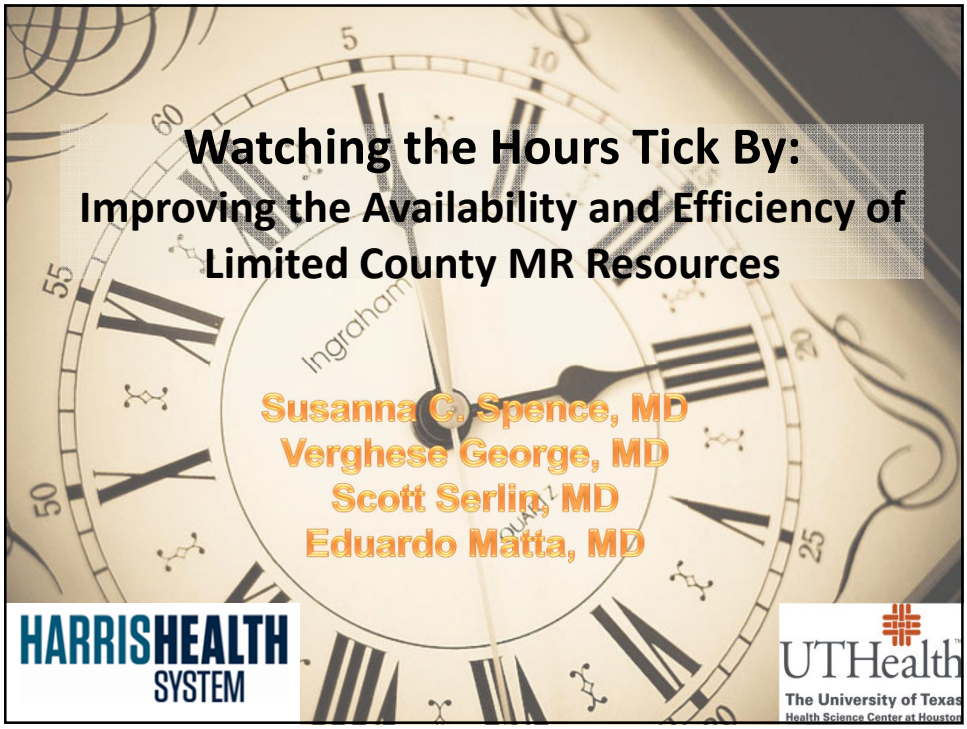
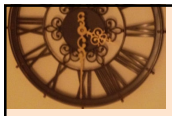


Introduction: the Problem

- LBJ county hospital:
  - has 330 inpatient beds
  - is the busiest level III trauma center in the state
- The hospital has a single 1.5T magnet to serve both emergency department and inpatient needs.
- In addition, the magnet shares responsibility with others in the system to serve a large outpatient population.
- The magnet runs extended hours daily 6:30am-9pm (21 slots) to serve the outpatient demand.
- Next available appointment for outpatients: 6 weeks 1 day

INPATIENT Outpatient Emergency



Introduction: the Problem

However, after obtaining an MR slot, at the start of the project:

- Almost half (48.5%) of outpatients were waiting >1 hour past their scheduled start time for their scan to begin.
- 16.2 % were waiting > 2 hours, and some 3-4 hours past their scheduled start time.

This resulted in frustration, with some patients walking out without being scanned because they had to return to work, family, or simply were not willing to wait.

Those patients then needed to be rescheduled, further delaying the information needed for their care.

ER and inpatient physicians were often aggravated due to long delays waiting for MRs to be performed between delayed outpatient slots.

Methods

Put together a multidisciplinary team, including

- Radiologists from neuro, body and MSK
- Technologists from multiple shifts
- Tech supervisors
- Administrative personnel

First steps:

- Go to Gemba
- Process mapping
- Cause/effect diagram

Methods

Discussion with our team, and following the technologists and patients showed many potential areas to be addressed:

SCHEDULING:

- Inpatient and ER add ons contributed to the outpatient delays. No reserved slots for inpt/ER add ons are permitted, therefore these patients are squeezed in front of, between, or after outpatients.
- Patient would arrive and wait, and only later would be found to be over the table weight limit, or be too claustrophobic to undergo the examination.
- Some patients would arrive in the morning for an evening exam (e.g. the 8:30 **PM** patient showing up at 8:30 **AM**), resulting in additional volume in the busy morning hours

PROCESS:

- The first patient of the day at 6:30am was often delayed until well after 7am. The radiology check in office did not even open until 7am, therefore the patient had to know to check in at the ER (but often didn't know)
- Frail or deconditioned patients take a lot of time to safely get on the table, delaying their scan.
- Anesthesia patients take up a lot of time, with patients being prepped on the MR table outside the room while the magnet is empty.

