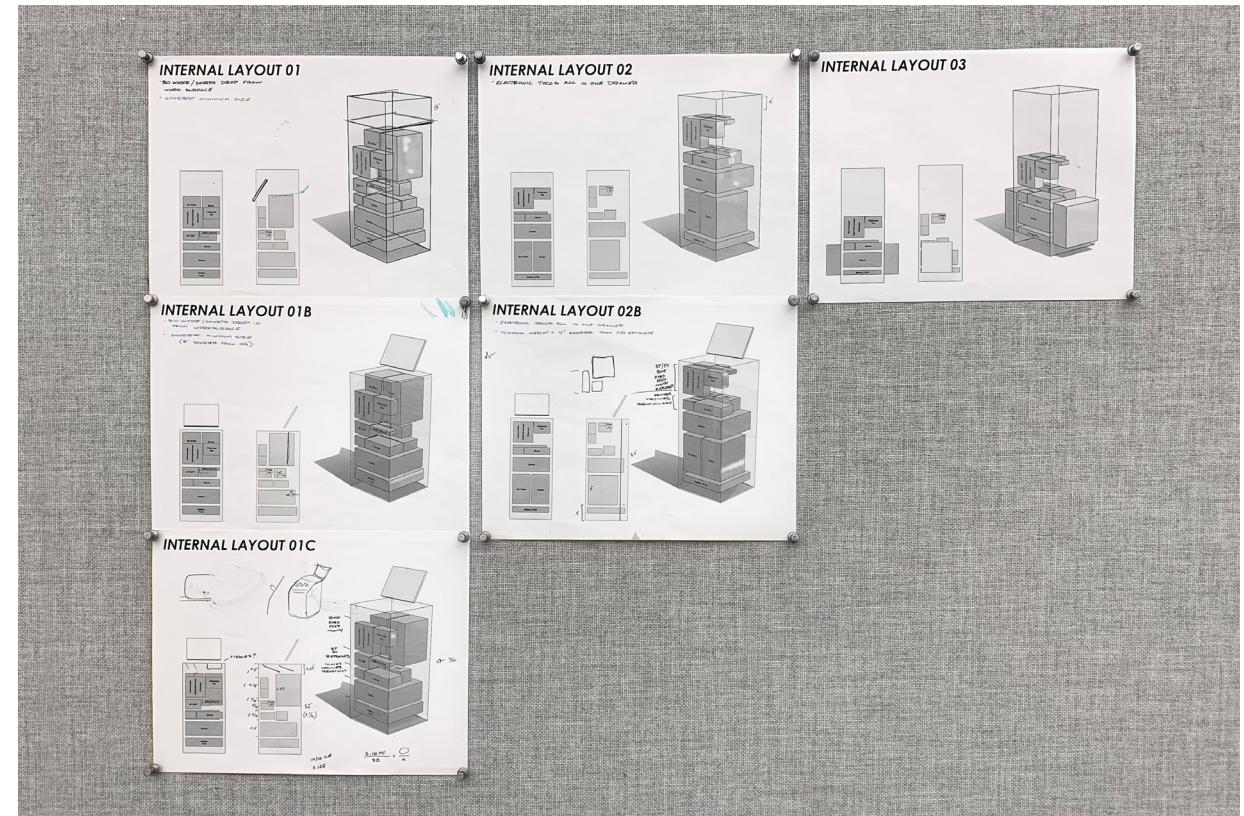


## What goes inside?

## Internal Exploration



Looking into all the tools pediatricians use and which are used for every exam, sick and well, was crucial to determine the overall volume needed for the workstation. Items such as throat culture swabs were ultimately left out because they are only used for sick visits and can be stored at the nurse's station.

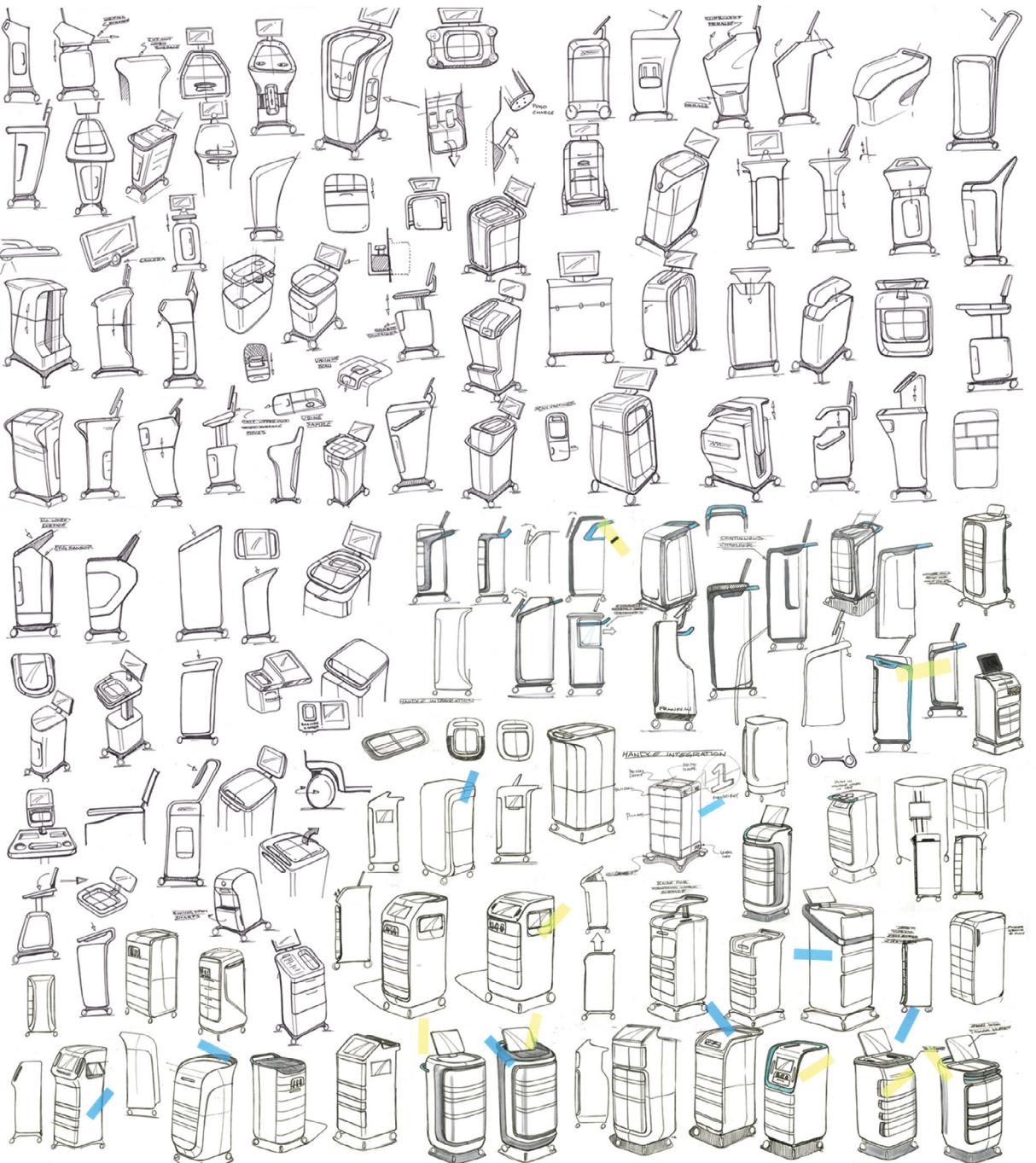


A few internal layout architectures were explored in order to find the best arrangement of tools and supplies for the workflow of the pediatric exam. A main consideration was the location of the sharps and biowaste containers as well as ensuring close proximity of the electronic devices to simplify the inner workings of the workstation.

## Rough Sketch



The rough sketch phase involved sketching over the different internal layout concepts. Focusing on the first read, this phase explored a variety of forms and proportions. Using blue tags for overall form and yellow for details, an internal ID review with classmates helped down select ideas heading into the refined sketch phase.



