

# **Hospital Operating Room Utilization: Scheduled Case Time and Actual Procedure Durations**

IE 6200 Term Project

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## **2 ABSTRACT**

One of the most significant and lucrative revenue sources for hospitals and medical centers around the world are procedures done in the operating room. With each hospital having a limited number of operating rooms available in their given facility, ensuring that these rooms are utilized in an optimal manner is essential towards maximizing both profitability as well as patient experience. This report aims to examine to examine and perform statistical analysis on the operating room data of a nearby hospital (Beth Israel Deaconess Medical Center) to assess the medical center's performance when it comes to their allocation of scheduled case times. We will be examining the impact patient gender has regarding the time a particular operating room procedure takes to provide recommendations on whether additional time should be scheduled for patients of a particular gender.

## **3 METHODOLOGY**

### **3.1 Source and Quality of Data**

The data utilized for this report derives from the internal database server for the Department of Surgery at Beth Israel Deaconess Medical Center (BIDMC). With one of our team members being employed as a Data Integration Analyst within BIDMC's Department of Surgery, unique access was granted to design the dataset for this report using internal data. After coming together as a group to discuss various ideas, we decided to analyze operating room (OR) data due to a shared interest in the topic and the high quality of data that was available. With this shared vision in mind, a SQL query was written to pull the desired OR data elements, filter the data to fit within our desired period (Jan 2022 – June 2022), and join this data with additional patient information to create a more detailed dataset.

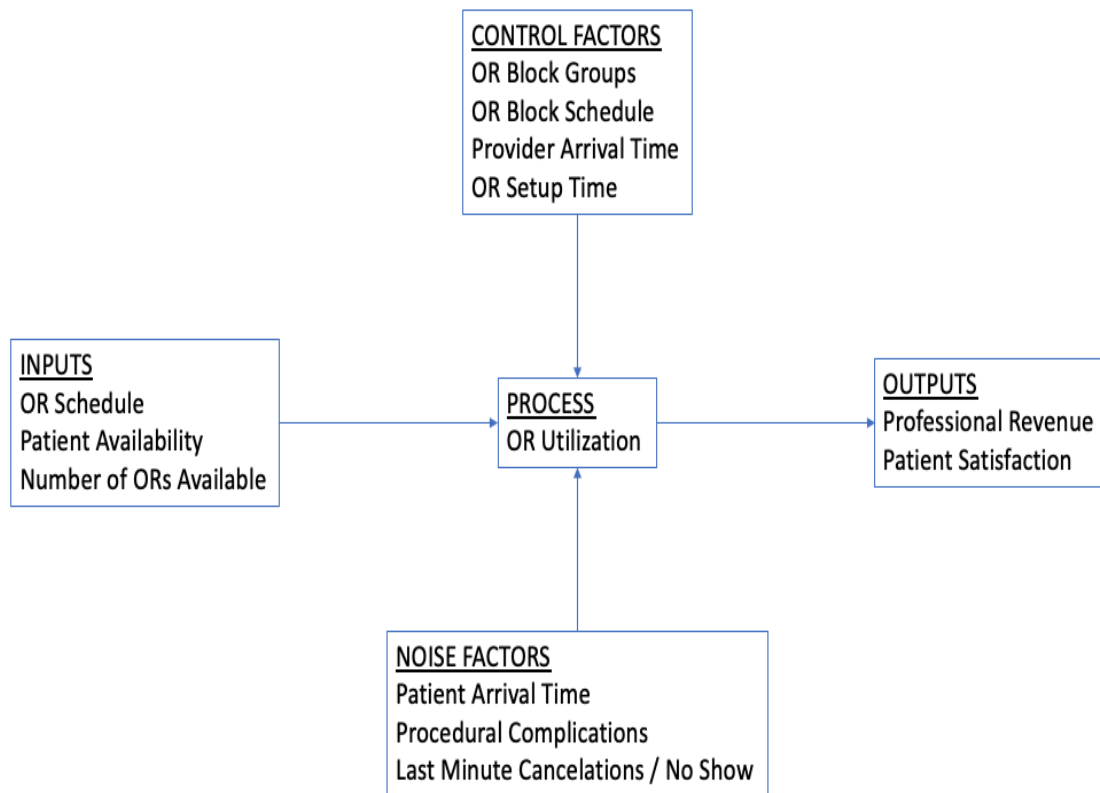
### **3.2 Data Fields**

Descriptions of each field used in the dataset for this report:

- **case\_id:** A unique six-digit identifier used to distinguish each OR case.
- **case\_start:** The date on which the OR procedure was held.
- **or\_suite\_desc:** The name of the OR used for the procedure.
- **prov\_div\_desc:** The type of procedure that was performed.
- **pat\_dob:** The date of birth of the patient.
- **pat\_gender:** The gender of the patient.
- **pat\_type\_bidmc:** Distinguishes whether the patient was listed as either inpatient, outpatient, or in observation at the time of the procedure.
- **setup\_dt\_tm:** The time when the physician began setting up the OR.
- **pat\_in\_dt\_tm:** The time when the patient arrived in the OR.
- **pat\_or\_dt\_tm:** The time when the patient left the OR.
- **tot\_or\_min:** The total amount of time the patient was in the OR in minutes.
- **sch\_start\_dt\_tm:** The time when the OR case was scheduled to begin.
- **sch\_end\_dt\_tm:** The time when the OR case was scheduled to end.
- **tot\_sch\_min:** The total amount of time scheduled for the OR case in minutes.

