

# ERAS APP for Patients



Final Presentation

**Team Ramblin' on FHIR**

Keith Adams, Lauren Aloia, Tyler Bobik, Chiawei Chien, Aaron Reed

Video Presentation Link: <https://www.youtube.com/watch?v=j0mnaBZKMhE&feature=youtu.be>

# Background Research

- Bowel Surgery Handbook
- Sessions with mentors/physicians
- ERAS App study

BRING THIS BOOKLET TO ALL HOSPITAL AND CLINIC VISITS

**Your Guide for Bowel Surgery**

EMORY HEALTHCARE

## An app for patient education and self-audit within an enhanced recovery program for colorectal surgery: A pilot study on validity and usability.



Tweet f 0 in 0

Nicola Pecorelli, MD<sup>1</sup>, Julio F Fiore Jr., MSc, PhD<sup>1</sup>, Pepa Kaneva, MSc<sup>1</sup>, Abarna Somasundram, BSc<sup>1</sup>, Patrick Charlebois, MD<sup>2</sup>, A S Liberman, MD<sup>2</sup>, Barry L Stein, MD<sup>2</sup>, Franco Carli, MD, MPhil<sup>2</sup>, Liane S Feldman, MD<sup>2</sup>, Steinberg-Bernstein Centre for Minimally Invasive Surgery and Innovation,<sup>2</sup>McGill University Health Centre

**Introduction:** While patient engagement and clinical audit are key components of successful enhanced recovery programs (ERPs), they require substantial resource allocation. The objective of this study was to assess the validity and usability of a novel mobile device application for education and self-reporting of adherence for patients undergoing colorectal surgery within an established ERP.

**Methods and procedures:** Prospectively recruited patients undergoing colorectal surgery within an ERP received a tablet (iPad, Apple®) at their bedside during their hospital stay. Patients were instructed on how to use a novel app specifically designed to provide daily recovery milestones and record adherence to 15 different ERP processes and 6 patient reported outcomes (PROs) using a daily questionnaire for each day in hospital. Primary outcome was validity as measured by the agreement index (Cohen's kappa coefficient for categorical, and interclass correlation coefficient (ICC) for continuous variables) between patient reported data through the app and those recorded by a clinical auditor. Secondary outcomes included acceptability and usability of the app as measured by the System Usability Scale (SUS).

**Results:** Thirty-four patients participated in the study (mean age 61 years, 62% female, 62% laparoscopic surgery, 9% rectal surgery, 56% malignancy). Overall, patients completed 122 of 136 (90%) of the available questionnaires through the app. Median time to complete a questionnaire was 195 seconds (IQR 147–269). Substantial (kappa > 0.6) or almost-perfect agreement (kappa > 0.8) and strong correlation (ICC > 0.7) was found for 14 ERP processes and 5 PROs. Use of preoperative carbohydrate drink (kappa = 0.930) and ability to use the bathroom independently (kappa = 0.576) were the only elements with moderate agreement. Patient reported usability was high: median SUS score was 93 (IQR 83–99), with 79% of patients reporting an overall SUS score higher than 80 of 100. Scores were particularly high for the SUS learnability domain (median 100, IQR 81–100). Only 5

## An app for patient education and self-audit within an enhanced recovery program for colorectal surgery: a pilot study on validity and usability.

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### Key Messages

- We designed an app that provides a mechanism to record patient adherence to care processes and patient reported outcomes
- Recorded data had high agreement with traditional clinical audit. The app had high usability and patient satisfaction.
- Future studies should investigate the use of mobile device apps as strategies to increase adherence to perioperative interventions



Daily milestones

Assessment of care processes

Real-time feedback

Assessment of criteria for hospital discharge

### Background

➤ Enhanced recovery programs (ERPs) are multidisciplinary, integrated care pathways designed to minimize surgical stress and improve recovery after surgery.

➤ Patient engagement and clinical audit are key components of successful ERPs but require substantial resource allocation.

➤ To assess the validity and usability of a novel mobile device application for education and self-reporting of adherence for patients undergoing colorectal surgery within an established ERP.

### Objective

➤ Prospective pilot study

**Design:**

**Participants:**

➤ Consecutive adult patients undergoing elective colorectal surgery without stoma formation from May to October 2015

➤ Exclusion criteria: inability to understand English or French

**Setting:**

➤ Patients treated within an ERP at a University hospital

**Intervention:**

➤ Patient received an iPad (Apple®) at bedside during hospital stay

➤ An app specifically designed to provide daily recovery milestones and record adherence to ERP processes and patient reported outcomes (PROs) using a daily questionnaire

**Primary Outcome:**

➤ Validity as measured by the agreement index between patient reported data through the app and those recorded by a clinical auditor

**Secondary Outcomes:**

➤ Acceptability and usability of the app as measured by the System Usability Scale (SUS)

**Statistical Analysis:**

➤ Cohen's kappa coefficient for categorical variables

➤ Interclass correlation coefficient (ICC) for continuous variables

### Results

Forty-five patients participated in the study (mean age 61 y; 64% male, 61% laparoscopic surgery, 11% rectal surgery, 67% cancer). The agreement between data collected through the app and those recorded by a clinical auditor was high as shown in Table 1. Table 2 shows data on app usability and acceptability. Forty (89%) patients found the app was helpful to achieve their daily goals, and 34 (76%) patients thought it increased their motivation to recover.

**Table 1. Assessment of validity of app adherence to care processes and patient reported outcomes recorded by app compared with the corresponding clinical audit. Agreement index, K-S, L.**

ERP care process	Agreement index	K-S, L
Preoperative carbohydrate drink	93%	0.930
Preoperative fasting	91%	0.910
Preoperative analgesia	91%	0.910
Preoperative antibiotic prophylaxis	91%	0.910
Preoperative oral analgesia	91%	0.910
Postoperative analgesia	91%	0.910
Postoperative walking	91%	0.910
Postoperative oral intake	91%	0.910
Postoperative catheter removal	91%	0.910
Postoperative voiding	91%	0.910
Postoperative walking	91%	0.910
Postoperative oral intake	91%	0.910
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Postoperative walking	91%	0.910
Postoperative oral intake	91%	0.910

# Innovation

- Use of Ionic Framework allows cross platform capability



Comparison of the "Setup: Name" form across three platforms: iOS, Android, and Windows.

**iOS**

**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

Next >

**Android**

**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

NEXT →

**Windows**

**SETUP: NAME**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

Next >

# Project Status

- Working app that runs on iOS, Android and Windows phones.
- We were able to hit almost all the goals we planned on, this includes: Making a user friendly app that educates colorectal surgery patients, stores their information in a database and interacts with FHIR which I will explain more in depth in the demo.

# Outstanding Elements

- Notifications that let the patient know if they miss a target.
- Save the profile as a questionnaire.

# Deploy Final Product

- No actual deployment, we will just be handing the code off to our mentors, explaining to them how to set it up and run it. It is up to them if they want to put it up on an app store or not.

# When you First Start the App

## Setup: Name

iOS

**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

Next >

Android

**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

NEXT →

Windows

**SETUP: NAME**

Please enter your first and last name as shown on your medical record.

First Name

Last Name

Next >

# Setup: Birthdate

iOS

**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name Marla

Last Name Dixon

Next >

iOS

**Setup: Birthdate**

Please enter your birthdate.

Birthdate Oct 04, 1972

< Back Next >

Touch to Enter Birthdate

iOS

**Setup: Birthdate**

Please enter your birthdate.