## Volumetric Models

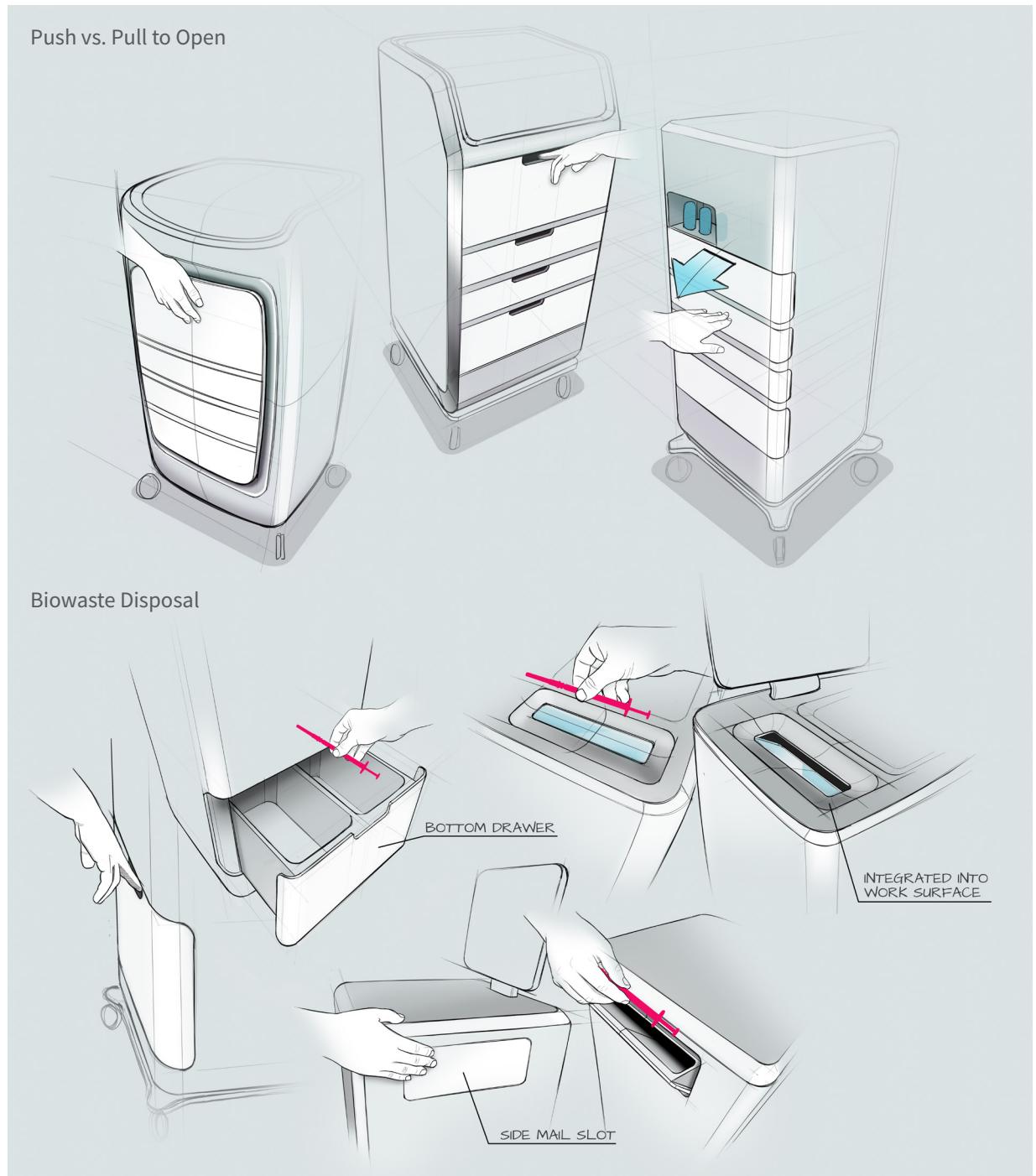


## Refined Sketch



During the refined sketch phase, it was important to talk to the physicians who would be using this workstation. A deck was sent out to about 30 physicians to get their feedback on overall form and various details and functional features. Dr. Ashton came to the studio to have an in depth conversation about each of the concepts (shown in the upcoming pages) and the volumetric studies. Through physician and internal ID feedback, the overall form of Concept 03 was selected to move forward with some features from the other two concepts.

\*See appendix for complete physician feedback results.



## Concept 01



### Overview

This concept takes on a softer form but an overall more precise aesthetic. The display integrates seamlessly into the waterfall on the front surface. Three of the five electronic tools sit exposed on top of the work surface for easy access. The raised work surface creates a grove for a subtle handle that allows for 360 degree mobility. Located on the left and right side of the body, two mail slots are present for sharps and biowaste disposal.

### Pros

- Clean, compact form
- Biowaste mail slots away from children
- Visual interest with handle

### Cons

- Display sits too low / seems too important
- Exposed tools not any more important than other tools
- Handle is a huge dust trap

## REFINED SKETCH 01



## Concept 02



### Overview

Concept 02 is the most precise form with hard edges and a large continuous chamfer running around the form. The display sits out of the way on top of the deep, contained work surface. Multiple handles offer 360 degree mobility allowing the physician to grab the workstation from any direction/orientation. The sharps and biowaste containers are housed in the bottom drawer. All drawers are pull-to-open.

### Pros

- Multiple grab points for 360 mobility
- Contained work surface
- Display at appropriate height

### Cons

- A lot of visual commotion
- Biowaste inconvenient/ unsafe location
- Not approachable enough

## REFINED SKETCH 02



## Concept 03



### Overview

Being the most visually approachable, concept 03 embraces the combination of soft surfaces and crisp edges. The push-to-open drawers are isolated on a floating island to draw attention to the importance of the tools/supplies. The sharps disposal is located conveniently on the top work surface while the biowaste disposal is off to the side. The push handle on the back of the workstation blends smoothly into the rest of the form.

### Pros

- Approachable form
- Tools highlighted as main feature
- Easily cleanable

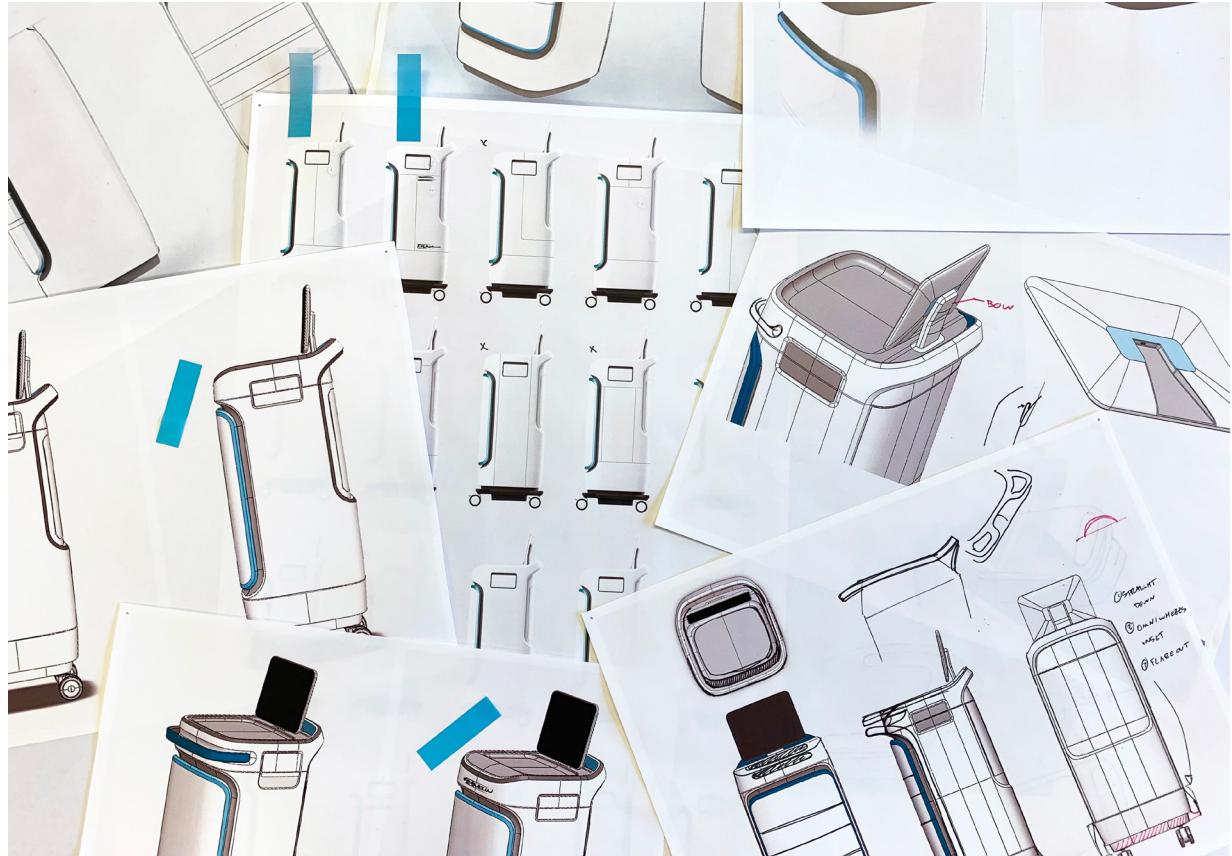
### Cons

- Sharps disposal muddies up work surface
- Only one handle grab point
- Currently no display mount solution

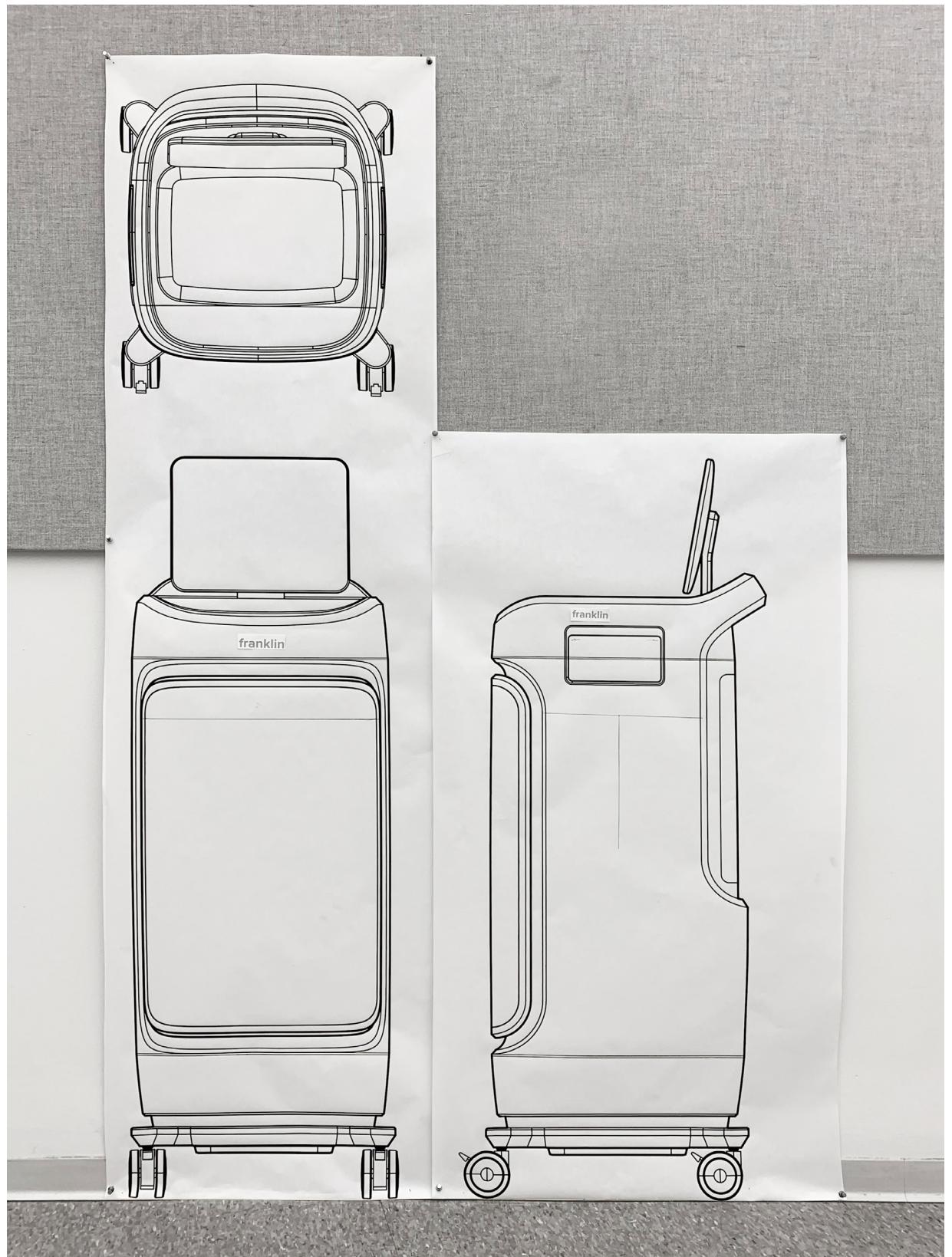
## REFINED SKETCH 03



## Rough Model



The third read was developed in the rough model phase. The tablet mount, parting lines, biowaste disposal and the push handle were all carefully considered and explored. Based on physician feedback and ID preference, the floating drawer front developed into a functional feature to allow the doctor to adjust the workstation while in a seated position. Full scale orthographics were generated to confirm overall proportions.