Methods

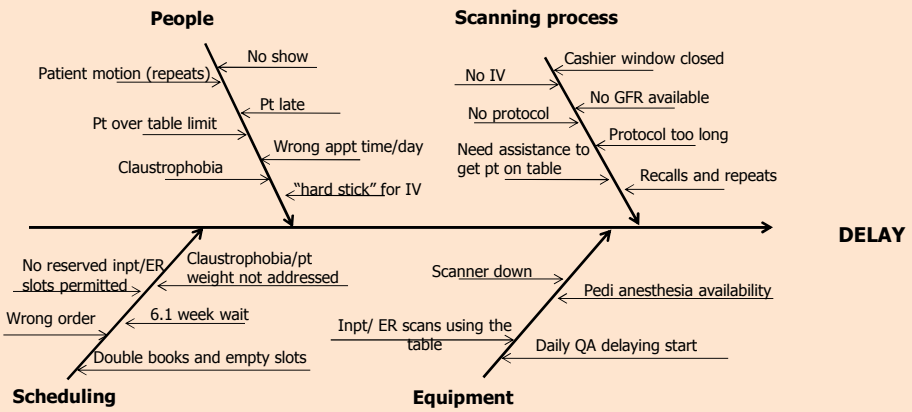
PEOPLE (INCLUDING THE RADIOLOGIST)

- If a radiologist protocol was not available, the patient could not be scanned until the protocol was completed.
- The outpatient slots are 45 mins long, but many of the scan protocols are outdated and long, running >1hr in those 45 min slots.
- Add patient changeover time to those long scan times, and you get an accumulating delay.

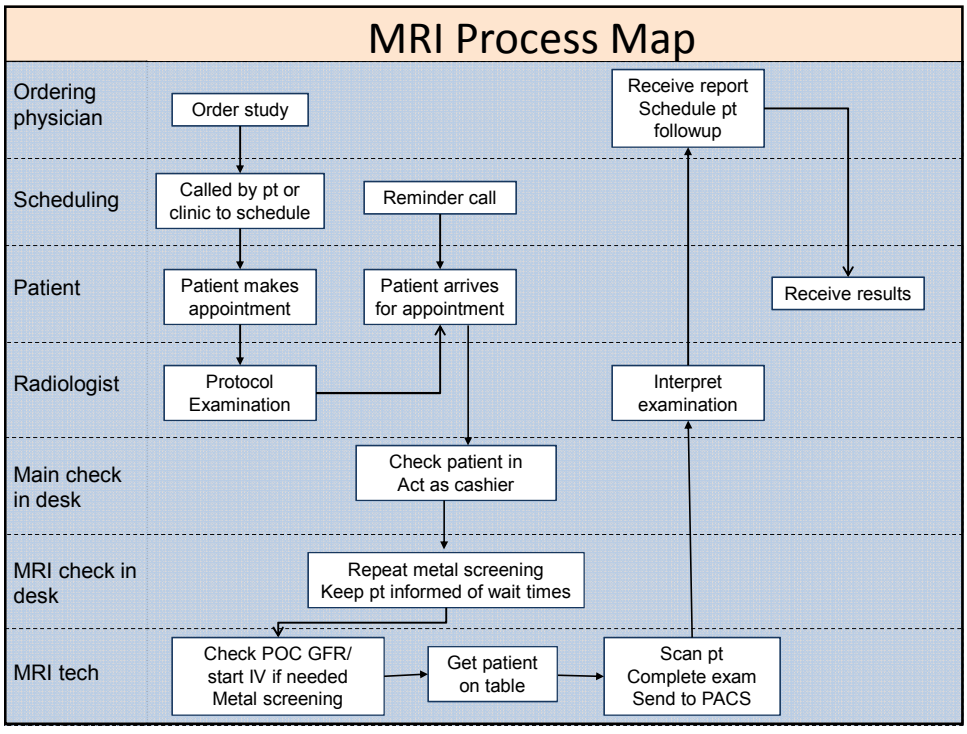
EQUIPMENT:

- Daily QA running into first appointment slot
- Table in use by the prior patient
- Scanner down

Fishbone: Cause and Effect



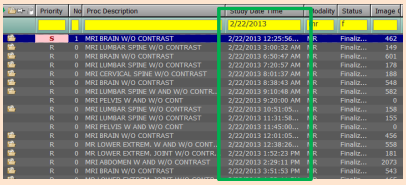
MRI Process Map



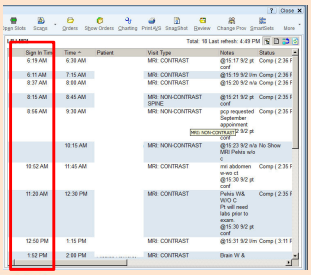
Data Analysis

Once several potential problems had been identified, data analysis of the baseline cases was performed to evaluate the true incidence of these problems

This was easier said than done. The check in data was manually entered in one system, and the exam start time data was entered into a completely different system. There was no automated way to obtain the numbers.



The numbers from each system were entered manually on an excel spreadsheet to create usable data



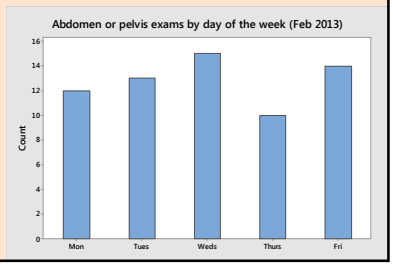
	Date	Pt #	Study type	Appt time	Sign in/check in time	Scan start time	Differential	inpt/ER	outpt scan	>1hr	>2hrs	>3hrs	>4hrs
482		1	l spine w/o	6:30	7:06	7:21	0:15		1				
483		2	brain w/o	7:15	6:22	6:51	0:00		1				
484		3	brain w/o	8:00	8:02	8:39	0:39		1				
485		4	l spine w/o	8:45	8:16	10:51	2:06		1	1	1		
486		5	l spine w/o AND brain w/o	9:30	9:37	11:32	1:55		2	2			
487		6	lower w and w/o	10:15	9:47	12:38	2:23		1	1	1		
488		7	lower w/o	11:00	10:46	13:52	2:52		1	1	1		
489		8	abd/pel w and w/o	11:45	11:21	14:29	2:44		1	1	1		
490		9		12:30	same pt as above								
491		10	brain w/o	13:15	12:37	15:52	2:37		1	1	1		
492		11		14:00	empty slot								
493		12	lower w/o	14:45	14:38	16:22	1:37		1	1			
494		13	l spine w/o	15:30	15:04	17:07	1:37		1	1			
495		14	l spine w and w/o	16:15	15:21	17:42	1:27		1	1			
496		15	brain w/o	17:00	16:56	18:33	1:33		1	1			
497		16	l spine w/o	17:45	16:54	19:10	1:25		1	1			
498		17	brain w/o	18:30	17:41	19:43	1:13		1	1			
499		18		19:15	empty slot								
500		19	c-spine w/o	20:00	7:51 AM!!	8:02 AM!!	0:00		1				
501		20	l spine w/o	20:25	20:12	20:51	0:26		1				
502		21	t and l w and w/o	21:30	16:44	21:53	0:23		2				
503						AVERAGE:	1:24						
504		INPT/ER											
505		1	brain w/o			0:26		1					
506		2	lumbar w/o			3:00		1					
507		3	pelvis and L spine w and w/o			9:11		2					
508		4	c-spine w/o			23:58		1					