- `prep_start_dt_tm`: The time when the physician began preparing for the incision.
- `prep_end_dt_tm`: The time when the physician finished preparing for the incision.
- `tot_prep_min`: The total amount of time the physician took to prepare for the incision in minutes.
- `inc_open_dt_tm`: The time when the physician made their first incision.
- `inc_close_dt_tm`: The time when the procedure was completed.
- `tot_inc_min`: The total amount of time the actual procedure lasted in minutes.
- `turnover_min`: The total amount of time after the patient left the OR where the facility went unutilized in minutes.
- `or_staff_num`: The number of people in the OR during the procedure.

## 4 P-DIAGRAM



## 5 DATA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	case_id	case_start	or_suite_d	prov_div_d	pat_dob	pat_gender	pat_type_b	setup_dt_t	pat_in_dt	pat_out_dt	tot_or_mir	sch_start_c	sch_end_dt	tot_sch_mi	prep_start	prep_end_c	tot_prep_n	inc_open_c	inc_close_c	tot_inc_mi	turnover_n	or_staff_num
2	625668	1/18/22	Shapiro 08	ORTHOPE	12/18/52	M	OP	10:00.0	59:00.0	28:00.0	89	45:00.0	30:00.0	105	07:00.0	11:00.0	4	11:00.0	24:00.0	73	65	2
3	629857	3/25/22	Main 09	ORTHOPE	6/20/44	M	INP	45:00.0	12:00.0	25:00.0	133	00:00.0	30:00.0	150	21:00.0	54:00.0	33	54:00.0	19:00.0	85	89	2
4	631618	4/21/22	Shapiro 07	ORTHOPE	12/24/49	F	OP	37:00.0	43:00.0	35:00.0	52	45:00.0	30:00.0	45	50:00.0	50:00.0	0	50:00.0	29:00.0	39	13	2
5	630427	4/4/22	Shapiro 06	SURGICAL	8/11/35	F	OBV	11:00.0	33:00.0	48:00.0	195	30:00.0	00:00.0	210	43:00.0	01:00.0	18	01:00.0	41:00.0	160	0	2
6	624988	1/3/22	Main 12	NEURO SUR	9/19/62	F	INP	02:00.0	40:00.0	58:00.0	318	30:00.0	45:00.0	315	51:00.0	23:00.0	32	23:00.0	39:00.0	256	0	2
7	635981	6/27/22	Cysto 1	UROLOGY	1/14/64	F	OP	40:00.0	56:00.0	56:00.0	60	45:00.0	15:00.0	90	01:00.0	09:00.0	8	09:00.0	46:00.0	37	34	2
8	630985	4/12/22	Main 14	OB/GYN	7/25/86	F	OP	12:00.0	10:00.0	55:00.0	105	30:00.0	00:00.0	150	25:00.0	53:00.0	28	53:00.0	42:00.0	49	0	2
9	629915	3/28/22	Cysto 1	UROLOGY	11/23/51	F	OP	00:00.0	48:00.0	57:00.0	69	30:00.0	00:00.0	90	54:00.0	06:00.0	12	06:00.0	37:00.0	31	0	2
10	628556	3/7/22	Cysto 1	UROLOGY	11/23/51	F	OP	40:00.0	55:00.0	19:00.0	84	30:00.0	00:00.0	90	17:00.0	25:00.0	8	25:00.0	56:00.0	31	24	3
11	633923	5/26/22	Main 11	ORTHOPE	7/27/36	F	OP	00:00.0	30:00.0	51:00.0	81	30:00.0	30:00.0	120	38:00.0	53:00.0	15	53:00.0	47:00.0	54	0	2
12	631820	4/25/22	Main 01	VASCULAR	9/6/68	M	INP	45:00.0	45:00.0	54:00.0	309	30:00.0	30:00.0	240	02:00.0	42:00.0	40	42:00.0	42:00.0	240	0	2
13	635776	6/23/22	Main 12A	COLON AN	8/25/65	M	OBV	57:00.0	37:00.0	15:00.0	98	30:00.0	45:00.0	135	46:00.0	06:00.0	20	06:00.0	06:00.0	60	123	2
14	633715	5/23/22	Cysto 1	UROLOGY	6/3/45	M	OP	01:00.0	14:00.0	36:00.0	22	00:00.0	30:00.0	90	18:00.0	24:00.0	6	24:00.0	29:00.0	5	31	2
15	627811	2/23/22	Shapiro 01	OPHTHALM	2/11/53	F	OP	51:00.0	06:00.0	32:00.0	26	00:00.0	45:00.0	45	14:00.0	15:00.0	1	15:00.0	29:00.0	14	25	2
16	633403	5/18/22	Feldberg 11	OB/GYN	3/20/39	F	INP	30:00.0	30:00.0	21:00.0	171	00:00.0	45:00.0	165	43:00.0	02:00.0	19	02:00.0	08:00.0	126	0	2
17	625528	1/13/22	Feldberg 08	OB/GYN	12/11/65	F	OP	20:00.0	52:00.0	07:00.0	195	45:00.0	45:00.0	180	01:00.0	23:00.0	22	23:00.0	25:00.0	62	52	2
18	629600	3/22/22	Shapiro 08	ORTHOPE	3/14/57	M	OP	46:00.0	03:00.0	53:00.0	170	15:00.0	15:00.0	120	15:00.0	20:00.0	5	20:00.0	49:00.0	149	25	2
19	634256	6/1/22	Shapiro 01	OPHTHALM	12/10/59	M	OP	17:00.0	33:00.0	02:00.0	29	00:00.0	00:00.0	60	39:00.0	42:00.0	3	42:00.0	00:00.0	18	30	2