Birthdate Oct 04, 1972

< Back Next >

Cancel Done

Month	Day	Year
Jul	01	1975
Aug	02	1974
Sep	03	1973
Oct	04	1972
Nov	05	1971
Dec	06	1970
	07	1969



# Setup: Surgery Date

iOS

**Setup: Birthdate**

Please enter your birthdate.

Birthdate Oct 04, 1972

< Back Next >

**Setup: Surgery Date**

Please enter your Date and Time of Surgery.

Date of Surgery Dec 03, 2016

Time of Surgery 9:00 AM

< Back Next >

Touch to Enter Date

Touch to Enter Time

# Setup: Smartphone

**Setup: Surgery Date**

Please enter your Date and Time of Surgery.

Date of Surgery	Dec 03, 2016
Time of Surgery	9:00 AM

[< Back](#)[Next >](#)

**Setup: Smartphone**

Do you use a smartphone?

[Yes](#) ☒

[No](#)

[< Back](#)[Next >](#)

Touch to check either Yes or No

# Setup: Support

**Setup: Smartphone**

Do you use a smartphone?

Yes ✓

No

< Back

Next >

**Setup: Support**

Do you have someone to support you during the time of surgery?

Yes ✓

No

< Back

Next >

Touch to check either  
Yes or NO

# Setup: Diabetic

GT FHIR Server Check for Diabetes on Marla Dixon  
Because it returns True, Yes is automatically checked.

**Setup: Support**

Do you have someone to support you during the time of surgery?

Yes ✓

No

< Back

Next >

**Setup: Diabetic**

Your health records show that you have Diabetes. Is this correct?

Yes ✓

No

< Back

Submit

If the user has no diabetes or the user's name is not located in the GT FHIR server the user must specify on their own whether they have diabetes or not.

**Setup: Diabetic**

Are you Diabetic?

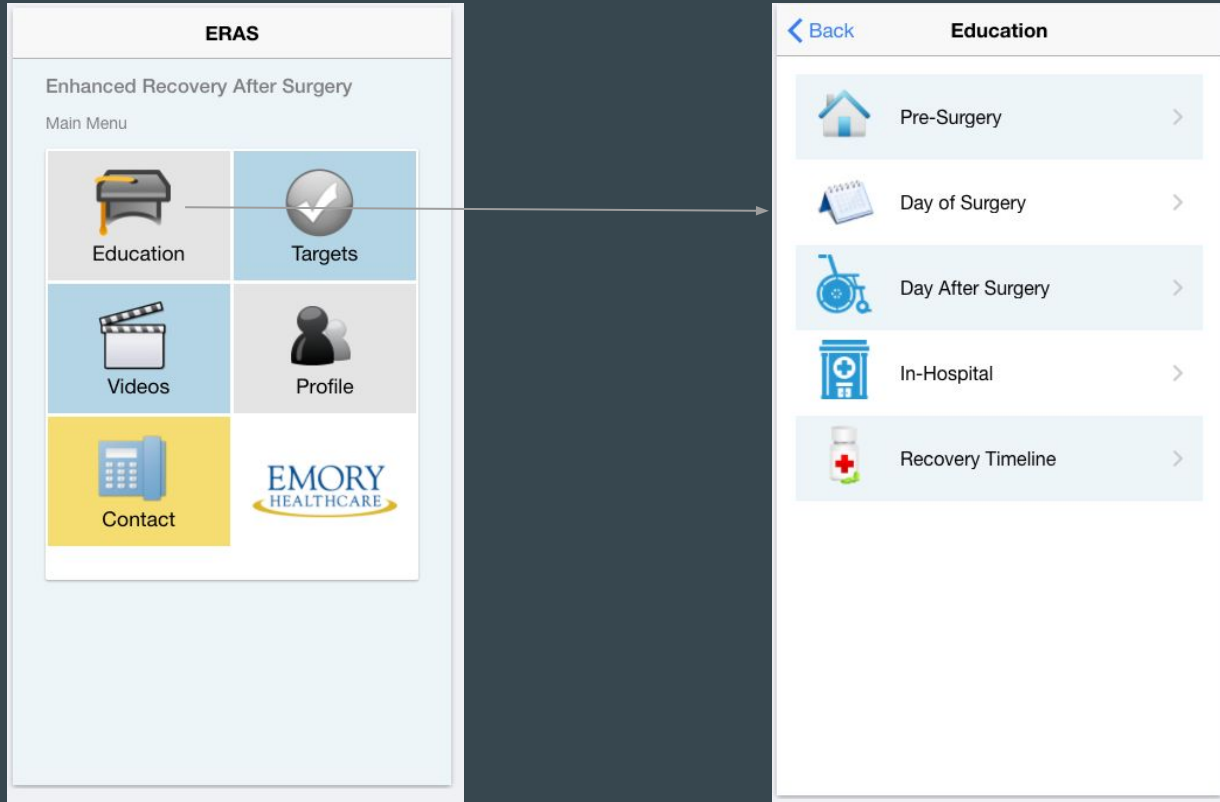
Yes

No

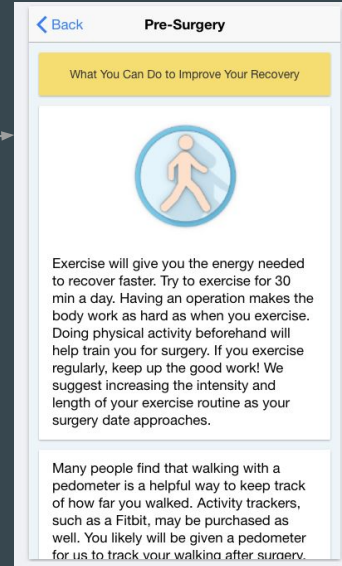
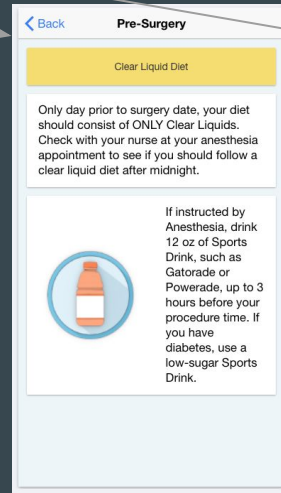
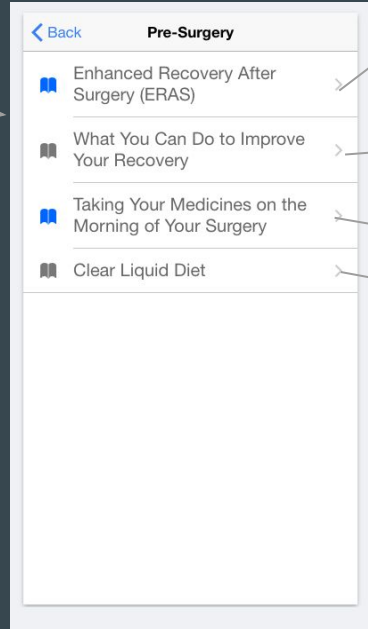
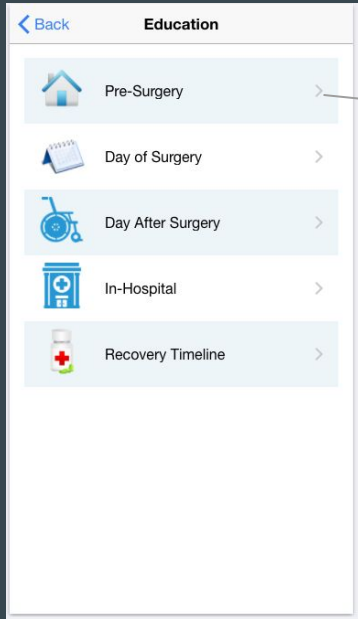
< Back