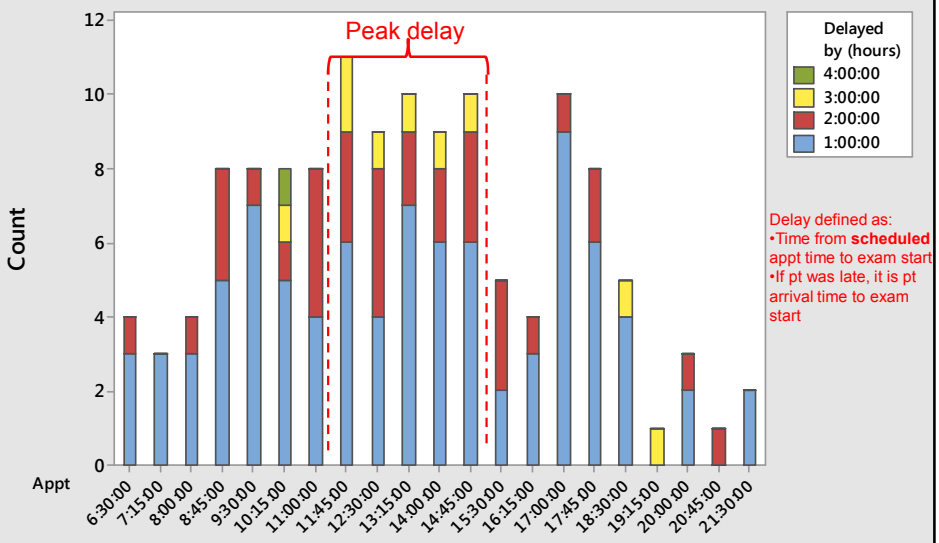
Data Analysis

Pt check in time, appointment time, exam start time, exam type and any comments were manually reviewed for an entire month, for baseline data.

The data were then analyzed based on:

- Time of day
- Day of week
- Effect of inpt/ER pts
- Exam type
- Recurring problems





Delay was cumulative, building up over the morning hours to a peak at midday. This focused our attention on the early and midmorning hours

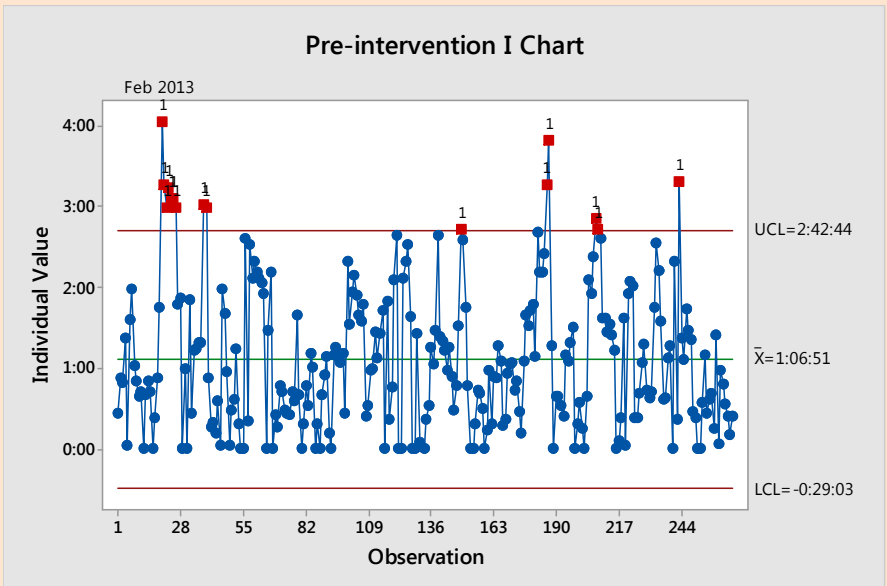
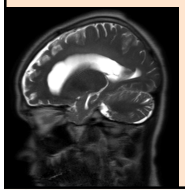


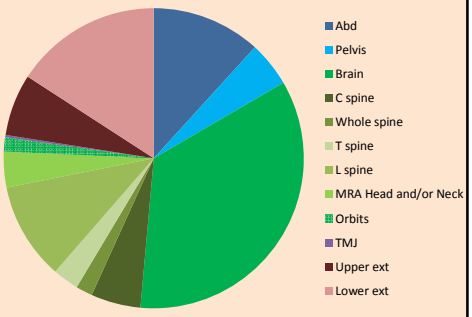
Chart shows the wait times of individual outpatients, sequentially, over the month of Feb, 2013
Mean wait time was 1:06:51 hours, with a huge variation from day to day

Baseline data: February 2013

Analyzing the most common examinations performed allowed us to target the most common exams for an extensive overhaul of the protocols.