## 03 The System

## The System

Franklin Health Systems creates an all-in-one pediatric workstation that allows physicians to focus less on their charts and more on the “Art of Medicine.” Within the drawers of the workstation are five smart, connected tools that automatically upload data to the patients health record via bluetooth. By integrating technology into the pediatric workflow in an unobtrusive manner, Franklin Health Systems embraces all the benefits of electronic health records and provides physicians with the tools they need to easily analyze their patients’ data. We understand that healthcare is more than the data; it is about human connection and trust. That is why we utilize artificial intelligence and its ability to understand the natural flow of human conversation so physicians can focus on having real, unscripted conversations with their patients and their families while the note writes itself.

## Office Flow

Thanks to the mobile workstation, physicians no longer have to stock each exam room with tools and supplies. A team of one nurse and one doctor can easily handle three exam rooms with two workstations. This allows smaller, private offices to cut their costs by not having to buy a set of tools for each exam room.

## BrightInsight

Franklin Health Systems is powered by BrightInsight and their ability to manage connected devices and integrate with EHRs as well as their advanced quality, security, privacy and compliance processes and tools.

*“[EHR has] the ability to change the care system. Once the electronic system is in place, it serves as a platform for change in a way that was not possible on paper.”*

**Dr. Andy Spooner**  
Cincinnati Children's



## EHR Tablet

*“We just click ‘normal’ now, well what does that mean? Or if there’s a skin lesion, pictures of those are very much more helpful than a description.”*

**Dr. Arnold Strauss**  
Cincinnati Children's

### Easily Removable/ Mountable

The tablet is the most portable option for physicians and their team. Rather than use a laptop or fixed display, Franklin Health aims to embrace all of the benefits of EHR. The quick release mechanism allows physicians to take photos of any rashes or skin lesions and upload them to the patient's chart to be referred to later or examined by other care providers.

### Battery Life

Thanks to inductive charging technology, the tablet will charge as long as it is mounted to the workstation resulting in an exceptionally long battery life.

### Zero Manual Data Entry

In addition to smart, connected tools, Franklin Health utilizes artificial intelligence and its ability to understand natural conversation to dictate any notes and important information that can not be recorded by the other tools in the system. The nurse's station and each doctor's private office are equipped with additional desktop workstations to review and make any changes to patient charts.



## Tablet Display



## Tablet Mounting Surface



## Drawer 01

### Thermometer

The temporal thermometer is a non-invasive tool used to measure body temperature with a simple stroke across the temporal artery in the forehead. Using advanced infrared technology, the temporal thermometer provides maximum ease of use and quick, consistently accurate measurements that can then be automatically uploaded to the patient's EHR.

**Output:** Metric

### Ophthalmoscope

The ophthalmoscope is used to examine the back part of the eye (fundus), which includes the retina, optic disc, choroid, and blood vessels. It has a light and different tiny lenses that allow the provider to view the back of the eyeball. Currently, doctors have to describe what they see via written word or check boxes. The Franklin ophthalmoscope allows physicians to capture a photo that is automatically uploaded to the patient's chart.

**Output:** Photograph

### Otoscope (+ Specula)

The otoscope is used to look into the ears to screen for illness during regular check-ups and also to investigate ear symptoms. This instrument is designed for visual examination of the ear canal and tympanic membrane or eardrum. With an embedded camera/LED module and a reciprocal mirror, the Franklin otoscope has the ability to capture photos in an effort to limit the amount of the manual data entry the physician has to enter.

**Output:** Photograph



*Thermometer*



*Ophthalmoscope*



Otoscope



## Drawer 02

### Blood Pressure Monitor

Now that health records are digital, physicians can utilize electronic blood pressure monitors effectively. The compact form sits neatly within the workstation and automatically uploads the patient's blood pressure to their chart when the process is completed.

**Output:** Metric

### Pulse Oximeter

Pulse oximeters measure a patient's oxygen saturation. By passing two wavelengths of light through a body part (usually a finger tip) to a photodetector, this device can measure the proportion of oxygenated hemoglobin in the blood in pulsating vessels.

**Output:** Metric

### Tongue Depressors

Often used with the light from the otoscope or ophthalmoscope, tongue depressors are used to depress the tongue to allow for examination of the mouth and throat.



*Blood Pressure Monitor*



Pulse Oximeter



## Drawer 03

### Reflex Hammer

A reflex hammer is used to test deep tendon reflexes. Testing for reflexes is an important part of the neurological physical examination in order to detect abnormalities in the central or peripheral nervous system.

### Vaccine Prep

When administering a vaccination, the nurse will obtain the syringe and vaccine vial from the nurse's station but the other required supplies are located in this drawer.

**Gloves** must be used where there is reasonable anticipation of employee hand contact with blood, other potentially infectious material, mucous membranes, or non-intact skin.

**Alcohol Prep Pads** are used to disinfect the skin prior to injections in order to prevent infections caused by bacteria on the skin being injected within tissue.

**Band-aids** are used to seal the breach of skin to prevent microorganisms from entering the body and to stop any minor bleeding if any.



## Biowaste Disposal



### Sharps

After administering a vaccine, it is important to dispose of the syringe and needles in a safe and clean manner. Located on the left side of the workstation, sharps can be disposed of into the push-to-open mail slot indicated by the name identifier “sharps” and the entry lid.

### Biowaste

All other biowaste can be disposed of through the mail slot on the right side of the workstation indicated by the name identifier “biowaste” and the lack of an entry lid. Biowaste materials fall into a secure biowaste container that can only be accessed by the care team.

### RFID Secure

Using RFID magnetic locks, the biowaste containers are safely guarded from curious young children. Sensors inside the biowaste alcove will alert the connected tablet when approaching full capacity. Any member of the care team can then scan their badge to unlock the access panel and retrieve/ replace the containers.





## Drawer 04

### Paper Gowns

Disposable paper gowns are worn by patients during the physical exam so that physicians can easily access the part of the patient's body being treated. The gowns are conveniently stored in the bottom drawer.



## Charging Dock

### Charging Dock

Located in the nurse's station, the charging dock offers a place for the workstation to spend the night. Because the tools are not drawing much power from the internal battery, the workstation can last a whole day off one charge. When the physician rolls the workstation over the dock, the cart will enter sleep mode and begin refueling via conductive charging.





## 04 Appendix

## EHR Experience Survey

Survey sent to 300 doctors.  
Responses: 60

### 1. What is your age?

25-29	0%
30-39	25%
40-49	8.3%
50-59	41.7%
60+	25%

### 2. How long have you been a healthcare provider?

<5 years	0%
5-9	16.7%
10-19	15%
20-29	40%
30-39	25%
40+	3.3%

### 3. Which EHR platform do you use/have used before?

This was the most difficult question to answer – frankly, I wouldn't know where to begin. This question was also the last one I answered, so maybe you can get the gist from the other answers.

### 4. Do you think EHR is...

Cumbersome	80% - Yes
Intuitive	85% - No
Logical	60% - No
Excessive Clicking	80% - Yes

### 5. How satisfied are you with the EHR you use?

Very dissatisfied	16.7%
Somewhat dissatisfied	26.7%
Neither satisfied nor dissatisfied	15%
Somewhat satisfied	31.7%
Very satisfied	10%

### 6. On average, how much time, per day, do you spend after hours completing your electronic charts?

< 1 hour	25%
1-2	28.3%
2-3	26.7%
3-4	13.3%
4-5	3.3%
5+	3.3%

### 7. Do you feel you've reached a plateau of efficiency? (No matter how comfortable you get with the EHR, it still takes you just as long to complete).

Yes	75%
No	25%

### 8. Do you use dictation to fill out your electronic charts?

Yes	13.3%
No	86.7%

### Do you use a scribe to fill out your electronic charts?

Yes	1.7%
No	98.3%

### 10. Do you feel you could see more patients in a day with EHR or paper charts?

EHR	30%
Paper Charts	70%

### 11. Are you willing to have a follow up conversation about your EHR experience? If so, please provide your name and email address.