Submit

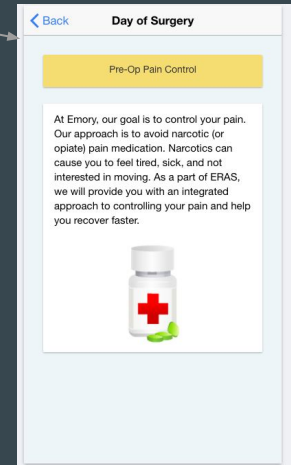
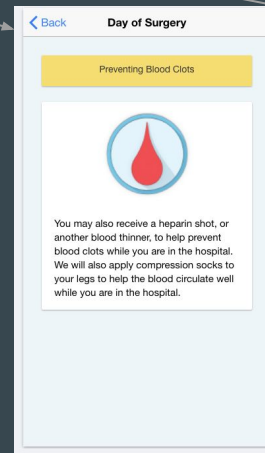
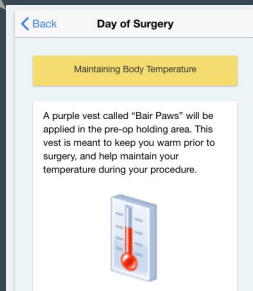
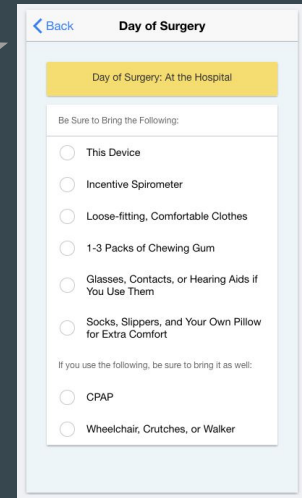
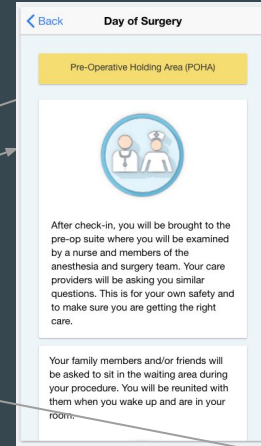
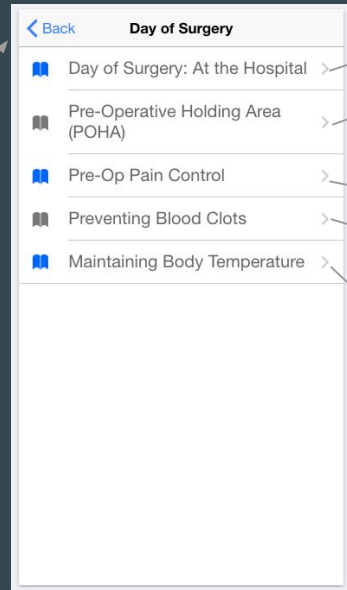
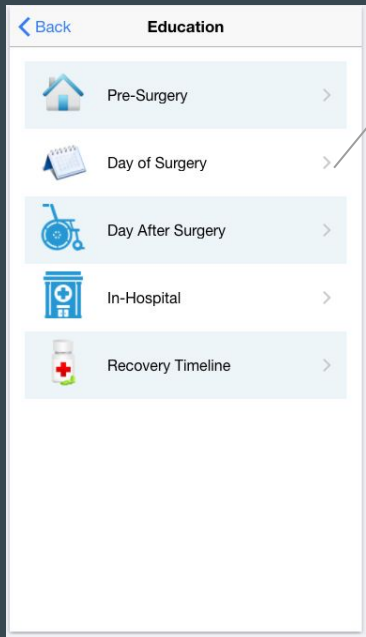
# Main Menu and Education



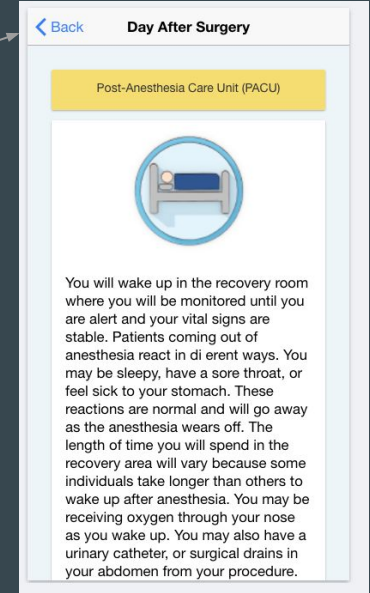
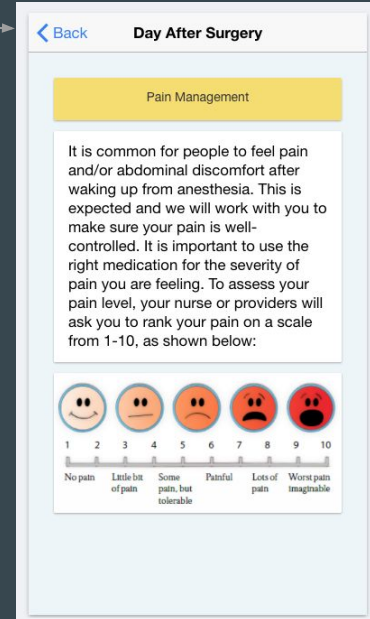
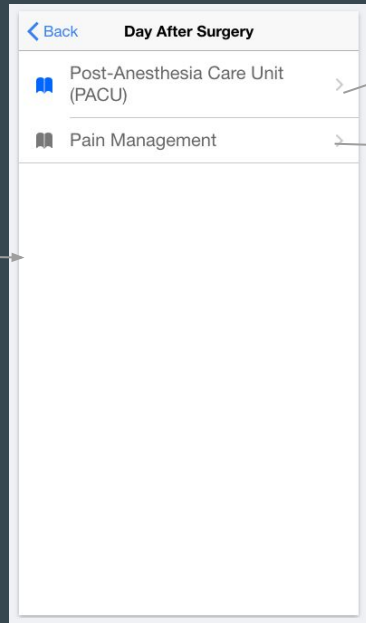
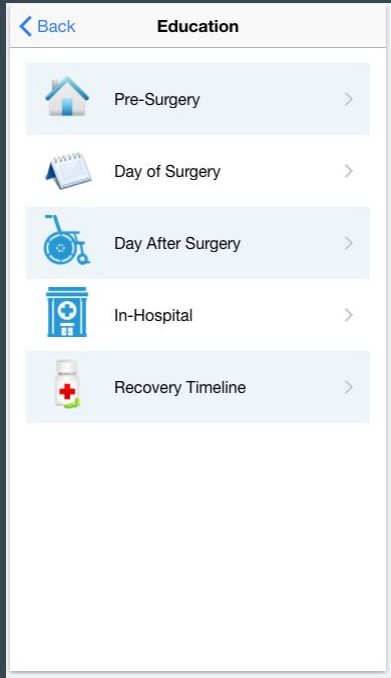
# Education: Pre-Surgery Screens