20	631833	4/26/22	Main 10	NEURO SUR	12/10/59	M	OBV	15:00.0	38:00.0	03:00.0	145	45:00.0	45:00.0	180	51:00.0	09:00.0	18	09:00.0	49:00.0	100	51	2
21	635153	6/15/22	Shapiro 01	OPHTHALM	12/10/59	M	OP	08:00.0	29:00.0	53:00.0	24	45:00.0	30:00.0	45	31:00.0	35:00.0	4	35:00.0	52:00.0	17	30	2
22	627497	2/17/22	Feldberg 02	UROLOGY	8/30/66	M	OBV	57:00.0	20:00.0	52:00.0	152	45:00.0	00:00.0	255	32:00.0	47:00.0	15	47:00.0	47:00.0	120	50	2
23	635213	6/15/22	Feldberg 02	ACUTE CAR	7/17/49	M	OP	38:00.0	05:00.0	18:00.0	73	15:00.0	30:00.0	135	12:00.0	27:00.0	15	27:00.0	11:00.0	44	49	2
24	630519	4/5/22	Feldberg 02	OB/GYN	8/8/60	F	OP	57:00.0	15:00.0	11:00.0	56	45:00.0	30:00.0	105	23:00.0	35:00.0	12	35:00.0	05:00.0	30	45	2
25	635509	6/20/22	Main 16	GENERAL S	9/26/45	F	INP	10:00.0	51:00.0	30:00.0	39	30:00.0	45:00.0	75	03:00.0	07:00.0	4	07:00.0	30:00.0	23	70	2
26	629696	3/24/22	Shapiro 03	SURGICAL	12/25/47	F	OP	12:00.0	37:00.0	12:00.0	95	00:00.0	30:00.0	150	45:00.0	09:00.0	24	09:00.0	05:00.0	56	36	2
27	632370	5/4/22	Shapiro 07	ANESTHES	1/26/34	M	OP	10:00.0	38:00.0	26:00.0	168	30:00.0	45:00.0	195	51:00.0	11:00.0	20	11:00.0	14:00.0	123	55	2
28	635375	6/17/22	Feldberg 02	GYNECOLO	2/18/70	F	OP	00:00.0	35:00.0	11:00.0	276	30:00.0	30:00.0	300	44:00.0	05:00.0	21	05:00.0	01:00.0	236	0	2
29	627224	2/14/22	Shapiro 01	OPHTHALM	1/7/54	F	OP	00:00.0	37:00.0	07:00.0	90	30:00.0	30:00.0	120	51:00.0	52:00.0	1	52:00.0	04:00.0	72	0	2
30	634627	6/7/22	Shapiro 08	ORTHOPE	3/31/63	F	OBV	33:00.0	07:00.0	00:00.0	173	15:00.0	15:00.0	180	17:00.0	43:00.0	26	43:00.0	34:00.0	111	46	2
31	626005	1/24/22	Feldberg 02	E.N.T.	1/11/41	M	INP	20:00.0	40:00.0	38:00.0	358	30:00.0	30:00.0	600	02:00.0	36:00.0	34	36:00.0	05:00.0	269	0	2
32	626071	1/25/22	Feldberg 04	E.N.T.	1/11/41	M	INP	00:00.0	08:00.0	47:00.0	159	00:00.0	45:00.0	165	27:00.0	36:00.0	9	36:00.0	08:00.0	92	0	2
33	629198	3/16/22	Feldberg 02	COLON AN	3/7/71	M	OP	45:00.0	49:00.0	59:00.0	70	30:00.0	45:00.0	75	55:00.0	01:00.0	6	01:00.0	54:00.0	53	0	2
34	631800	4/25/22	Main 05	CARDIAC S	8/12/38	M	INP	50:00.0	18:00.0	00:00.0	282	15:00.0	45:00.0	330	02:00.0	43:00.0	41	43:00.0	46:00.0	183	0	3
35	630211	3/31/22	Cysto 1	RADIATION	7/20/49	M	OP	30:00.0	49:00.0	36:00.0	47	15:00.0	15:00.0	60	55:00.0	03:00.0	8	03:00.0	27:00.0	24	25	2
36	625024	1/3/22	Feldberg 08	SURGICAL	7/16/66	F	OBV	00:00.0	56:00.0	49:00.0	233	15:00.0	15:00.0	300	05:00.0	22:00.0	17	22:00.0	55:00.0	93	0	2
37	632874	5/11/22	Shapiro 01	OPHTHALM	2/19/61	F	OP	51:00.0	25:00.0	54:00.0	29	45:00.0	30:00.0	45	33:00.0	33:00.0	0	33:00.0	51:00.0	18	42	2
38	629686	3/23/22	Feldberg 06	COLON AN	11/7/58	M	INP	30:00.0	30:00.0	10:00.0	160	30:00.0	30:00.0	180	39:00.0	56:00.0	17	56:00.0	06:00.0	130	0	2
39	631304	4/15/22	Main 04	CARDIAC S	3/2/47	F	INP	25:00.0	01:00.0	28:00.0	267	00:00.0	30:00.0	330	38:00.0	09:00.0	31	09:00.0	08:00.0	179	60	3
40	631567	4/21/22	Shapiro 08	ORTHOPE	3/23/64	M	OP	10:00.0	18:00.0	47:00.0	29	30:00.0	00:00.0	30	20:00.0	27:00.0	7	27:00.0	43:00.0	16	16	2
41	635522	6/21/22	Feldberg 06	COLON AN	10/4/66	M	INP	25:00.0	05:00.0	11:00.0	126	15:00.0	45:00.0	210	17:00.0	37:00.0	20	37:00.0	04:00.0	87	64	2
42	635986	6/27/22	Main 09	ORTHOPE	7/21/54	F	OBV	00:00.0	36:00.0	43:00.0	127	30:00.0	00:00.0	150	51:00.0	06:00.0	15	06:00.0	24:00.0	78	0	2
43	628983	3/14/22	Feldberg 07	UROLOGY	2/17/59	F	OBV	30:00.0	58:00.0	41:00.0	223	00:00.0	45:00.0	285	10:00.0	43:00.0	33	43:00.0	20:00.0	157	64	2