Yes      32 responses

### Online Articles

#### EHR Use

Use of Electronic Health Record Systems by Office-Based Pediatricians - [pediatrics.aappublications.org](http://pediatrics.aappublications.org)

#### Workflow

Top Physician EHR Issues Disrupting Clinical Workflows - [ehrintelligence.com](http://ehrintelligence.com)

25 Quotes That Show Just How Fed Up Physicians Are With EHRs - [dolbey.com](http://dolbey.com)

40% Of Physicians See More EHR Challenges Than Benefits - [ehrintelligence.com](http://ehrintelligence.com)

#### Patient - Doctor Relationship

EHR Use Shown To Negatively Impact Patient-Provider Relationship - [ehrintelligence.com](http://ehrintelligence.com)

EHRs Are Ruining The Physician-Patient Relationship - [medicaleconomics.com](http://medicaleconomics.com)

EHRs Steal Primary Care Doctors Face Time With Patients, Study Finds - [healthcareitnews.com](http://healthcareitnews.com)

#### Burnout

Electronic Health Records Key Driver Of Physician Burnout - [www.the-hospitalist.org](http://www.the-hospitalist.org)

The Doctor Is Out? Why Physicians Are Leaving Their Practices To Pursue Other Careers - [nbcnews.com](http://nbcnews.com)

#### Patient Safety

Pew: EHR Usability Concerns May Still Impact Patient Safety - [healthitanalytics.com](http://healthitanalytics.com)

## EHR Experience Survey Follow Up

**Dr. Elizabeth Panzner**  
Union Pediatric Medical Group

### You've been a health care provider for 30-39 years. What has changed in the field since you began your career?

A variety of new vaccines have been developed and introduced in our armamentarium and as a result we have seen a dramatic reduction in vaccine preventable diseases – a very gratifying change. However, the availability of the internet has been another change which is a “double edged sword” for the pediatrician. Parents are much more protective and parents are seeking more information online than ever before. It is a challenge for parents to separate facts from fiction and “Googling” medical issues create unnecessary anxieties. One of the biggest challenges a pediatrician faces now is acceptance of vaccines – a very frustrating change.

### Are there any new / other responsibilities such as checking your in-basket or email that slow down your process?

In-basket and email is a nightmare – as I write this I have over 250 unread emails going back 2 months. I just don't have the time, nor the inclination to read through them in a timely manner. I am, however, compulsive about clearing the in-basket because that is related to patient care. This too, is time consuming because the information you get through the in-basket has to be annotated in the patient's EMR.

### Can you elaborate on what makes EHR so cumbersome, unintuitive and illogical? What would you change about it?

This was the most difficult question to answer – frankly, I wouldn't know where to begin. This question was also the last one I answered, so maybe you can get the gist from the other answers.

### You mentioned you are somewhat dissatisfied with the EHR. Is that primarily due to it being cumbersome, unintuitive and illogical or are there other factors? Is there anything you DO like about it?

Once a patient's paper chart is abstracted, it gives me such satisfaction to see the medical record organized in an orderly manner. However, it is very time consuming since you have to take the time to be accurate. EPIC is such a robust system and to this date, I still don't know all the functionality. For example, I would like to edit some of my templates or make my own templates. I haven't been able to do this efficiently, and there really isn't anyone I can readily contact to help me - when I need them or have the free time.

### You spend 5+ extra hours a day completing your patients' records. Is that really extra hours spent after work or does that number just reflect the extra time spent throughout the day? Have you tried any solutions or made any sacrifices to help you reduce the extra amount of time you spend on your patients' records?

Mostly this reflects extra time spent throughout the day in between patients. Whereas in the past, I would use that extra time between patients reading journals (either online or paper), now I am so behind on my readings. I can't say that I can catch up on the weekends because I am still using that free time to do patients' paper chart abstractions. I will not take my daily work home at the end of the day; I complete the patients record before the end of the day.

### Is dictation reliable?

Very much so and it is one of the features I like. It is surprisingly accurate, except for capturing doctor's names. I typically do not dictate in front of the patient/parent because it is too distracting for me, trying to formulate my thoughts in

an examining room that may have 2-3 screaming kids, BESIDES the patient. Instead, if the visit requires a dictation, I wait until the end of the visit to go in my private office to complete the dictation of the chart. If the visit does not require dictation, then I complete the chart outside of the exam room at the nurses' station before I see the next patient. The one thing I regret not having is wireless dictation. At the time we were set up with EPIC, wireless dictation wasn't available to us. If I had wireless dictation, then I think I would be able to dictate at the nurses' station; this probably could be a time-saver.

### Why do you feel you've reach a plateau of efficiency?

I have been unable to see more than 15 patients/day. I believe if I can modify my templates and clear up some of the cluttered information that is in them, I could improve my efficiency.

### Does the EHR, physically or otherwise, get in the way of your relationship with the patient?

Yes! I go in the exam room with my laptop, mini-mouse (because I'm so spastic when I use that little red button on the laptop that acts like a mouse – that the cursor arrow travels all over the screen – but with my mini-mouse I have better control, but more clutter in my hand) and otoscope and ophthalmoscope head. So I'm juggling all these things as I'm entering the room and invariably something falls to the floor (usually the mini-mouse) as I make my ‘grand entrance’ into the room. Then I have to find a place to put the laptop, (but away from little curious, sticky hands,) so that I can face the parent and/or patient. I'm still looking for a good computer table on wheels. I haven't found one I like – one of the problems with that is that the legs/wheels stick out too much and with kids in the room they can trip on it and I can just see my whole setup come crashing to the floor.

### On average, how many patients do you see in a day?

15

### What is it about paper charts that makes you feel like you can see more patients in a day than you can with EHR?

I was not documenting as much as I am with EHR and that, in retrospect is a negative. So with EHR there is most certainly a lot more extraneous information, but it might not necessarily be meaningful information.

### Additional comments / questions?

Will you be keeping us informed of your progress? Best of Luck Jack! I feel your success may also be ours.

**Dr. Phil Scaduto**  
Scaduto and Renz

### You've been a health care provider for 30-39 years. What has changed in the field since you began your career?

The changes in the daily practice of medicine have been stunning. Computerized health care records in the hospital and office have significantly altered the flow of how an office visit is conducted, sadly almost entirely for the worst. While the technology changes in medicine have also come fast, they have been logical and progressive, whereas the EMR has been forced on all of us before it was really ready and consequently has adversely affected the practice of medicine.

**Are there any new / other responsibilities such as checking your in-basket or email that slow down your process?**

Many things slow us down- the in basket is not too bad, but other items like the extensive documenting of data during the visit required for payment, getting approval for certain drugs and tests, and other insurance hassles are major issues.

**Can you elaborate on what makes EHR so cumbersome, unintuitive and illogical? What would you change about it?**

We are on a system called Epic, which is absurdly complicated. None of the basic aspects of medical charting are easy or intuitive. Refilling meds, completing a note, responding to messages, etc. all require many more clicks than necessary. A big problem is the ridiculous level of data entry required to complete a visit. I would make it very simple to use and intuitive and I would reduce the amount of documentation required.

**You mentioned you are very dissatisfied with the EHR. Is that primarily due to it being cumbersome, unintuitive, and illogical or are there other factors? Is there anything you DO like about it?**

The only thing useful is the ease to access most records on the patient and those from other providers. Every other aspect of recording a visit takes more time.

**You spend 1-2 hours after work completing your patients records. The average response is 2-3 hours. Other than using dictation, have you tried any other solutions or made any sacrifices to help you reduce the extra amount of time you spend on your patients' records? Is dictation reliable?**

I do dictate and that helps a lot. Because of the way the system is put together, I and my colleagues do not see other ways to improve the efficiency.

**Why do you feel you've reached a plateau of efficiency?**

Yes- for the most part. I may get a little more adept over time, but not enough to ever like it.

**Does the EHR, physically or otherwise, get in the way of your relationship with the patient?**

Yes it is a major intrusion. It prevents me from maintaining eye contact and giving each patient the personal attention they deserve. It is like having 2 patients in the room at the same time.

**On average, how many patients do you see in a day?**

18-19

**What is it about paper charts that makes you feel like you can see more patients in a day than you can with EHR?**

It was much simpler and much less time consuming- it's not just the EMR but what is expected to be recorded. 90% of today's EMR office notes are worthless; they are long, filled with meaningless filler required by the payers, and much less informative than notes from the past. They take more time to read through to get the salient reason for the visit and treatment advised.

**Dr. Andy Spooner**

Cincinnati Children's Hospital

**You've been a health care provider for 30-39 years. What has changed in the field since you began your career?**

(1) Onset of Evaluation and Management documentation requirements in the mid- to late-90s, (2) Constant and ongoing shift of care to outpatient context, (3) Greatly increased supervision of trainees [residents, students], (4) Giant boost in sophistication of tools used to manage patient information, including, but hardly limited to, EHRs, (5) Big leap in the specificity of genetic data that can be used to tailor treatment or render prognoses

**Are there any new / other responsibilities such as checking your in-basket or email that slow down your process?**

I'd hesitate to characterize that as "slowing down" without a clear comparison. When I graduated from medical school in 1988, email was a niche application that users of America Online or CompuServe used in a very limited context. It was legitimate to ask if someone "did email" in those days. Now, it's assumed that everyone has multiple email addresses and that they can be used in reliable, professional communication. Is checking one's email in-basket "slowing me down"? It depends on what one is comparing that to. Clearly, email is much faster than paper mail or phone calls. But the reduced overhead—that is, the greater ease by which email messages can be sent—result in a much greater volume of messages than what could be sustained by paper mail or phone conversations. If I had to manage all the communication I manage today on paper, electronic is MUCH faster. Conversely, if I got the number of communications today that I would have received in 1988, I'd have a lot more time on my hands to do other things. Is this bad? No, just different. Today we live in a much more information-rich environment, which is good and bad.

As for responsibilities outside of the email context, like patient information, yes, there is more information there, too. It is no longer acceptable to think of information as too hard to access. In the "old days," we often worked with missing information, and made reasonable assumptions to fill the gaps. Now, we can fill the gaps. More work? Yes. Better patient care? Yes. One must master new skills to manage the increased volume of information. No one promised medicine would be easy, or would get easier with time.

**You mentioned EHR is cumbersome and unintuitive, yet logical. Can you elaborate on why you feel this way? What would you change about it?**

If you compare the software development process of an application like Microsoft Word to that of an EHR, it's obvious there are some big differences. Word is complex, but it has one basic function: To create printable documents. Word gets updated continuously, but major additions of features occur only once every couple of years, and the rate of adding features seems to be slower and slower as the application gets saturated by everything we know to do with document creation. I predict the Word of 2028 will seem familiar to 2018 users. If you look at EHRs, we are not yet to the feature saturation point. We might be happier—one is tempted to thin—with a very simple EHR, where the developer intentionally limits features. But the market cannot support this; companies have tried and failed to sustain a product offering of a simple EHR at scale. Individual docs have programmed their own simple EHRs, but even those garage projects have a steady upgrade process. The guy who creates his own EHR is adding features intentionally based on his own identified needs. The software company that creates an EHR has a much tougher mission: to improve the product for a very heterogenous user base, with an essentially insatiable desire for more functionality. One doc's indispensable feature is another's pain in the neck. Combine this complexity with the phenomenon of constant feature change and you get a usability problem.