# Education: Day of Surgery Screens

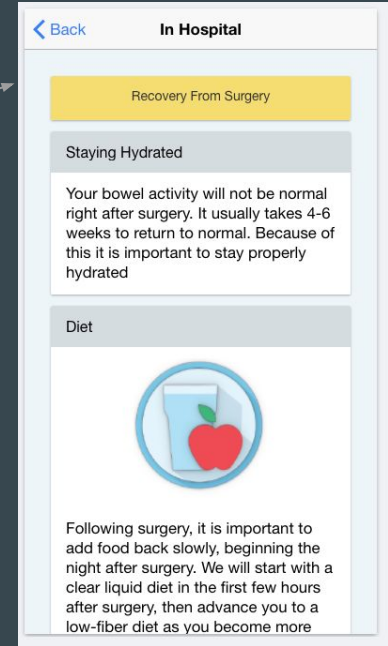
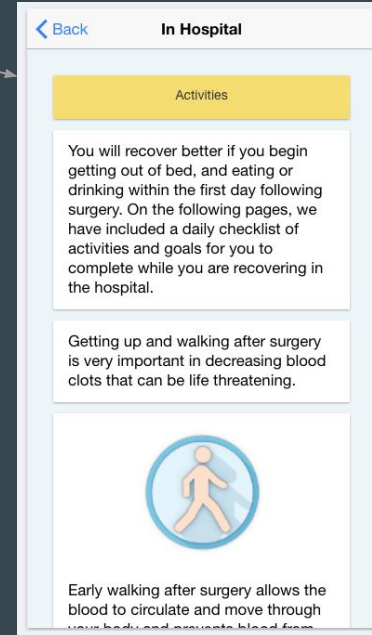
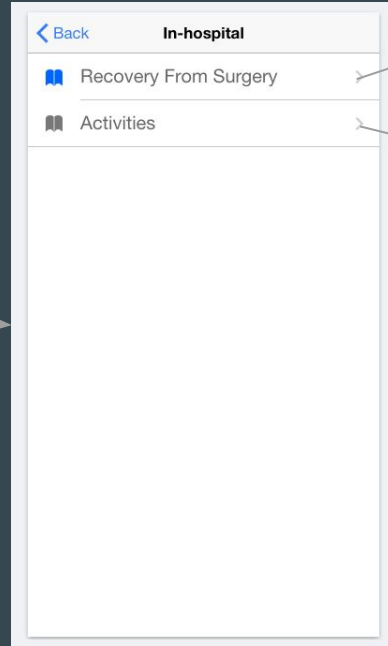
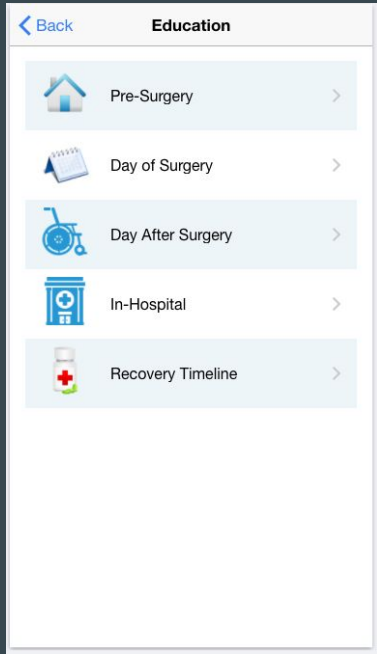


# Education: Day After Surgery Screens

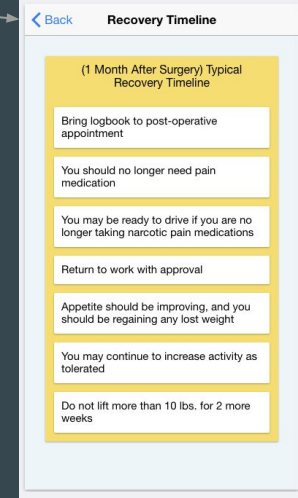
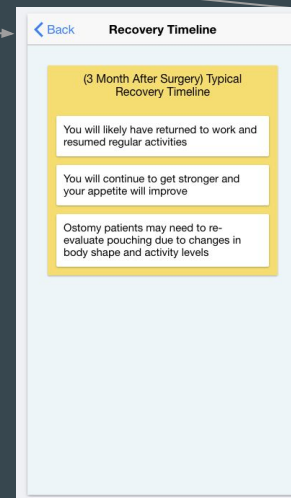
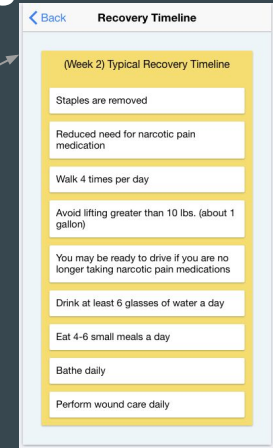
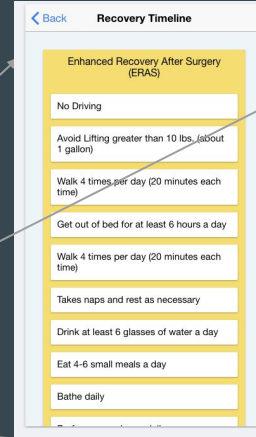
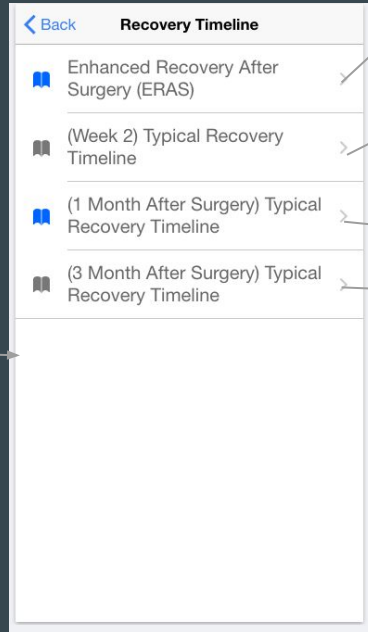
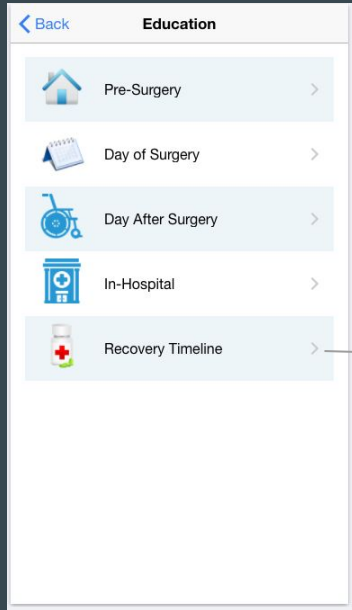




# Education: In-hospital Screens



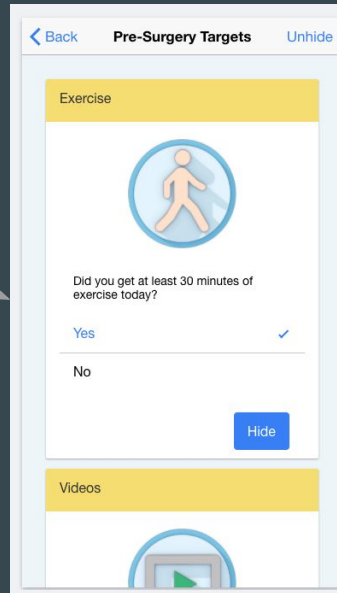
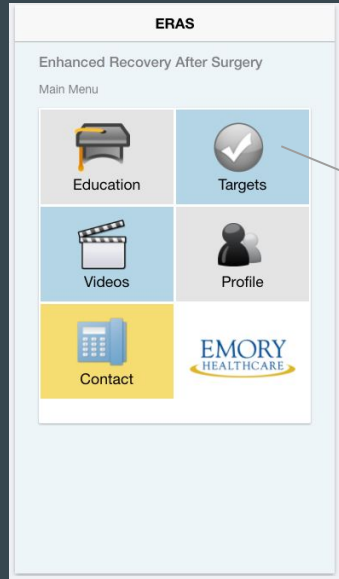
# Education: Recovery Timeline Screens