Brain, lumbar spine and lower extremity examinations were shortened to <30 mins

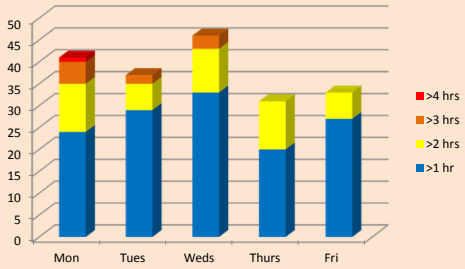




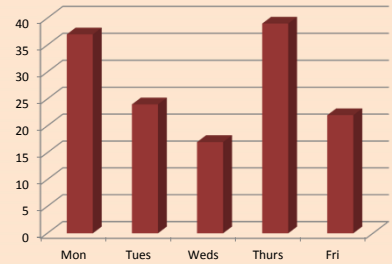
Distribution of exam types
(Neuro, Body, MSK)

Baseline data: February 2013

Outpatient delays by day of the week



Number of inpatients scanned by day of the week



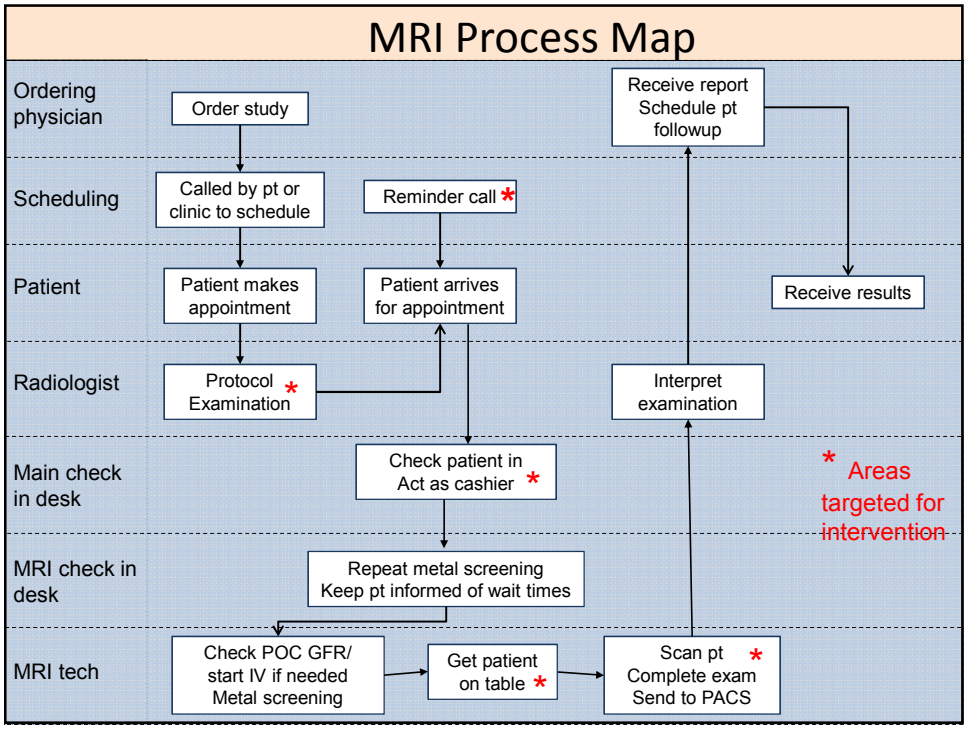
While the greatest number of delayed patients were on Wednesdays, the longest delays were on Mondays

Initial assumption: A larger number of inpatients were being scanned on Mondays, perhaps backlogged from the weekend.

However, while it was true that the second highest number of inpatients were scanned on Mondays, even more were scanned on Thursdays, **without the same result**

The small number of inpatients scanned on Wednesdays **do not explain** the significant delays on that day.

Additional investigations based on types of exams, number of no shows, number of contrast exams failed to show a 1:1 correlation. The problem is multifactorial, with different issues dominating from day by day.



Interventions

Based on input from all parties, the following were undertaken:

OWNER: RADIOLOGISTS

- All protocols shortened to <40 mins, except for some complex body studies => at least 5 mins left for table turnaround
- Some common exams (MR brain w/o, lumbar spine w/o, knee w/o, shoulder w/o shortened to <30 mins)
- Second hand MR table purchased for more efficient patient turnaround
- Instituted protocolling of all outpatient studies at least 2-3 days before patient arrival, to ensure protocol was ready when patient arrived