\*Note: Displayed are only the first 43 rows of 10,700 rows worth of data.

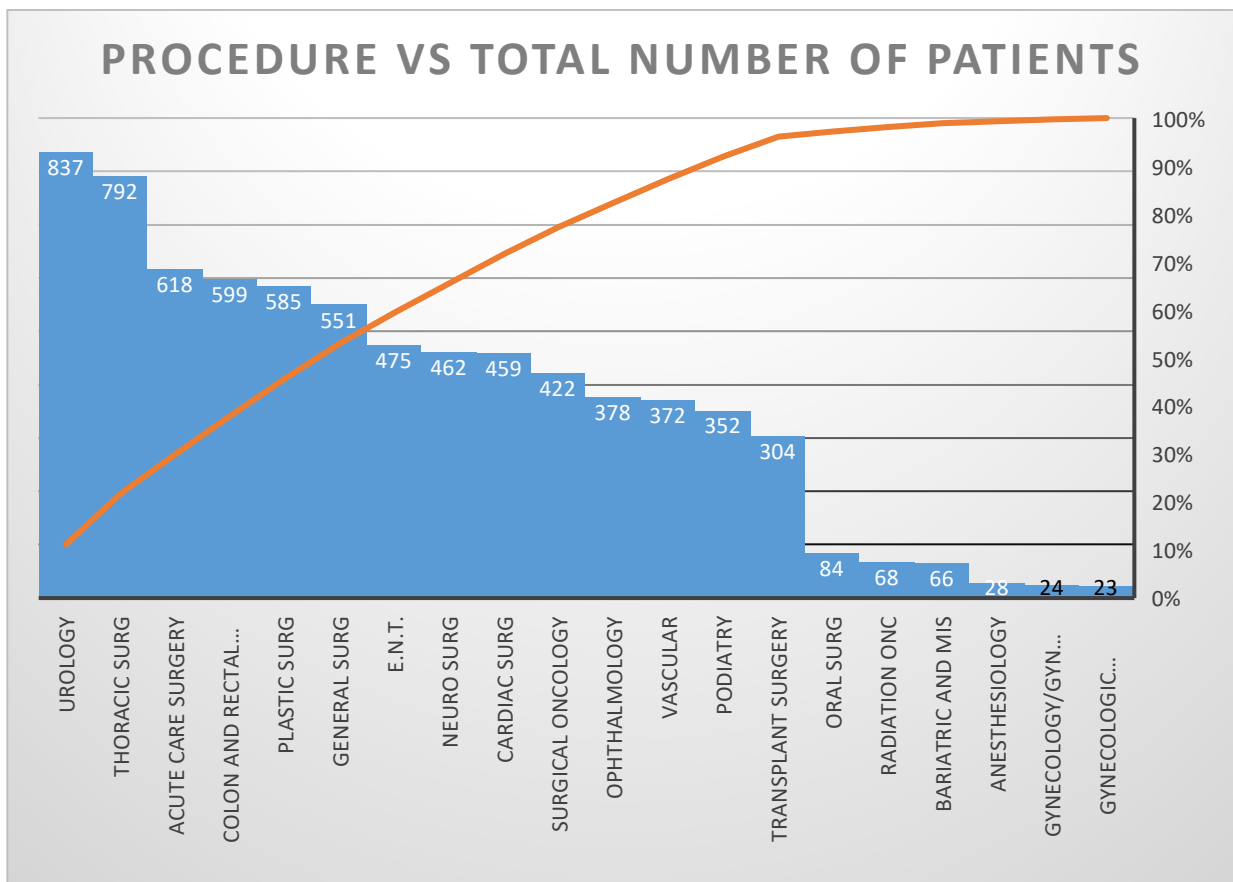
## 6 DESCRIPTIVE STATISTICS

We classified each procedure to delve deeply into the analytical insights provided by the data. And calculated the number of patients corresponding to each type of procedure, as well as the number of OR theatres used for each type of procedure. We calculated the total time an Operation Room is empty by subtracting the expected and actual case time for each procedure. We concluded some suggestions backed by strong insights for the hospital to maximize the utilization time of the operation theatre based on a procedure's demand for a specific type of OR theatre. To compare the data values for each procedure, we used pivot tables. We used histograms and stack graphs to visualize this data.