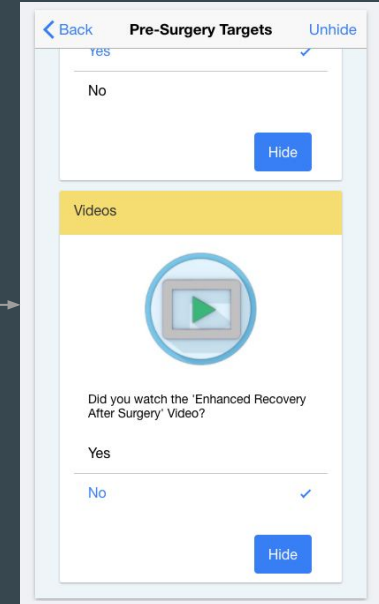
# Targets: Pre-Surgery Targets

- Pre-Surgery targets are conditional on the surgery date and the current date

If surgery date is more than 2 days before the current date: Only these targets displayed  
**Pre-Surgery Targets**



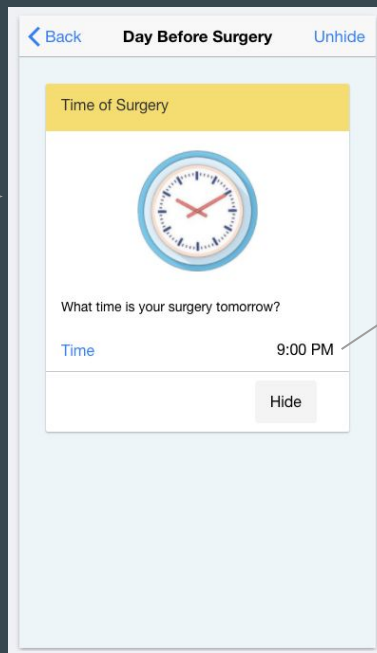
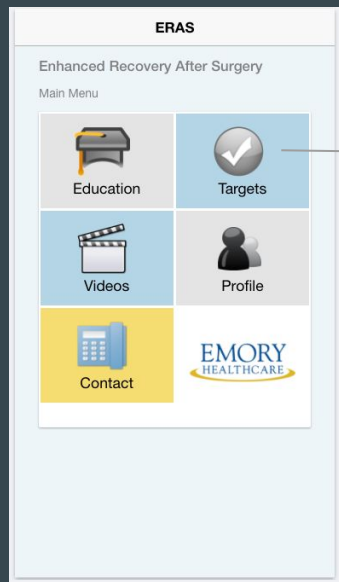
Scroll Down



# Targets: Day Before Surgery

- Targets are conditional on the surgery date and the current date

If surgery date is 1 day before the current date: Only these targets displayed  
**Day Before Surgery Targets**



Time automatically added from when the user inputted it at the start via the database it was saved to.

# Targets: Day of Surgery (Yes Diabetes)

Targets are conditional on two things:

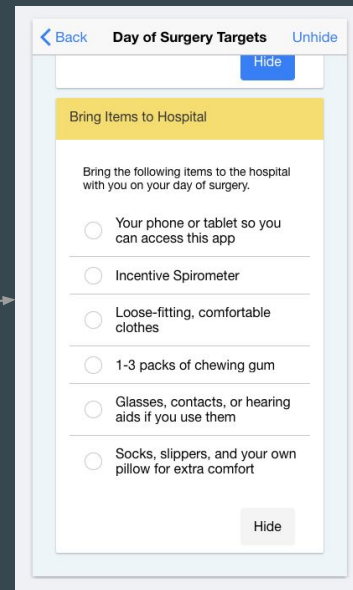
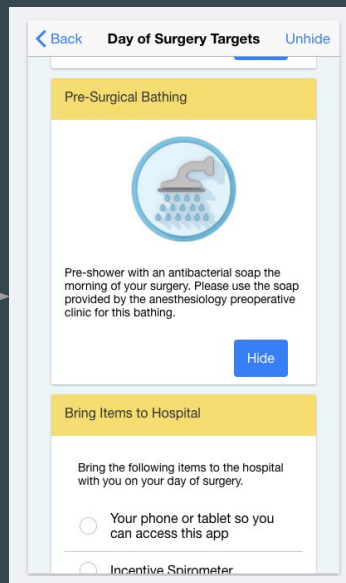
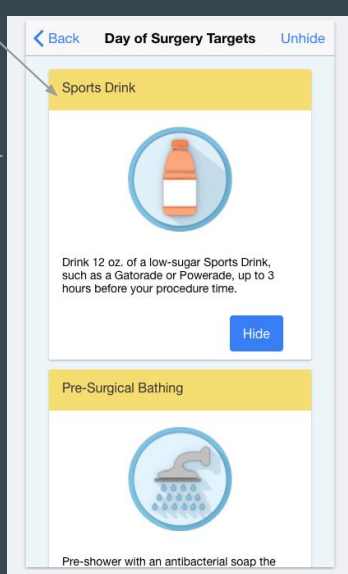
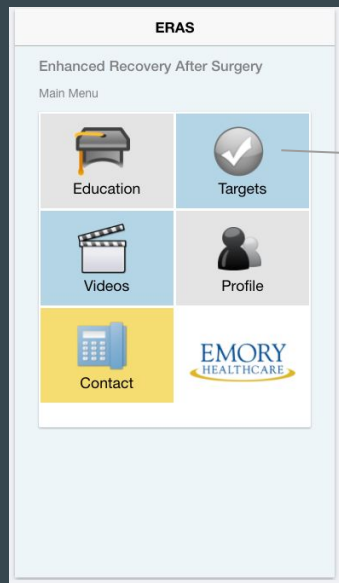
1. The surgery date and the current date
2. If the patient has Diabetes or not: If Yes, then when the day of surgery matches the patient's **Day of Surgery** they entered on setup, drink a low-sugar sports drink card appears. If No diabetes is entered, the card will not appear.