If we could reduce heterogeneity of practice, we could get to more usability, but this is a useless association. We often hear about how fabulous the old VA electronic system is (soon to be replaced by Cerner). The VA system is relatively crude. Physicians who work in the VA system grew up using it, and got very familiar with it. Because development resources were limited, it did not change as fast as a commercial system. And there was a stronger sense that the users were in charge of feature change requests, because it was not created by someone outside the VA system. This string of observations is also useless, since it would be foolish to try to replicate such an unsustainable situation (did I mention this system is going to be replaced by Cerner?). The Vanderbilt University EHR story is similar. They had a home-grown system. The users felt they

were more in charge of how it worked. They had some cool gizmos set up in that system. But they replaced it with Epic after they realized it was not sustainable; it was impossible to keep up with the regulatory requirements and expansion of the system to accommodate an increasingly complex medical center.

The best action we can take is to reform the Evaluation and Management documentation rules to better reflect the electronic world. Just as we now assume everyone has email, we can assume most everybody has an EHR, and we should shift the incentives for payment away from long documentation to accurate but very limited data collection. For example, for a simple ambulatory complaint, what more do we need than a chief complaint, a diagnosis and a record of any prescriptions written to document care? And for complex cases, what more do we need than an attestation of the time spent and a general description of what was discussed?

**Although you find EHR to be cumbersome and unintuitive, you are very satisfied. What are some pros and cons to EHR? Anything you DO NOT like?**

- Pros
1. Access, access, access. Having the info is the best thing about the EHR world.
  2. Data recording as a by-product of work processes. When you write an order or a prescription, it is saved indefinitely, and can be used to put together a timeline of care.
  3. The ability to organize care in a way not possible with paper.
  4. The ability to change the care system. Once the electronic system is in place, it serves as a platform for change in a way that was not possible on paper.

- Cons
1. EHRs seem to drive most people to write a lot, out of fear they will not be able to justify their actions for the purpose of payment.
  2. The tremendous overhead entailed by EHR maintenance. No one seems to know how to tamp down the demand for more features. Until then, we hire a lot of folks to work on those features.
  3. When one moves to a new practice situation, one must learn a new EHR. In my younger days I did a lot of moonlighting, where I practiced in various locations. Not sure I could do that now.

**You only spend less than an hour extra completing your patients' records. The average response is 2 extra hours. What's your secret? Have you tried any other solutions or made any sacrifices to help you get down to zero extra hours?**

I don't write much. I tend to be good at using the features of the EHR to find data and display relevant info without a lot of fuss.

**Does the EHR, physically or otherwise, get in the way of your relationship with the patient?**

No. Patients expect me to know their information. I make them a partner in viewing it. And despite their expectation that I know what's going on, they also expect me to be a nice human being, too. Medicine is a hard that way.

**On average, how many patients do you see in a day?**

When I practice, I see complex hospitalized patients. By "complex," I mean kids who have artificial airways, home ventilators, feeding tubes, multiple medications, multiple chronic problems. We cap our service at 10 patients, which is about as much as any attending can master when dealing with these kinds of patients.

**You are very satisfied with EHR and only spend less than an hour extra throughout the day yet you feel you can see more patients in a day with paper charts than you can with EHR. Why is that?**

If no one cared what I knew (because they knew I could not find anything) and all I had to do is put my signature below my resident's, of course I could move faster. That's what we had before. I would not want to go back to those days.

**Dr. Arnold Strauss**  
Cincinnati Children's Hospital

**You've been a health care provider for 40+ years. What has changed in the field since you began your career?**

Many things have changed, including the introduction of EHRs, remote access to patient information, and medical record documentation requirements. But, the most important changes have been discoveries of new drugs, therapeutic approaches, devices, and diagnostic tools that have improved patient outcomes and decreased morbidity and mortality.

**Are there any new / other responsibilities such as checking your in-basket or email that slow down your process?**

Not really. These actually facilitate patient care and communication with families and the provider team.

**You find EHR to be unintuitive but not cumbersome or illogical. Other than finding it unintuitive, this response is opposite of most Epic users. Can you elaborate on why you feel this way?**

The EHR follows a typical history and physical examination format from the paper record days, so is logical to me. Check boxes and smart phrases allow rapid responses, making it less cumbersome than old written records.

**The survey results show that EHR is less popular with older doctors yet you are very satisfied. What is it about EHR that you like so much?**

It is logical and allows rapid completion.

**You spend less than an hour extra per day completing your patients' records. The average response is 2 hours extra. What's your secret? Have you tried any other solutions or made any sacrifices to help you get down to zero extra hours?**

Nothing special. Dictation efficiency depended very much on the transcriber expertise, which was often less than ideal.

**Why do you feel you've reached a plateau of efficiency? Is it purely because of the manual data entry? Do you think dictation or a scribe would be useful?**

No, I do not think dictation would be useful. A scribe might help, but I prefer to document myself to save review and correction time.

**Does the EHR, physically or otherwise, get in the way of your relationship with the patient?**

I complete my EHR after the patient visit, not during it. So, there is no interference with communication.

**On average, how many patients do you see in a day?**

My usual specialty schedule is 12-15/day.

**What is it about EHR that makes you feel like you can see more patients in a day than you can with paper charts?**

Standardization and smart phrases.

**Dr. Corinne Lehmann**  
Cincinnati Children's Hospital

**You've been a health care provider for 20-29 years. What has changed in the field since you began your career?**

Electronic medical records and more technology in medical care in general. Also having to check outside medical databases to provide care, such as the OARRS program to provide controlled substances through the state of Ohio would be one example.

**Are there any new / other responsibilities such as checking your in-basket or email that slow down your process?**

Of course. Everyone expects instant answers to email messages or EPIC messages. In the older days, if the message was urgent, you were called or paged. Now everyone just sends an electronic message but without regard to how urgent it is. It is frustrating for clinicians to sort through >100 messages a day to figure out which one is urgent, and then patients are put at risk if an urgent message is missed.

**Can you elaborate on what makes EHR so cumbersome, unintuitive and illogical? What would you change about it?**

I cannot stand the 400 clicks it takes to finish a patient visit. Processes are set up for data collection for other users- like billing or research- but not set up for a natural flow of an office visit. You should come and watch me chart a visit- you would laugh or cry on how clunky it is. EHRs were set up without consulting the actual providers that use it.

**You mentioned you are somewhat dissatisfied with the EHR. Is that primarily due to it being cumbersome, unintuitive and illogical or are there other factors? Is there anything you DO like about it?**

Yes- the EHR is well set up for providers who do similar things over and over again- like a surgeon performing the same operation frequently. In primary care, we could encounter a thousand different types of visits. Then we have to free text, and then EHR falls apart. Free text is no better than writing- and possibly slower. We don't have access to scribes due to cost in our area. Also, we have increasing requirements to complete flowsheets to collect data for billing and it is clunky and frustrating. Again- come see it and I will show you.

Also- the human factors. In the office, you are forced to sit at workstations that are generic. I have gotten carpal tunnel and back pain from this. I am short and the workstations are not the correct size for my frame. We also run out of computers for everyone in the office frequently. We now tell students to bring their own laptop.

Also- the computers freeze or run slowly or just break down on a regular basis. Staff do not pay attention to updating the computers, and then we lose time when updates need to happen in the middle of the office day. Remembering all of the passwords are maddening too.

Also pop up alert fatigue- too many pop ups. And not a good way to put your own "sticky note" to remind yourself of something about the patient you really want to remember the next time you have contact with that patient. You could do that in paper charts.

**You spend 2-3 extra hours a day completing your patients' records. Have you tried any solutions or made any sacrifices to reduce the extra amount of time you spend?**

The sacrifice comes at the expense of my family time, or my scholarship/research/administrative time. I will not sacrifice for patients. I have tried to create some smartphrases and visit templates- that helped. One development in last year that has helped is pre-visit charting. However, that is more work on the front end of the visit- so overall, not sure the time of charting visits decreased, but you feel more in control of the work flow with visit pre-charting- and hopefully getting things in advance that patients will need.

**Why do you feel you've reached a plateau of efficiency? Is it purely because of the manual data entry? Do you think dictation or a scribe would be useful?**

Heck yes a scribe or dictation would help. I have tried the dictation software a few times... I just did not think it was ready for practical use. Again, we are getting asked to check off more and more boxes for billing. If this institution would allow nurses to do more of that work, it would improve medical provider work flow for this.

**Does the EHR, physically or otherwise, get in the way of your relationship with the patient?**

Yes- you are pressed for time and you have to chart some of the visit in the room or you will never go home. Some of our office rooms are poorly arranged for computers on wheels (which is what we have).

**On average, how many patients do you see in a day?**

16

**What is it about paper charts that makes you feel like you can see more patients in a day than you can with EHR?**

It was quicker to read a paper chart. You could flip to the info you needed more quickly. Search engines in EHR is not good enough at this time. You could arrange the chart to your needs. EHR contain so many notes, especially if the patient was admitted, that are combined into our outpatient notes, and it makes it really hard to organize. When that happens, people ignore or don't even try to find the information. I think inpatient and outpatient notes need to be separated out in EHR.

**Dr. Julie Ashton**  
Franklin Pediatrics

#### Patient Satisfaction

There is a younger nurse in my office who has been trained with EHR. After a visit one day, the patient's mother came up to me expressing how uncomfortable she felt. She said the whole visit was very scripted and robotic and felt like they weren't being listened to.

#### Patient Trust

We have had adolescents with eating disorders hide weights under their gown to try and deceive the doctor about their actual weight.