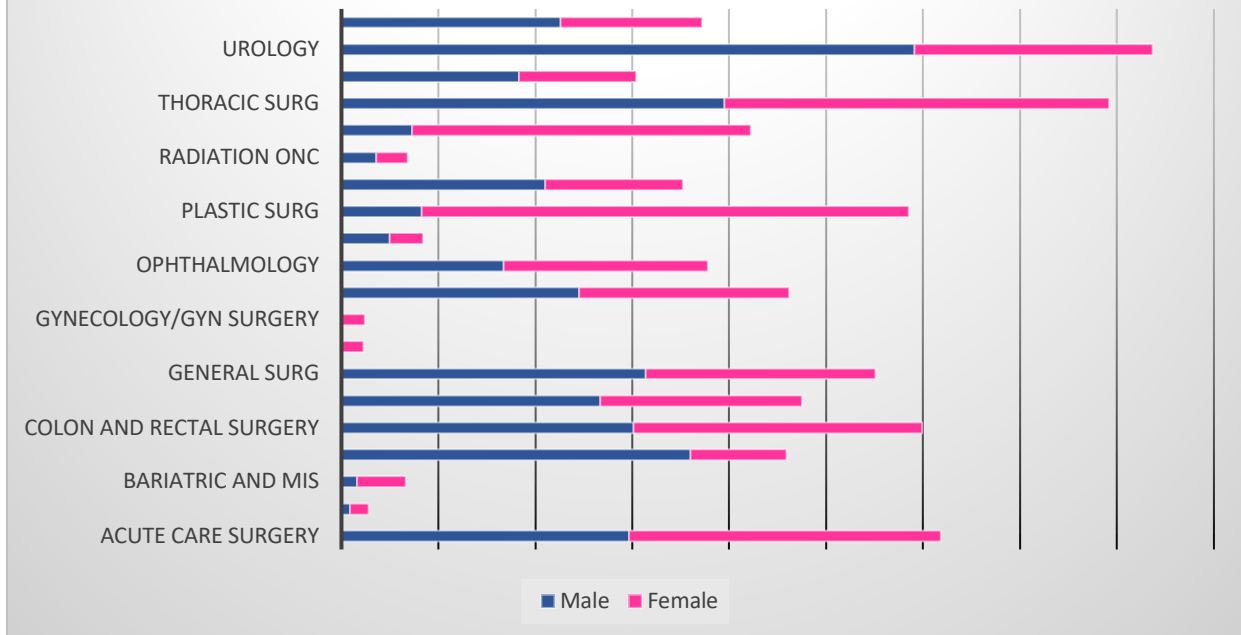
Procedure	Male	Female	Total num	Min of Patien	Max	Sum of	Sum of	Average	Average	Difference	M OR	F OR	M Sch	F Sch	Sched	Sched	Time d	Average
ACUTE CARE SURGERY	297	321	618	19	102	83202	95255	134.63	154.1	19.5	40311	42891	44685	50570	14.727	23.922	19.503	60.11165
ANESTHESIOLOGY	9	19	28	49	88	2901	3900	103.61	139.3	35.68	917	1984	1230	2670	34.778	36.105	35.679	62.60714
BARIATRIC AND MIS	16	50	66	22	83	10640	11429	161.21	173.2	11.95	2078	8562	2445	8984	22.938	8.44	11.955	46.71212
CARDIAC SURG	360	99	459	30	89	138741	152930	302.27	333.2	30.91	107333	31408	119351	33579	33.383	21.929	30.913	65.2658
COLON AND RECTAL SURGERY	301	298	599	19	103	76742	88314	128.12	147.4	19.32	39834	36908	44758	43556	16.359	22.309	19.319	54.91987
E.N.T.	267	208	475	19	94	72747	86518	153.15	182.1	28.99	42155	30592	48719	37799	24.584	34.649	28.992	57.58737
GENERAL SURG	314	237	551	21	87	89546	102099	162.52	185.3	22.78	49511	40035	56367	45732	21.834	24.038	22.782	57.22686
GYNECOLOGIC ONCOLOGY	0	23	23	40	77	4608	5235	200.35	227.6	27.26	0	4608	0	5235	NULL	27.261	27.261	59.86957
GYNECOLOGY/GYN SURGERY	0	24	24	20	65	2857	3720	119.04	155	35.96	0	2857	0	3720	NULL	35.958	35.958	39.58333
NEURO SURG	245	217	462	19	92	95888	105366	207.55	228.1	20.52	50164	45724	55228	50138	20.669	20.341	20.515	61.68182
OPHTHALMOLOGY	167	211	378	28	93	20670	27645	54.683	73.13	18.45	9507	11163	13125	14520	21.665	15.91	18.452	69.4418
ORAL SURG	50	34	84	19	85	14130	14895	168.21	177.3	9.107	6170	7960	7275	7620	22.1	-10	9.1071	48.5
PLASTIC SURG	83	502	585	18	87	117061	134355	200.1	229.7	29.56	15005	102056	17685	116670	32.289	29.112	29.562	47.69573
PODIATRY	210	142	352	13	91	26889	35939	76.389	102.1	25.71	14937	11952	20489	15450	26.438	24.634	25.71	59.76136
RADIATION ONC	36	32	68	34	89	4616	6390	67.882	93.97	26.09	1810	2806	2475	3915	18.472	34.656	26.088	63.80882
SURGICAL ONCOLOGY	73	349	422	20	90	74488	84195	176.51	199.5	23	12176	62312	13410	70785	16.904	24.278	23.002	57.80095
THORACIC SURG	395	397	792	20	96	104356	126388	131.76	159.6	27.82	52213	52143	61918	64470	24.57	31.05	27.818	62.85354
TRANSPLANT SURGERY	183	121	304	19	90	65246	66321	214.63	218.2	3.536	41245	24001	40183	26138	-5.803	17.661	3.5362	59.12171
UROLOGY	591	246	837	19	94	117161	141672	139.98	169.3	29.28	87856	29305	104803	36869	28.675	30.748	29.284	62.03943
VASCULAR	226	146	372	17	97	73512	78214	197.61	210.3	12.64	46419	27093	48217	29997	7.9558	19.89	12.64	68.61559