If surgery date = current date AND Diabetes = True:

Only these targets displayed

## Day of Surgery Targets

*Shows because user has Diabetes*



# Targets: Day of Surgery (No Diabetes)

Targets are conditional on two things:

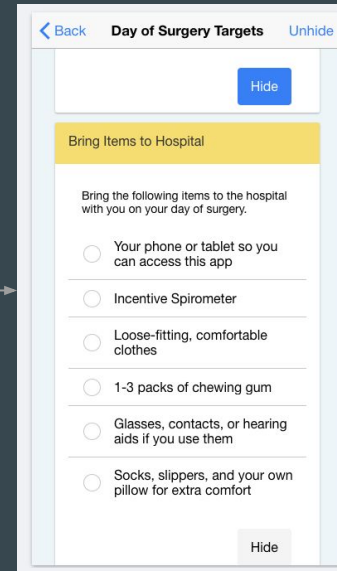
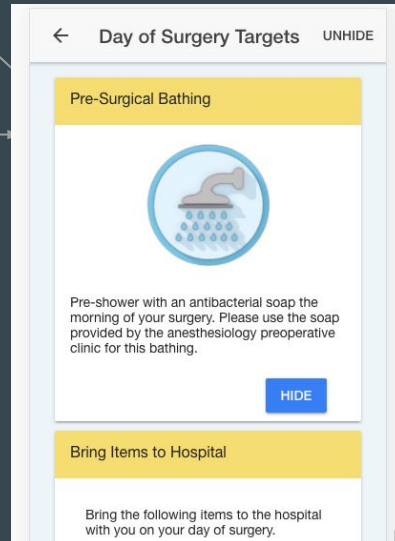
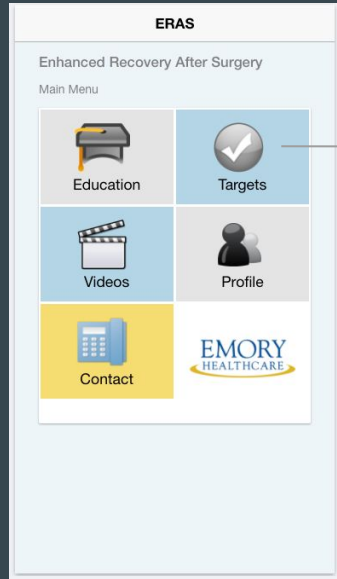
1. The surgery date and the current date
2. If the patient has Diabetes or not: If Yes, then when the day of surgery matches the patient's **Day of Surgery** they entered on setup, drink a low-sugar sports drink card appears. If No diabetes is entered, the card will not appear.

If surgery date = current date AND Diabetes = False:

Only these targets displayed

**Day of Surgery Targets**

*Sports drink card Disappears because  
Diabetes is false*

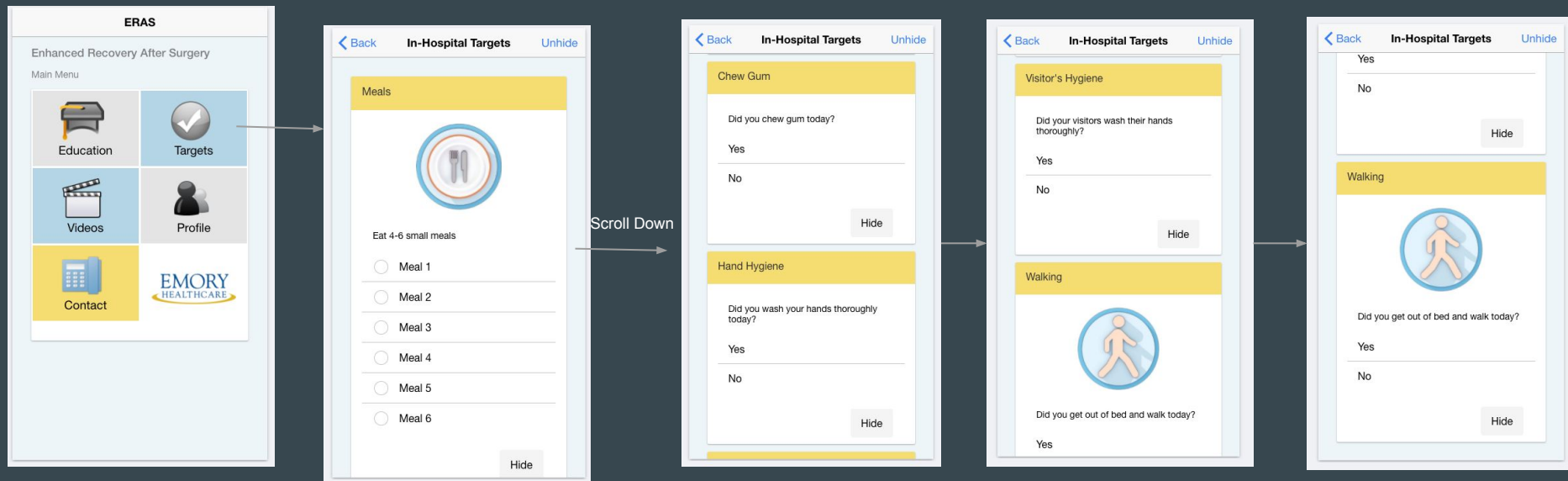


# Targets: In-Hospital

- In-Hospital targets are conditional on the surgery date and the current date

If surgery date was 1 day before the current date and less than a week after surgery:

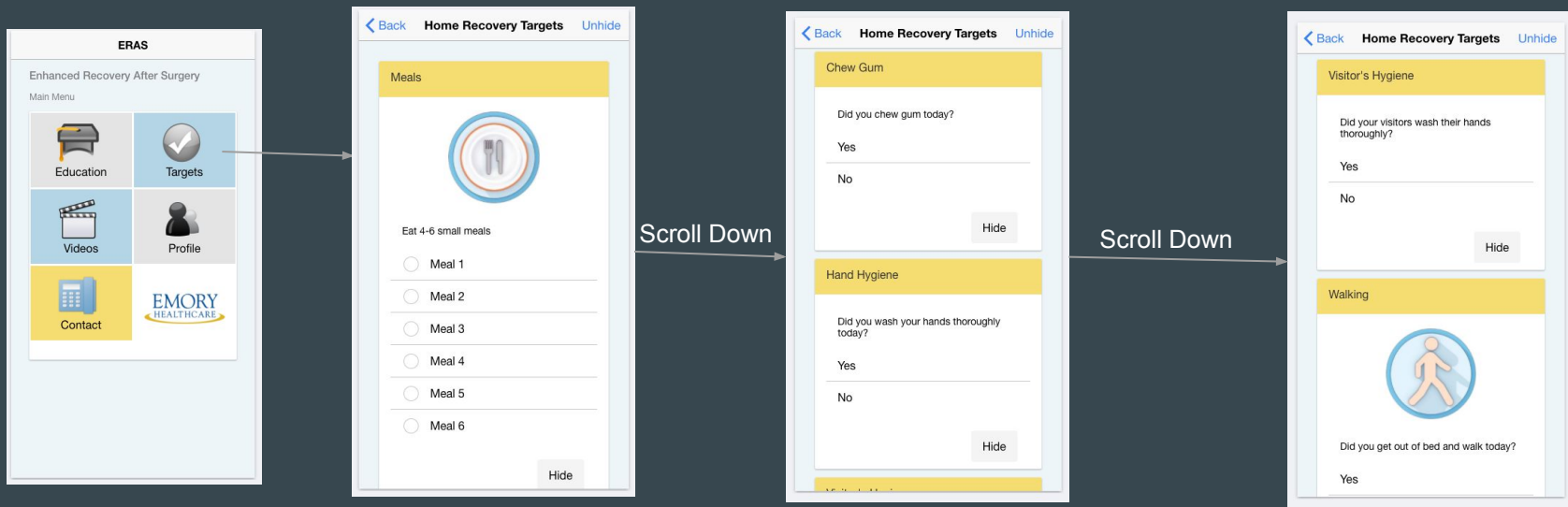
Only these targets displayed  
**In-Hospital Targets**



# Targets: Home Recovery

- Home Recovery targets are conditional on the surgery date and the current date

If surgery date was 7 days before the current date: Only these targets displayed  
**Home Recovery Targets**