#### Physician Burnout

My partner for the past 28 years is retiring earlier than planned because the extra hours charting has finally taken its toll. She feels it is not fun anymore, but rather a burden. She never even brings the laptop in the room with her because she feels it interferes with her relationship and discussion with the patient. So she enters the data after leaving the room and therefore also can't see as many patients.

## Interview Transcript

Interview completed with Margot Harknett, GRCD

### Dr. Arnold Strauss

Cincinnati Children's Hospital

Dr. Strauss: I think the biggest issue that has created problems, for example with your mom, is the increased requirements for documentation, period. So whether it was written or scribed or EMR, the requirements for documentation are what take time. And so then when it...so for example, a general pediatrician, 15 years ago, could see 100 patients a day but an EMR, if you fill it out yourself, even for a pretty simple visit, it's going to take at least 5 or 10 minutes. That creates the frustration of not being able to see as many patients and taking the time to...again whether it's written or electronic. For me, so I'm actually a general cardiologist which means that I do see general patients and it's out-patients right now although I've done in-patient work in the past. So it's very much like...somewhat like working in a pediatrician's office although the number of patients is fewer. So, you know, we started an electronic medical record when I was down at Vanderbilt then we came up here - and we implemented Epic, which is the most common by far - 8 or 9 years ago. And, you know, it's a difficult transition for some people but I didn't find it particularly difficult - especially when we have sort of learning/helper type people.

**Jack:** Do you think there are ways, though, even within the...because the transition for you, you said was pretty straightforward and simple but do you think there's still things that maybe could help increase your efficiency at all?

Oh absolutely. So epic is, as you may know, based upon very outdated coding. It's not a modern... so changing it or customizing it becomes problematic. And this is one of the big issues for any EMR is adapting it to the particular needs of a specialty or office. Various physicians [and] pediatricians, for example, do things very quite differently so customizing it or making it more efficient for the user, I think, still is the biggest issue. We here at Children's, because we're big and we were one of the first pediatric institutions and have a very strong informatics group, we're able to work with the company to customize it a little bit and that improved the efficiency for a lot of folks but there are still much, much better ways to do it.

**Do you think that transition would have been maybe a little more difficult had you been in a smaller practice without having the...**

Yeah because we had, and still have, I forget what their title is...Champions. So if I'm sitting there and, you know, some glitch turns up, I could call somebody and they could come and help me fix it and they're there on site. Where as in...I do see patients in a pediatricians office and I use the Children's EMR but, you know, there's nobody there that's really an expert..there's no IT experts. So yeah, if there's a glitch, it's more difficult to fix and it's more difficult to maintain for them if they're an independent practitioner. So one of the things that I think we, as an institution, should do, for example, for pediatricians is provide them with that support service or hotline and, you know, updating their equipment and all that kind of thing to make it more efficient. The thing that hasn't changed as much as I think it could, and should, is using voice. So some of the people still like to dictate and using voice activation is not as efficient because voice recognition it's not as good as it should be.

**Yeah and that's like some of the feedback on that survey - there's only a small portion who use the dictation tool and the ones who do, seem to really like it but the ones who don't say they've tried it and it's just not...and they have to go back and correct all...**

And correct it all. So that's the main reason that I actually like the EMR. When I used to dictate notes, not 15 years ago, yeah, you'd have to go back and correct them and then, depending on what the system was, it would have to go back to the transcriber. It actually became very inefficient, you know; that doesn't happen now.

**Right, it's just easier to type it out yourself so you know it's accurate.**

Well, and mostly click it. You don't have to type too much.

**Right, that's true. So what would be the biggest change from old school paper charts to EMR? Because you mentioned having to document a lot or the fear to document a lot.**

Yeah well that's related to billing requirements which is...so when you send out a bill, that's with a certain code and you get reimbursed based on whether or not the documentation is appropriate for that billing code and it makes a huge difference financially. So that's why there was such a push from people who were administrators, like myself, realize that if we had an EMR, and it was appropriately utilized, we would be able to be more accurate in the generation of those and receive the appropriate reimbursement for what we did. And that has happened and every place I've been it's happened so that has worked very well.

**One of the feedbacks that we did get on the survey, they did talk about "oh, it's great for billing purposes but it's not totally in tune for the general flow of an office visit because things always change" but I guess it kind of comes back to what you're saying about the customization.**

Well a little bit. It can interfere with office flow but mostly with patient physician interactions. So if you're sitting there typing and keyboarding and not looking at your family, you miss a lot. So I don't actually do that. I don't do the notes in the rooms so that I can interact with the family and the patient. So I'll give you an example of this because it's kind of fun. Back when I was a medical student, like 45 years ago, one of the attendings was a neurologist and we would have rounds with him and so he brought up, I forget, I think it was about a two year old into the room and put him in a crib on the floor and the patient's history was being presented to him and he never touched the patient but when the person got done presenting the history, he said "now I want to tell you about the physical examination." He never touched the patient because he was looking at the child all the time and seeing what they could do. Watching them grab stuff, how they would move around; he could do a huge amount of work just by observing and so observing what happens and the patient-family interactions [and] the families expressions that's very important. And if you're looking at a keyboard you're not doing that.

**Yeah, that's sort of the vibe I've been picking up and sort of the main frustrations for a lot of people but like you said, you do yours after the visit. Do you think that limits the amount of patients, then, you can see in a day?**

No I actually think it, in some ways, is more efficient because you get all the information and then start to enter it. And so you can tailor what might be in the first part of your note based upon what you learned at the end of your interview. So I actually think it can be just as efficient if not more efficient; certainly potentially more accurate. So if you're typing something in and it turns out that you didn't appreciate what was actually being said or done by the patient, then you have to go back and change your note. That actually takes more time.

**Margot: So when you mentioned that you were taking notes after you see the patient, does that walkthrough kind of look like: you have your interaction with the patient, you leave, you take your notes, and then do you look at your next patients notes and then go into...**

Yeah, for me it totally depends upon how busy it is. So yeah, often I will see a patient, complete their note before I go in to see the next patient but not always. So if there are people waiting, I will not do that. I will go see the next patient and I may even complete the note the next day if it's really busy so it really depends upon... and how much time the family needs, you know, if I see a patient and it turns out they're going to need open heart surgery, it takes a little bit of time to explain that and that may make it so that I can't adhere to the schedule. But for the most part, yeah, I do the notes the same day and that's actually much more efficient as well because, you know, I complete the note, the EMR uses your Note to generate a letter and then that letter is sent to the referring physician. In my case, they're all referred patients. So they're sent to the referring physician the same day and that's another tremendous advantage because then they know what's happening and are not surprised when the family calls him up, "Well Dr. Strauss said my kid needs open heart surgery. What am I going to do?" and you don't want them to be caught by surprise.

**Just one more question about your note taking process, and I realize this could be a patient to patient difference, but typically when you say you will take a note, how detailed or how long or short is that note? Are you typically putting in one sentence that summarizes...**

Well, so there are different templates for our patients based upon the reason that they are being seen and there would be in any office. So there would be, for example, in a pediatric office, a lot of them will be well child visits or some of them would be an upper respiratory infection so there's a different template for those things. For us, it is: are they born with heart defects (unknown) heart disease? That's one template. The template is somewhat age-dependent and then there's others for other common complaints like chest pain or palpitations - feeling your heart beat funny. So the templates different and, to get to

the answer to your question, that means that most of what you do is really click. But yes, there will be a sentence or two usually at the beginning to sort of give the details. And the templates are very important because it does cut down the amount of time and that's one of the customization features. If you can customize them appropriate for your types of patients that you are seeing, it's much more efficient and yeah, you don't have to type as much. The only disadvantage is, when you dictate something, you usually do go into more detail but that's not as important perhaps as it used to be especially if you have the right template.

**Jack:** Just to jump back a little bit, when you review your notes to then go on to the next patient, is that something you do before you enter the room or do you sort of review the history with the patient in the room?

Oh, I usually do it before I... so like I have a clinic tomorrow and I've gone through the patients' records already. So the ones that I've seen before, obviously, are previous notes. Some of the patients have had laboratory studies already and yes I go back and look at those and so that adds a little bit of time but it does prepare you better to be more efficient when you see the patient.

**And then when you have to explain, like your example before, the patient needs open heart surgery, when you take the time to explain those situations, do you do that all in the exam room or do you take them to a private office?**

Well our exam rooms are all essentially private offices so yeah, we don't usually go somewhere else.

**And what kind of tools, other than your stethoscope, do you bring into the room with you?**

Most Physicians offices have...are equipped with the following: the sink, so you can wash your hands, the computer, and then an ophthalmoscope to look in the eyes, an otoscope to look in the ears...so really all that I, as a physician, bring in, yeah, is my stethoscope. Some other neurologists will bring in something else. Reflex hammer, things like that, but most of it's in the exam room already.

**So I guess you guys are pretty good at keeping them where they are? They don't ever go missing from time to time?**

No, they're actually... most of the stuff is screwed into the wall so...

**Oh, really? Okay. And the computer, I'm assuming, is just stationary as well?**

Well they're usually on an arm. So yeah, they're on the wall and then they come down and you can adjust them so you can actually look at the screen and look at the family at the same time; but obviously still have to look there. I don't have to look at the keyboard but you got to see what your typing. You can interact but not as much. And especially for kids - you can't examine them in the same way you would an adult. You have to have them sit on their parent's lap and be patient when they're running around the room and all those kinds of things. So that's why I do it after.

**Margot:** So to kind of tie into that, since I'm looking at the graphic side of these things, I'm also looking into forms of distraction. So do you...what kind of do you use if you encounter a kid who won't stay still, is freaking out a little bit...

Yeah, so we have something called Child Life and they have all kinds of materials to distract a child: toys, dolls, trucks, and television sometimes when we're doing laboratory tests. And then, nowadays, the families almost always have some device that they're showing videos or cartoons to their kids and this becomes important because often families will have... will not only bring the patient, but they'll bring other kids and there's waiting time. So being able to distract the patient is very important so that they're not a mess (inaudible). Obviously we call them in and try to get into the room very quickly so that they don't go ballistic but yeah, we have a lot of things to distract them and those are very important. On the back end, this explanation about open heart surgery, for example, the graphics, and I wish we did them much better. So we have some graphics/diagrams of hearts. We even have some videos of types of heart surgery but they're not able to be used efficiently. So I will always give the family a diagram of what their diagnosis is, whether or not they need surgery, and/or show them if they have a (inaudible) problem, show them where the (inaudible) problem is. But it would be really nice to be able to do that better and so there are companies, actually, that (inaudible) who do graphics and demonstrations of what the defects are and how they're fixed and repaired but they're not very good.