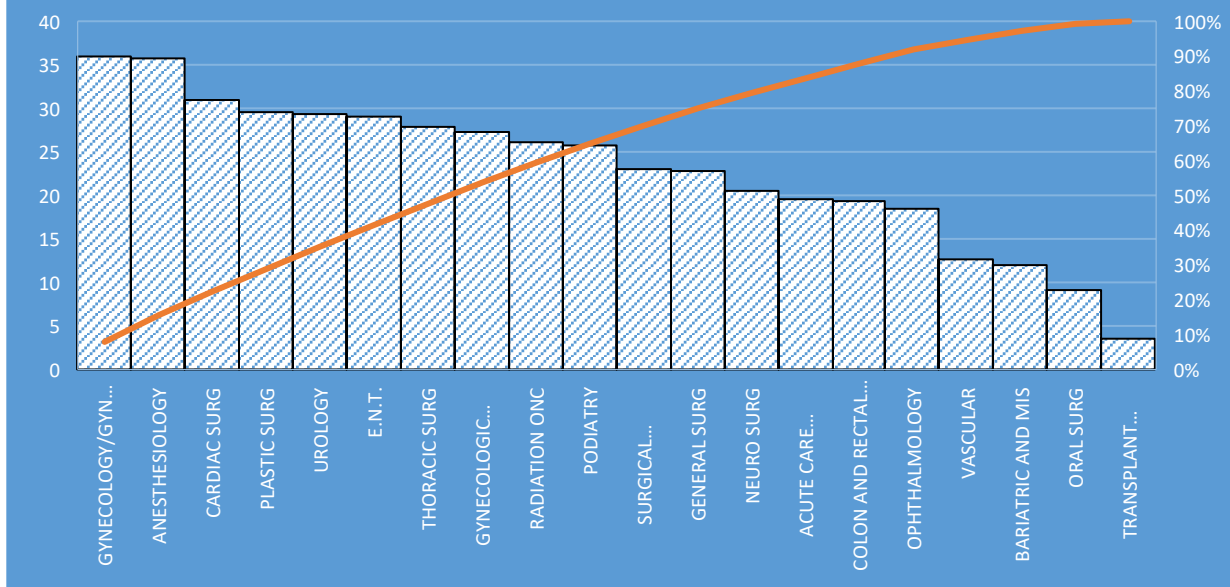
Procedure	Time difference b/w	Total Number of Pati	Total time OR ro
ACUTE CARE SURGERY	19.50323625	618	12053
ANESTHESIOLOGY	35.67857143	28	999
BARIATRIC AND MIS	11.95454545	66	789
CARDIAC SURG	30.91285403	459	14189
COLON AND RECTAL SURGERY	19.31886477	599	11572
E.N.T.	28.99157895	475	13771
GENERAL SURG	22.78221416	551	12553
GYNECOLOGIC ONCOLOGY	27.26086957	23	627
GYNECOLOGY/GYN SURGERY	35.95833333	24	863
NEURO SURG	20.51515152	462	9478
OPHTHALMOLOGY	18.45238095	378	6975
ORAL SURG	9.107142857	84	765
PLASTIC SURG	29.56239316	585	17294
PODIATRY	25.71022727	352	9050
RADIATION ONC	26.08823529	68	1774
SURGICAL ONCOLOGY	23.00236967	422	9707
THORACIC SURG	27.81818182	792	22032
TRANSPLANT SURGERY	3.536184211	304	1075
UROLOGY	29.28434886	837	24511
VASCULAR	12.63978495	372	4702
			<b>174779</b>