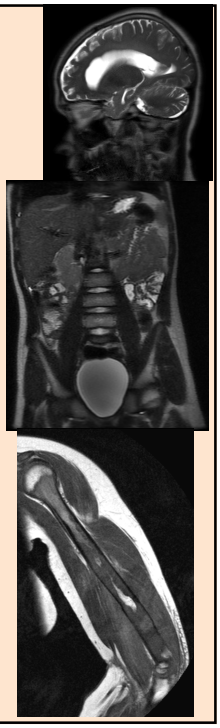
Interventions

OWNER: SCHEDULING

- Remind pts of **PM** time of evening appointments
- Ensure two exams aren't booked in the same slot
- Remind 6:30am patients that they need to go to the ER to check in.
- Ask screening questions for patient weight, claustrophobia, metal
- Step up reminder calls

OWNER: MR TECHNOLOGIST

- Implement the updated protocols
- Utilize the second table for more efficient turnaround
- Raise problems/ issues as they arise

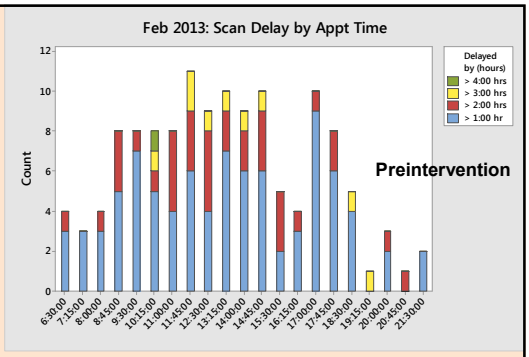


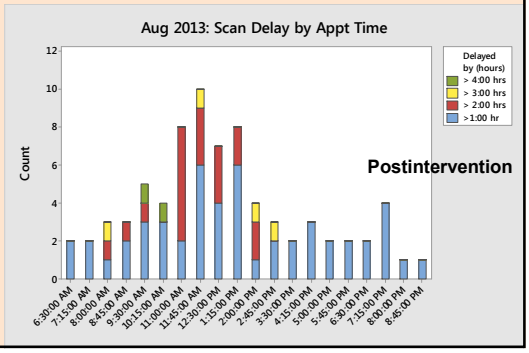
Results

Delay by appointment time decreased across the board.

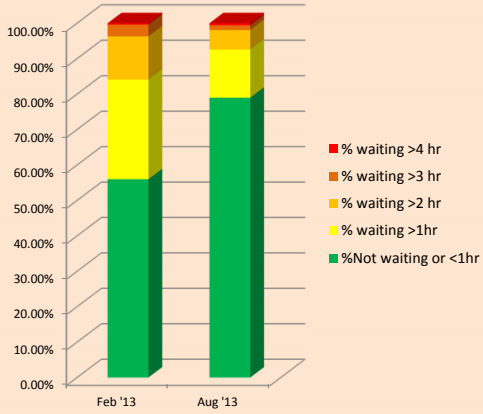
Notably, the delays started later in the day, the peak was lower, and the wait time recovered faster than in the preintervention period.

There was still a midday peak in wait times





Results



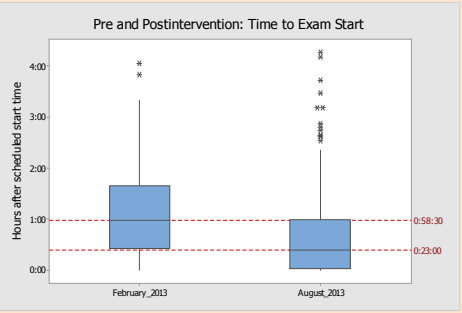
	Feb '13	Aug '13
% waiting >1hr	28.1%	13.6%
% waiting >2 hr	12.2%	5.5%
% waiting >3 hr	3.3%	1.3%
% waiting >4 hr	0.4%	0.6%
Cumulative total (pts waiting 1hr or longer)	**48.5%**	**24.1%**

Number of patients waiting >1hr past their scheduled start time for their exam to start decreased from 48.5% to 24.1%

This information is made available to the techs, to show progress, and the work that is left to be done.