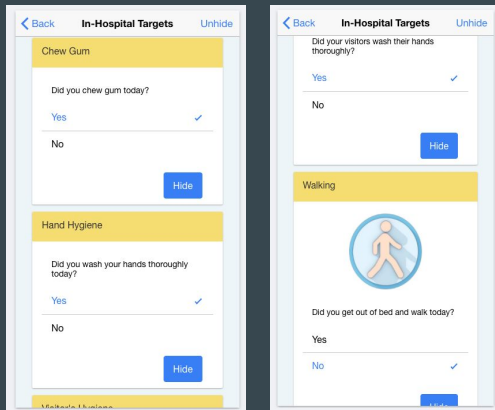




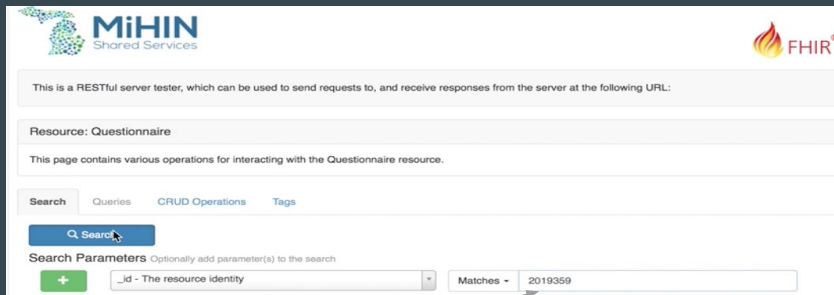
# Targets Integration With FHIR: Questionnaire

For Questionnaire and QuestionnaireResponse on FHIR:

1. It saves when you leave targets.
2. Finds all the questions on the targets page that are 'radio'
3. Sends to server and checks if questionnaire already exists. If yes, it uses that questionnaire id.
4. Gets user's responses and creates QuestionnaireResponse resource. Sends to server and gets back id.



```
top
Hello Targets Page
profile surgery date 2016-12-01
in-hospital-targets
true
Today's History Found.
Today's History matches current phase.
saving
Saving targetsHistory
saving
Saving targetsHistory
saving
Saving targetsHistory
saving
Saving targetsHistory
saving
Found Patient ID = 2019346
Found Questionnaire ID = 2019359
New QuestionnaireResponse ID = 2019388
```



## Questionnaire

```
{
  "resourceType": "Questionnaire",
  "id": "2019359",
  "meta": {
    "lastUpdated": "2016-12-04T03:00:00.798-05:00"
  },
  "type": "searchset",
  "link": {
    "relation": "self",
    "url": "http://52.72.172.54:8080/fhir/baseDstu2/Questionnaire?_id=2019359"
  }
},
{
  "entry": [
    {
      "fullUrl": "http://52.72.172.54:8080/fhir/baseDstu2/Questionnaire/2019359",
      "resource": {
        "resourceType": "Questionnaire",
        "id": "2019359",
        "meta": {
          "lastUpdated": "2016-12-04T02:00:41.598-05:00"
        },
        "status": "published",
        "date": "2016-12-04T02:00:41.132Z",
        "publisher": "CS 0448",
        "subject": "CS 0448"
      },
      "group": {
        "linkId": "q1",
        "question": {
          "linkId": "q1",
          "text": "Did you chew gum today?",
          "type": "radio",
          "options": [
            {
              "code": "1",
              "display": "Yes"
            },
            {
              "code": "2",
              "display": "No"
            }
          ]
        },
        "linkId": "q2",
        "text": "Did you wash your hands thoroughly today?",
        "type": "radio",
        "options": [
            {
              "code": "1",
              "display": "Yes"
            },
            {
              "code": "2",
              "display": "No"
            }
          ]
        },
        "linkId": "q3",
        "text": "Did your visitors wash their hands thoroughly?",
        "type": "radio",
        "options": [
            {
              "code": "1",
              "display": "Yes"
            },
            {
              "code": "2",
              "display": "No"
            }
          ]
        }
      ]
    }
  ]
}
```

# Targets Integration With FHIR: QuestionnaireResponse Resource

For Questionnaire and QuestionnaireResponse on FHIR:

1. it saves when you leave targets.
2. Finds all the questions on the targets page that are 'radio'
3. Sends to server and checks if questionnaire already exists. If yes, it uses that questionnaire id.
4. Gets user's responses and creates QuestionnaireResponse resource. Sends to server and gets back id.

## QuestionnaireResponse Resource

top

Hello Targets Page

profile surgery date 2016-12-01

in-hospital-targets

true

Today's History Found.

Today's History matches current phase.

saving

Saving targetsHistory

saving

Saving targetsHistory

saving

Saving targetsHistory

saving



Saving targetsHistory

saving

Found Patient ID = 2019346

Found Questionnaire ID = 2019359

New QuestionnaireResponse ID = 2019388

This is a RESTful server tester, which can be used to send requests to, and receive responses from the server at the following URL:

Resource: QuestionnaireResponse

This page contains various operations for interacting with the QuestionnaireResponse resource.

Search Queries CRUD Operations Tags

Search Parameters Optionally add parameter(s) to the search

Matches 2019388

```
{
  "resourceType": "QuestionnaireResponse",
  "id": "2019388",
  "meta": {
    "lastUpdated": "2016-12-04T03:00:20.834-05:00"
  },
  "type": "searchset",
  "link": {
    "relation": "self",
    "url": "http://52.72.172.54:8080/fhir/baseDstu2/QuestionnaireResponse?_id=2019388"
  },
  "entry": [
    {
      "fullUrl": "http://52.72.172.54:8080/fhir/baseDstu2/QuestionnaireResponse/2019388",
      "resource": {
        "resourceType": "QuestionnaireResponse",
        "id": "2019388",
        "meta": {
          "lastUpdated": "2016-12-04T02:59:47.139-05:00"
        },
        "questionnaire": {
          "reference": "Questionnaire/2019359"
        },
        "status": "completed",
        "subject": {
          "reference": "Patient/2019346"
        },
        "authored": "2016-12-04T07:59:46.736Z",
        "group": {
          "linkId": "root",
          "question": {
            "linkId": "1",
            "answer": [
              {
                "valueInteger": 1
              }
            ]
          },
          "linkId": "3",
          "answer": [
            {
              "valueInteger": 1
            }
          ]
        },
        "linkId": "4",
        "answer": [
          {
            "valueInteger": 1
          }
        ]
      },
      "linkId": "5",
      "answer": [
        {
          "valueInteger": 2
        }
      ]
    }
  ]
},
{
  "search": {
    "mode": "match"
  }
}
```

# Videos

## ERAS

### Enhanced Recovery After Surgery

Main Menu



Education



Targets



Videos



Profile



Contact



## ERAS Video Resources

Video 1: Enhanced Recovery After Surgery for Patients

Full screen is unavailable.  
[Learn More](#)



Enhanced Recovery After Surge  
*For Patients*



Video 2: Come Clean: Stop surgical infections before they start



EMORY  
HEALTHCARE

**Come Clean!**  
Stop surgical infections before they start



## ERAS Video Resources

Enhanced Recovery After Surge  
*For Patients*



Video 2: Come Clean: Stop surgical infections before they start



EMORY  
HEALTHCARE

**Come Clean!**  
Stop surgical infections before they start





# Profile


**ERAS**


Enhanced Recovery After Surgery


Main Menu


  
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**Setup: Name**

Please enter your first and last name as shown on your medical record.