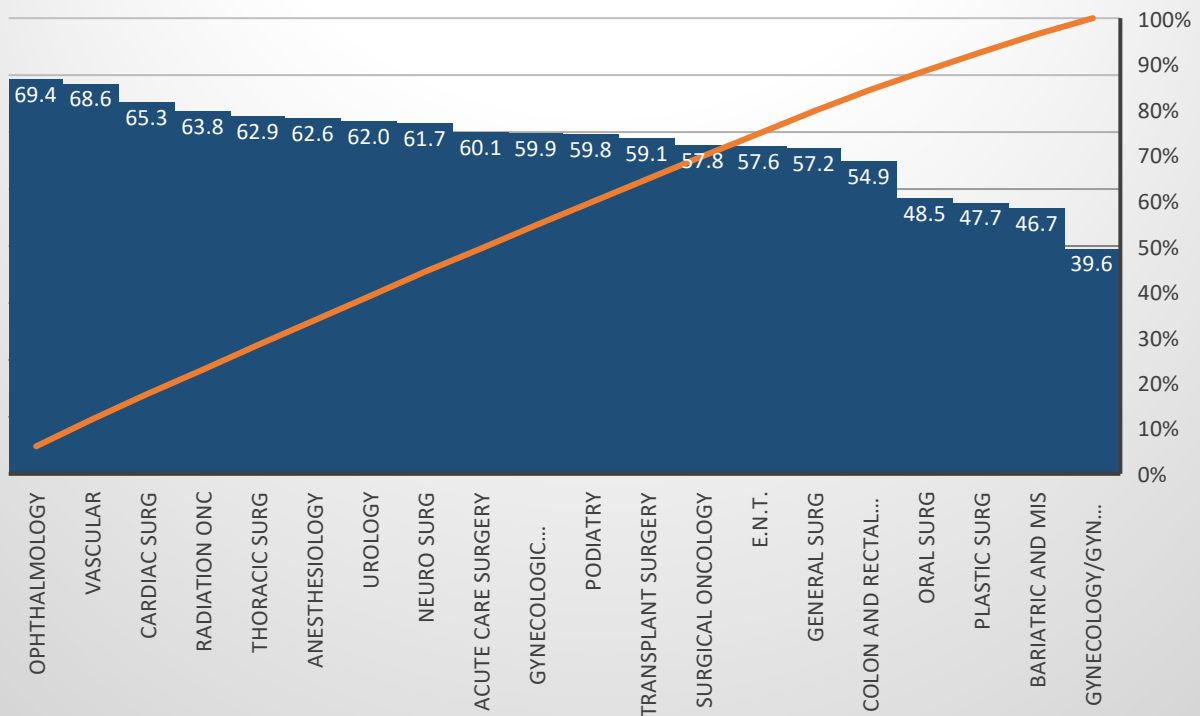
## Procedure vs Gender demographics



## Procedure Vs Time difference (min) b/w Actual and Scheduled



## Procedure vs Average age of patients



## 7 STATISTICAL ANALYSIS

After determining the five divisions within the dataset that have the highest volume of cases, a series of t-tests were conducted to determine the impact patient gender has on operating room procedure time. With gender being the variable evaluated in our tests, the decision was made to exclude doing t-tests for OB/GYN, as despite it being the second most populated division within the dataset, these procedures concern women's reproductive health and as a result 99% of OB/GYN patients in the dataset are female. Due to this, the five divisions that were evaluated include: Acute Care Surgery, Colon & Rectal Surgery, Orthopedic Surgery, Thoracic Surgery, and Urology. With inpatient procedures typically taking significantly longer than outpatient procedures, two t-tests were conducted for each division, one for inpatient procedures and one for outpatient procedures, resulting in ten total tests.

For our project, the null hypothesis is that there is no statistically significant difference between male and female procedures time and that they are the same. Rejecting this null hypothesis would indicate that the time for each gender is statistically different. In terms of the statistical question, the null hypothesis is that the hypothesized mean difference is equal to zero and the alternate hypothesis is that the hypothesized mean difference is not equal to zero. The significance level (alpha) used for this experiment was 0.05, which was compared with the p value from the two-tailed test for each case.

Statistical Question:

$H_0: \mu_1 - \mu_2 = 0$

$H_A: \mu_1 - \mu_2 \neq 0$  (2-sided)

$H_A: \mu_1 - \mu_2 > 0$  or  $\mu_1 - \mu_2 < 0$  (1-sided)

$\alpha = 0.05$

### t-Test: Two-Sample Assuming Equal Variances for Inpatient Acute Care Surgery Procedures

	<i>tot_or_min_ac_inp_m</i>	<i>tot_or_min_acs_inp_f</i>