**Jack:** Do you think they're not efficient because they are not in-depth enough or...?

That's part of it but it's a subject content problem. Every patient's a little bit different and the things that we deal with (camera skip) people who design them don't understand them. So if you're going to do it, you have to do it as a partnership with somebody who does understand them and can fix them for you.

**With the distraction - jumping back again - is that something you use mostly with stuff like vaccines or something where it's a painful thing for the child or is it even for things like the otoscope and general tasks?**

Yeah, no, it's for everything. For example, you want to listen to the heart and you want them to be quiet, not talking, and relatively stationary. So if they have a spinning light thing that they can press, they'll be doing that while I'm listening to them. We do a lot of laboratory tests like echocardiograms, ultrasounds (inaudible). Those take half an hour, 45 minutes and if you're two years old, you're not going to lie there for that long unless there's a cartoon on the TV or something else that distracts you. So almost every patient has some kind of distraction time that's needed.

**Unless you have any other questions on that front, maybe we can sort of talk about where we're maybe thinking of going with our project - at least early stages?**

**Margot:** Yeah, do you mean just on the distraction side or overall?

**Jack:** Yeah just overall.

**Margot:** So like I said, I'm focusing on the graphics and since we are focusing more on a general pediatric office, I'm looking into the early on developmental assessments that they do - which is a lot of: draw a circle, name this color, name these letters - and looking into how to take all those assets and put them in one singular place to use and then how, possibly, that would streamline collecting the data. If you could maybe touch on any time that you worked with that kind of assessment type flow or how that works...

Yeah I don't really do that and I can tell you that, in fact, a lot of that is unnecessary. As I gave you the example with the neurologist, you can tell almost instantly how the patient interacts with the environment and if it's age appropriate. We do ask a few questions about development. There are other ways to do that which I think would potentially...again this is not my thing, but so during the waiting time, whether it's in the waiting room or actually in the room waiting for the physician to come in and see the patient, you could video record what they're doing - either with instructions or without - and that would... you know, draw a circle or have them try to read something or whatever it is and that would save a lot of time, yes. And if there were a standard approach to that...I mean ancillary people are probably spending 80% of the time with the patient and their family in any office. The Physician or the nurse practitioner spends, as you may know, spends very little time. And doing those kinds of things either before or after, with ancillary people like technicians or whatever, is probably much more efficient.

**Jack:** So you touched on something there that sort of ties in, almost directly, with where we were thinking of going with the idea of potentially using, like you mentioned, if you could video record the child doing that stuff, maybe you could take that video and upload it, basically, to the child's health record and...

and actually analyze it. In these days, with, you know, artificial intelligence, you can really get an analysis and a comparison. And especially in pediatrics, it's very important for age specific activities. And yeah, you can get an interpretation and the physician, or nurse practitioner, wouldn't even have to deal with it. It would create a report just like when you take an x-ray, somebody reads it and creates a report and I think that would be a huge boom to be able to do that and it would be more standardized. So you made this point and there is some real benefit to be able to standardize what's done and what's not done so that you can compare patients of the same age for example.

**So my understanding with the...one of the intentions of the electronic health record was to sort of build this platform [so] that different doctors can easily see the patient's record and with that idea, we thought of, this is where we're sort of maybe thinking about heading is the idea that some of these tools that the pediatrician uses, or the physician uses, could, potentially, automatically upload data to the patient's EHR. So say, for example, the otoscope, instead of having to describe what you see in written words, if it could snap a photo of...**

Yes, exactly. So a really good example of that is looking at the back of the eye. That's actually hard to do but it can be done with photographs and they can be analyzed for things like much better, actually, than a physician trying to describe that and it's of course much more detailed in the photos and it's permanent and it's not operator dependent. So those would be really good things and you can do the same thing with a heart examination, for example, and in fact there are remote...doing remote physical examinations, now you can do virtually all of these things with a robot and an operator. So yeah, absolutely I think...and it would be much more both standard and permanent.

**Right. And so with that idea, some of the tools and ideas that at least...that may be specific to tools you work with like, for example, the EKG could maybe upload a graph or the stethoscope could somehow upload audio files that maybe you can refer back to. Like you mentioned before, the echocardiograms could upload photos...**

Those are already recorded and...EKG and Echo are recorded and placed in the EHR. The echo is very difficult because it took a long time...because there's so much data. I don't know how many bytes it is but it's huge. But the physical exam is not generally...so yes, if you had a stethoscope that audio recorded things that would create...and again, because many different physicians see the same patient over the years, having it permanently recorded so you can listen to it rather than what the description is. I mean, for example, we quantify murmurs by a scale of one to six. Well, you know, you may quantify it as a two and I may call it a three or one. If you were to be able to go back and listen to that, then you would know what it is.

**Okay and is there anything...I guess other than the EKG and echocardiogram, is there any other tools that you see currently doing stuff like that where they are...you know the ophthalmoscope or the otoscope uploading photos to the EMR is that...**

Yeah, I mean, for example, in an oral, when looking in the mouth, when looking at the teeth, taking pictures of that, yes, that would be...again, it would be... so, you know, we just click normal Now, well what does that mean? Or if there's a skin lesion, pictures of those are very much more helpful than a description.

**Or a rash?**

A rash or we have things called hemangiomas which are blood vessel tumors and in fact a lot of dermatologist now do this. They do sort of remote...using photographs, remote diagnosis because there's not enough of them. Another area that's a really big area that I would...you might want to focus on, is behavioral and mental health. So 50% of children have some behavioral or significant mental health diagnosis and most physicians/pediatricians are not trained to take care of those patients. So ADHD...the teachers make a diagnosis, the parents make a diagnosis. Do they really have ADHD? Do they really deserve a medication that can really impact their brain development? So being able to record behaviors and potentially have them looked at later by the same expert would be a tremendous benefit. We actually have a faculty member here who's a PhD (inaudible) who has used artificial intelligence to analyze patients' response in terms of depression. By also recording their responses to questions, he has developed an algorithm that he thinks, well he's documented, is 70 or 80% accurate in predicting who will go on to attempt suicide. He's taken suicide notes that patients leave if they're not successful and analyze those to be able to predict what their likelihood of trying to commit suicide is in the future. Behavioral and mental health is a huge problem for all of us. The number of psychiatrists is small and as I said, most Physicians aren't trained and yet we have to be able to recognize those patients and the earlier they are recognized, we all think that the greater the likelihood that they could be adequately treated. That would be an interesting subject for a project and yes, it's absolutely...it's like looking at rats in a maze. I mean you can get a lot of information.

**In both of our presentations that we've had to give to our professors and our classmates, something we've been stressing is medicine, in particular pediatrics, is more than just a physical exam. It's about the family care and the patient's health so just trying to stress that and whether that's something we go after directly or something that we can maybe solve in the process of making the doctors workflow more efficient...**

Well let me give you another example. So we know that the environment in which a patient lives or goes to school or works is a huge determinant of their health. So how do you document that? You can ask but everybody's house is wonderful. Everybody's happy at home when you talk to them but what if you recorded what goes on during the day in their home or have the capability to do that on a patient that you were concerned about? Or in school...so teachers will send in notes telling parents you need to go see the doctor because they're misbehaving at school. Part of the time they are misbehaving, part of the time the teachers don't know what they're talking about, and part of the time they're just trying to get the kid out of their class. So yeah, it's being able to do that kind of analysis and do it in a quantitative and somewhat standardized way I think would be

very helpful and we don't do that. Occasionally I'll have a family member come in...so, for example, it's a trivial problem but sometimes kids will get blue hands and feet and they'll come in, of course, and they look perfectly fine. Occasionally the parent will actually have taken a picture and bring it in and I can say "oh, I know exactly what that is." Some of them even record heart sounds. They'll tell me "I can hear this abnormal sound in the heart" and I say "oh, well that's crazy, nobody can do that." If they bring it in or recorded it, you can hear it. So using audio and video analysis in the home environment is, I think, a really huge potential. And then, of course, it would be great if the patient didn't have to come to the physician's office at all or rarely because we can do telehealth from home.

**Right, and that's sort of a missing gap. And maybe that's somewhere we could potentially take this - outside of the pediatric office or outside of the exam room and focus on that home environment because there are a lot of consumer health trackers but it's just for general health and nothing really focused on what you were saying with the mental health.**

Another good example, right, is child abuse. So you read about this all the time, right? There are probably 200 child abuse experts in the entire United States. Nobody else knows how to interview the patients. They don't know how to document the physical findings that are consistent with child abuse or sexual abuse. So we do that. We have a tela capability (?) here in which an emergency room or a physician's office in Timbuktu can call in and (inaudible) and the whole procedure can be documented so that the patient doesn't have to go into a traumatic environment for them here. They can be in a different environment and mental health and psychiatric health is exactly the same way.

**Do you think there's a difference between the telemedicine...maybe there's a difference now between telemedicine and the in person visit because now telemedicine is all over the phone or Skype but if telemedicine morphed into being able to see these videos and audio recordings if that would maybe take telemedicine a step up from where it is now?**

Yup, I do. Of course the problem is time but especially for unusual, difficult, and mental and behavioral disorders...the physician's office is such an artificial environment. So the behavior of the patients is often worse in a physician's office. Sometimes it's better. Usually it's worse.