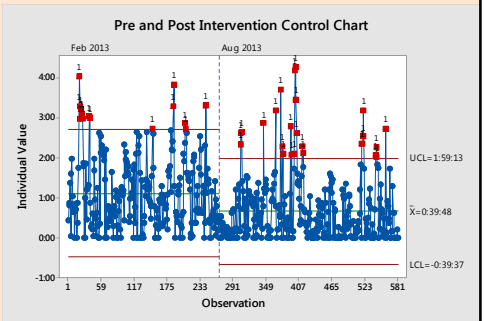
All wait time categories decreased, except for one extra patient waiting >4hrs in the post intervention period

Results



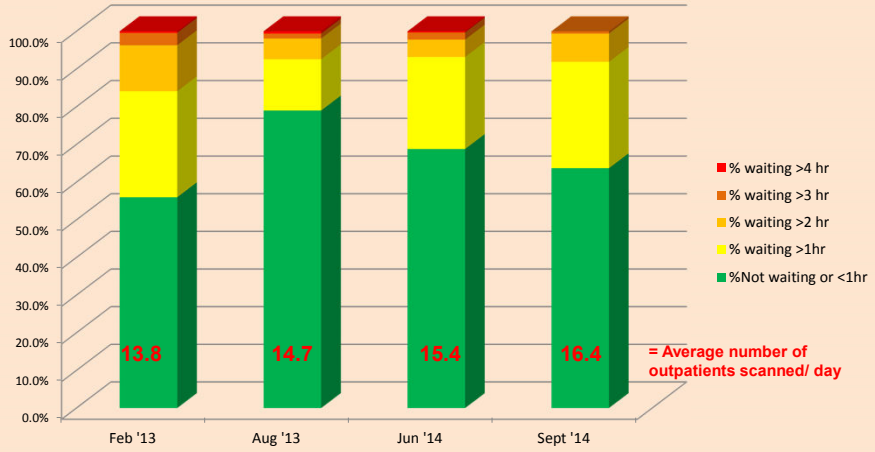
Median time to start scan decreased from 58:30 to 23:00 minutes

Mean time to start scan decreased from 1:06:51 to 39:48



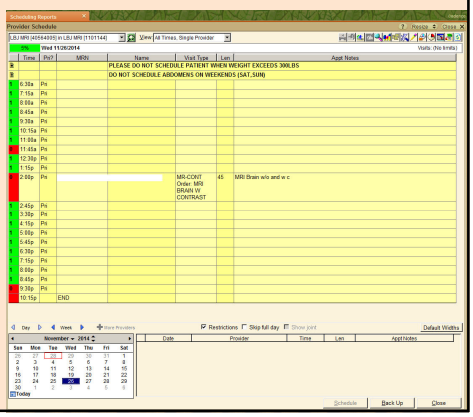
MRI outpatient wait times: 2014 update

- Number of outpatients scanned per day continues to increase over time (see red numbers below).
- No extra slots have been created, the increase is a result of a drop in the number of “no shows” and patients leaving before their scan.
- The increase in patient volume is causing an upwards creep in the wait times again.



Next Steps

- Change the scheduling template so that longer examinations are alternated with shorter ones, to avoid cumulative morning delays
- Make sure different examination types are scheduled next to each other, so that the next pt can be prepped outside the room on the 2nd table, as a different coil will be used
- Recruit the MR tech students to assist in preparing the next patient outside the room on the 2nd table, to allow the MR tech to continue with the current scan



Lessons Learned

When the project was started, most of the radiologists were oblivious to the amount of time the patients were waiting

The reasons for the wait time were multifactorial, but simply looking at the numbers would never have told us the answers

The different reasons for the delays were contributed by techs, schedulers and administrators on the ground, and by direct observation.

Several of the problems were **pretty evident** to the techs and supervisors working there day to day, however the **solutions** were either unclear, or beyond their sphere of influence (radiologist protocol unavailable, scan protocol too long etc).

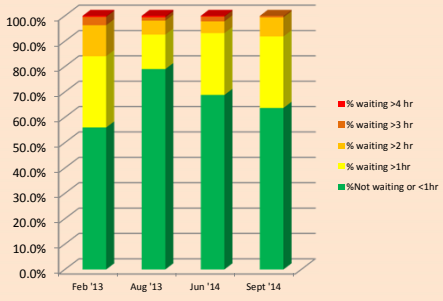
Getting us all together and raising awareness was already a huge step in the right direction.

Lessons Learned

We have never declared victory on this project. A “green” bar that encompasses patients waiting up to 59 mins past their start time is not our end goal. Wait times are not good enough yet.

We will continue to work with our techs, schedulers and administrators in the next phases of the project to bring wait times down further.

We look continue to run our PDSA cycles until we reach a level we are happy with.



Many Thanks to Our Team!

- Tony Thomas
- Canh Phan
- Shekita Williams
- Thomas Verghese
- Norma Thomas
- Susanna Spence
- Verghese George
- Scott Serlin
- Eduardo Matta