First Name

Marla

Last Name

Dixon







Next >

# Contact

**ERAS**


Enhanced Recovery After Surgery

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 Videos	 Profile
 Contact	


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**Anesthesia Preoperative Clinic**


 EUH Clinic

 [404-712-5306](tel:404-712-5306)

 EUHM Clinic

 [404-686-1561](tel:404-686-1561)

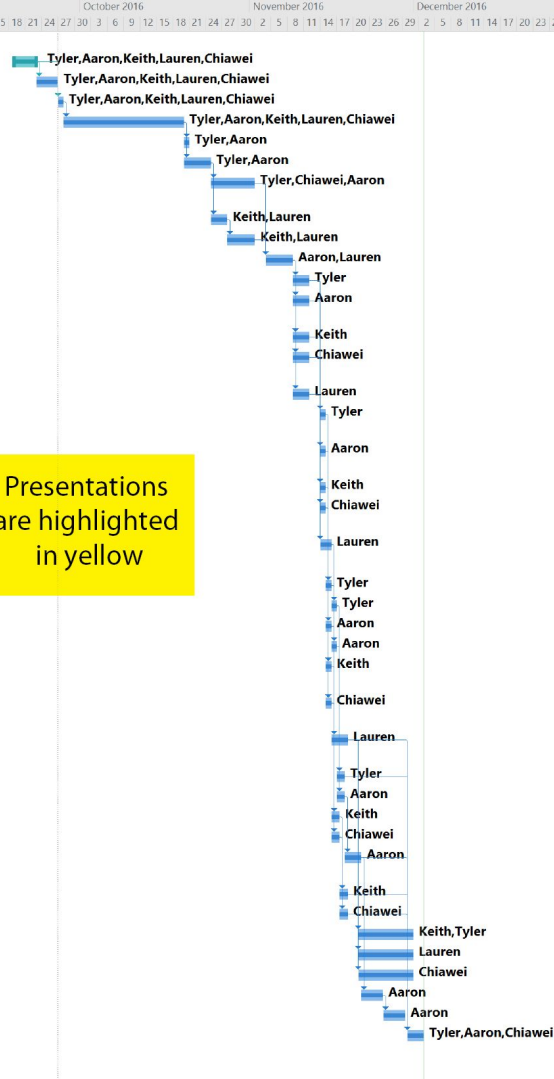
 EJCH Clinic

 [678-474-7633](tel:678-474-7633)

# Gantt Chart

	Task Mode	Task Name	Duration	Start	Finish	Prec	Resource Names
1							
2	✓	Team formation	4 days	Mon 9/19/16	Thu 9/22/16		Tyler,Aaron,Keith,Lauren
3	✓	Team Formation Presentation	2 days	Fri 9/23/16	Mon 9/26/16	2	Tyler,Aaron,Keith,Lauren
4	✓	Meet with mentor	1 day	Tue 9/27/16	Tue 9/27/16	2	Tyler,Aaron,Keith,Lauren
5	✓	Gather requirements	16 days	Wed 9/28/16	Wed 10/19/16	4	Tyler,Aaron,Keith,Lauren
6	✓	Refine project plan	1 day	Thu 10/20/16	Thu 10/20/16	5	Tyler,Aaron
7	✓	Technical presentation	3 days	Thu 10/20/16	Mon 10/24/16	5	Tyler,Aaron
8	✓	Setup DB server and design/create schema	6 days	Tue 10/25/16	Tue 11/1/16	7	Tyler,Chiawei,Aaron
9	✓	Setup PHP server	3 days	Tue 10/25/16	Thu 10/27/16	7	Keith,Lauren
10	✓	Create UI design/layout	3 days	Fri 10/28/16	Tue 11/1/16	9	Keith,Lauren
11	✓	Team Progress Report	3 days	Fri 11/4/16	Tue 11/8/16	10,8	Aaron,Lauren
12	✓	Login Screen	3 days	Wed 11/9/16	Fri 11/11/16	11	Tyler
13	✓	Intro Screen (Purpose of app)	3 days	Wed 11/9/16	Fri 11/11/16	11	Aaron
14	✓	Bowel Prep Screen	3 days	Wed 11/9/16	Fri 11/11/16	11	Keith
15	✓	Purpose of Procedure Screen	3 days	Wed 11/9/16	Fri 11/11/16	11	Chiawei
16	✓	Before surgery screen	3 days	Wed 11/9/16	Fri 11/11/16	11	Lauren
17	✓	What you can do to improve recovery screen	1 day	Mon 11/14/16	Mon 11/14/16	12	Tyler
18	✓	Taking meds morning of screen	1 day	Mon 11/14/16	Mon 11/14/16	13	Aaron
19	✓	Daily recovery diary screen	1 day	Mon 11/14/16	Mon 11/14/16	14	Keith
20	✓	Home intake/output logbook (p. 24)	1 day	Mon 11/14/16	Mon 11/14/16	15	Chiawei
21	✓	Daily tasks (p.23) and reminders	2 days	Mon 11/14/16	Tue 11/15/16	16	Lauren
22	✓	Clear liquid diet screen	1 day	Tue 11/15/16	Tue 11/15/16	17	Tyler
23	✓	Day of surgery screen	1 day	Wed 11/16/16	Wed 11/16/16	22	Tyler
24	✓	Before your surgery screen	1 day	Tue 11/15/16	Tue 11/15/16	18	Aaron
25	✓	After your surgery screen	1 day	Wed 11/16/16	Wed 11/16/16	24	Aaron
26	✓	Your hospital stay info screens (2)	1 day	Tue 11/15/16	Tue 11/15/16	19	Keith
27	✓	When can I leave the hospital screen	1 day	Tue 11/15/16	Tue 11/15/16	20	Chiawei
28	✓	Recovery timeline at home screen	3 days	Wed 11/16/16	Fri 11/18/16	21	Lauren
29	✓	Bowel recovery screen	1.5 days	Thu 11/17/16	Fri 11/18/16	23	Tyler
30	✓	Hospital maps screen	1.5 days	Thu 11/17/16	Fri 11/18/16	25	Aaron
31	✓	Contact info screen	1.5 days	Wed 11/16/16	Thu 11/17/16	26	Keith
32	✓	Ostomy education screen	1.5 days	Wed 11/16/16	Thu 11/17/16	27	Chiawei
33	✓	Best health with an Ostomy screen	1 day	Fri 11/18/16	Mon 11/21/16	30	Aaron
34	✓	Low residue diet screen	1.5 days	Thu 11/17/16	Fri 11/18/16	31	Keith
35	✓	resources screen	1.5 days	Thu 11/17/16	Fri 11/18/16	32	Chiawei
36	✓	Finalize Application Functions	8 days	Mon 11/21/16	Wed 11/30/16	34	Keith,Tyler
37	✓	Finalize Application Skinning	8 days	Mon 11/21/16	Wed 11/30/16	28	Lauren
38	✓	Application Icon and Graphics	8 days	Mon 11/21/16	Wed 11/30/16	35	Chiawei
39	✓	Organization Final Turn In	4 days	Mon 11/21/16	Fri 11/25/16	33	Aaron
40	✓	Finalize Gantt Chart	2 days	Fri 11/25/16	Tue 11/29/16	39	Aaron
41	✓	Final Project Presentation	3 days	Wed 11/30/16	Fri 12/2/16	35,34	Tyler,Aaron,Chiawei

Presentations are highlighted in yellow



# Next Step (Future Improvement)



- Deployment with client - 12/7/2016
- Communication with Existing Client EHR Server
- Full SQLite Implementation
- Push notification from physician (ex: change of surgery date)
- Consult physician through in app messaging
- Admin login on physician end to track patient targets within app