**And with artificial intelligence being able to listen to those audible cues that sort of hint at a patient's mental health but do you think maybe there's a space for it to also just listen to the natural flow of the conversation and document notes that maybe you would have to take? Like the notes that you are taking now, do you think maybe artificial intelligence can sort of listen in on the conversation and do that for you or do you think that's more in line with dictation where you'd have to go back and fix errors?**

No that is being done. So even in electronic health records, doing what's called natural language processing of the notes is a way to extract more information out of the notes, especially around mental and behavioral health. I'll give you another example, same guy, he's a very smart guy. He's looking at patients with epilepsy. So we have drug therapy for epilepsy and then we have surgical therapy where we open up the brain and record where the seizures are and then spend days trying to figure out...and then the neurosurgeon goes in and whacks out a piece of brain hoping to cure the epilepsy. And well what he's done is been able to take the electronic medical record notes, use natural language processing of the recording of how frequent seizures are and how severe they are, and predict who's going to need surgical intervention two years earlier than the standard way that it's being done. So yes, it's absolutely another way to improve patient care and improve diagnosis but also improve treatment of course.

**Margot: I was intrigued when you mentioned that a lot of the stuff could be done at home. It definitely got me thinking of a lot of things.**

Well to give you some examples there, we have, unfortunately, a fair number of chronically ill patients who are dependent on a breathing machine or assistive devices. So for the parents to get them to a hospital, or a physician's office, is an incredible...and we could do essentially all (inaudible) video equipment and the electronic recording of things like their vital signs and behavior. So it would save them an incredible amount of time and it's actually risky to take the patient and have to move them 50 miles or get them in and out of a vehicle. So being able to do home health care in a really sophisticated way, I think it should be (inaudible). Think about old people. I mean, you got a bunch of old people like me and you know it's really hard for them you have to get in a special vehicle or you have to have an assistant or whatever it is to get them from their home or nursing home. Why should we have to do that?

(omitted)

**Jack:** So basically we were thinking of a connected suite of pediatric tools that would, theoretically, automatically populate the patient's record when possible like the otoscope, the ophthalmoscope, thermometer, blood pressure - those sort of tools. They'd be housed in this mobile workstation that could get moved from room to room and maybe, to your point with ai, maybe it could be this whole system that helps, at least a little bit, with the doctor's efficiency so that they don't have to spend the time with the manual data entry but also focusing on things like mobility. I know you mentioned here all of your stuff is screwed to the wall but that's the case in only some offices but sometimes the tools, like my mom's, for example, sometimes will change room to room. Like if the battery on one of the otoscopes goes bad, they'll pull it from another room and then that room's now missing one so if it was all just sort of housed in this one unit...

Well we did a retreat and an exercise once when I was at Vanderbilt and they sort of presented this idea of what...in 10 years, what would be...and my idea was that, yeah, it would be a mobile station. You come in and the patient puts their hand into it and it records all of their vital signs - it's like Star Trek - and literally that would save everybody a huge amount of time, be more accurate, be in the EMR and if you wanted to get things like a blood test or an echocardiogram, you could do that with the same device rather than...so when I see a patient now, it takes 4 people to do it when really it should only take, at most, two...because we don't know what we're doing (laughter) and that's what you guys can fix in design and patient flow and all that.

Yeah that's one of the overall things we are looking at, you know, if we can change the workflow or the whole system of that pediatric visit. And another thing we saw was the doctor to staff, or doctor to nurse, ratio. Maybe there's ways to reduce that and then maybe that allows you to see more patients or just hire less staff.

Exactly. And we do a little bit of this where you get a...like I had a doctor's appointment yesterday. I got a note the day before, you know, "fill out these things electronically" and that saved me and the receptionist and the nurse and the medical technician a lot of time because I had done all that. But it also facilitates accuracy. So another example is, we use, in (inaudible) psychology in particular, we use kiosks or workstations. Well the patients, especially teenagers, are much more likely to say what they're really thinking on a kiosk - especially if their parents are around when they go into the room - so the accuracy... so they're sitting in the waiting room, they go to a laptop or a workstation or a kiosk and there's a bunch of questions they get asked - could be audio questions, could be written questions - and they respond. And then when they go in to see the provider, the provider already has that information and it turns out they're much more likely to tell the truth. I mean, do you want to ask every 15 year old in front of their mother whether they're sexually active or whether they take drugs? I mean, are they going to tell you that? But they amazingly will often say that when there's nobody else around.

That's good to know because something else we were poking around with the idea of, because you know, right now they check in and then they just have to sit around and they maybe get a piece of paper with that survey on it or get asked it in the exam room but if there was a way, because everything is digital now, you know, hand them an iPad or something and have them fill it out and it can just be in the EHR.

Well that's what we do. But I can tell you...I'll give you another example. My wife has a fair number of medical problems and she goes to different health systems. So you go to doctor in health system Y and the doctor in health system X and they don't exchange information, or enough information. So now you're filling out the 10 page form over here and then you do exactly the same form over here. It drives her nuts.

**It drives my dad nuts too. That same thing.**

Its... why? Why should that be the case?

**And even going back to the same...he'll take me and my siblings to the dentist, it's like every 6 months, and he's filling out the same paperwork. He's like "don't they have this already on file?"**

Yeah, it's absolutely frustrating and it's inefficient for everyone. Yeah well, you guys can fix all those problems.

## Pediatric Exam Procedure

### Nurse

01. Urine Sample
02. Height, weight, BMI Calculation
03. Blood Pressure / Pulse
04. Temperature
05. Respirations
07. History

### Doctor

08. Physical Exam
  - Ears
  - Eyes
  - Mouth
  - Neck
  - Listen to chest
  - Belly
  - Squeeze Tests
  - Reflexes (knees / elbows)
  - Privates

### Nurse

09. Vaccines
10. Throat Culture
11. Send Prescriptions
12. List of instructions for patient

## Internal Refined Sketch Review

5 Industrial Designers, 1 Graphic Designer

### Overall Form

- |            |         |
|------------|---------|
| Concept 01 | 2 votes |
| Concept 02 | 1 vote  |
| Concept 03 | 3 votes |

### Tagged Details

- Waterfall 01
- Handle 02
- Handle 02
- Handle 03
- Tools 02
- Drawers 03

## Physician Refined Sketch Survey

Survey sent to 32 doctors  
Responses: 11

### Part 01 - Overview

#### 1. From the 3 concepts, focusing on overall form and visual aesthetic, which is your favorite?

Concept 01	27.3%
Concept 02	45.5%
Concept 03	27.3%

#### 2. Additional Comments (optional)

For visual aesthetic - Concept 01 would be my favorite since it looks neat (as in tidy, not "neat" as in cool). However, functionally I'm not so sure I would like it since, if I'm standing, the screen would be too far away from eyes and I would have to bend over forward to have a better view of the screen. Actually, that would be my complaint with all three concepts.

I think you'd need some type of manual keyboard as you'd want at least easy ability for physicians to edit transcription errors. This moved concept 1 down my list even though the aesthetic is my favorite.

### Part 02 - Details / Functionality

#### 1. Handle

360 degree - Concept 01	18.2%
360 degree plus sides - Concept 02	63.6%
Back side - Concept 03	18.2%

#### 2. Tool Placement

Exposed - Concept 01	45.5%
Semi Exposed - Concept 02	18.2%
Concealed - Concept 03	36.4%

#### 3. Screen Position

Integrated into form - Concept 01	18.2%
Above work surface - Concepts 02/03	81.8%

#### 4. Sharps / Biowaste Disposal

Side Mail Slot - Concepts 01/03	45.5%
Bottom Drawer - Concept 02	0%
Work Surface - Concept 03	27.3%
Work Surface / Mail Slot - Concept 03	27.3%

#### 5. Drawers

Push to open (A/C) - Concepts 01/03	63.6%
Pull to open (B) - Concept 02	36.4%

#### 6. Any additional comments or concerns? Would you add or remove any features?

Again, sharps disposal tends to fall to non-physician roles.

At the end of the work day - how are sharps emptied from the workstation? Someone has to empty the workstation sharps drawer and then empty that drawer into the big Red Sharps containers that gets picked up by biohazards company. Too dangerous to handle since you run the risk of getting pricked. So maybe the Sharps or BioHazard drawer isn't needed in the pediatric workstation.

I guess I don't fully understand why there need to be so many things in the drawers. Isn't a lot of this stuff like gloves and gowns reasonable to keep in rooms or other shared spaces? This works fine and would be easier to restock than the mobile station that may be in use or hard to find.

Must make sharps opening high enough away from reach of children.

## Physician Refined Sketch Review

Select FaceTime Physician Review Highlights

#### Dr. Julie Ashton

Franklin Pediatrics

I like the form of two, but I'm not sure about the concealed tools. I like the contrast of the handles. The pushing and the pulling. The bumper effect when you're knocking into things it's not going to beat up the side wall of the cart.

Even though I'm used to having them [the tools] on the counter and I just grab them from their base and that is convenient, I feel like it distracts from the whole cart with them popping out like that. So I think concealed is fine if you want it nice and clean and nobody knows what's in there. You run the risk of damage if they're on the top like that. It's super convenient, in and out, I like that but things could fall on it, something gets in the way, I don't know. From safety and just keeping all your stuff in a neat appearance and just put it all away!

I think people that are standing up would probably prefer the screen up top..

Even though the convenience of [the sharps disposal] being on top is great, I feel like maybe stuff could just get stuck in there and fall in there so I think I would say no to the top. It is kind of disguised [on the sides] and you don't have to bend over so I'm going to say the side mail slot. Not the combo.

When your hands are full, it would be nice to just bump into the drawer and have it open so I do like the drawers on three. I'm just picturing...if I'm doing a couple swabs or whatever and I could use my elbow to open the thing, you know what I mean? Or the back of my hand, something like that and not have to reach in.

The more I think about it, from a clinical, medical office perspective and sanitary issues, number two has a lot of complicated surfaces to clean and be able to wipe it down to keep that thing sterilized. I think three is so much easier to...if it's all just one piece like that, it makes cleaning it so much easier. There are so many parts of two that would be hard to clean. You can't just keep the surface clean in one fell swoop. If you're looking for a very smooth, neat, clean, appearance I think everything...like a clean surface on the top, a clean surface on the front, you can wipe it down nice and easy and it doesn't get grimy in any way...because also, having the tools exposed, especially on the top, dust and grime will get inside the opening.

**Thank you to everyone who helped me through this project. To my  
classmates, professors, mentors, family and friends.**

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