Mean	137.2415254	134.6812227
Variance	5366.252056	4534.797058
Observations	236	229
Pooled Variance	4956.809854	
Hypothesized Mean Difference	0	
df	463	
t Stat	0.392046385	
P(T<=t) one-tail	0.347602167	
t Critical one-tail	1.64815134	
P(T<=t) two-tail	0.695204335	
t Critical two-tail	1.965100873	

### t-Test: Two-Sample Assuming Equal Variances for Outpatient Acute Care Surgery Procedures

	<i>tot_or_min_acs_op_m</i>	<i>tot_or_min_acs_op_f</i>
Mean	116.5	113.4411765
Variance	2944.66	1459.466132
Observations	26	34
Pooled Variance	2099.635903	
Hypothesized Mean Difference	0	
df	58	
t Stat	0.256231745	
P(T<=t) one-tail	0.399339276	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0.798678552	
t Critical two-tail	2.001717484	

### t-Test: Two-Sample Assuming Equal Variances for Inpatient Colon & Rectal Surgery Surgery Procedures

	<i>tot_or_min_colorec_inp_m</i>	<i>tot_or_min_colorec_inp_f</i>
Mean	224.9	200.3829787
Variance	14425.35683	11867.05228
Observations	140	141
Pooled Variance	13141.61978	
Hypothesized Mean Difference	0	
df	279	
t Stat	1.792518593	

P(T<=t) one-tail	0.037066611
t Critical one-tail	1.650333455
P(T<=t) two-tail	0.074133223
t Critical two-tail	1.968503127

t-Test: Two-Sample Assuming Equal Variances for Outpatient Colon & Rectal Surgery Procedures

	<i>tot_or_min_colorec_op_m</i>	<i>tot_or_min_colorec_op_f</i>
Mean	51.43670886	51.66666667
Variance	723.1774974	1040.429224
Observations	158	147
Pooled Variance	876.0446659	
Hypothesized Mean Difference	0	
df	303	
t Stat	-0.067798849	
P(T<=t) one-tail	0.472995238	
t Critical one-tail	1.649898073	
P(T<=t) two-tail	0.945990477	
t Critical two-tail	1.967824098	

t-Test: Two-Sample Assuming Equal Variances for Inpatient Orthopedic Surgery Procedures

	<i>tot_or_min_ortho_inp_m</i>	<i>tot_or_min_ortho_inp_f</i>
Mean	171.7443439	163.0137931
Variance	10438.82565	6668.373081
Observations	442	435
Pooled Variance	8568.681175	
Hypothesized Mean Difference	0	
df	875	
t Stat	1.396498963	
P(T<=t) one-tail	0.081459211	
t Critical one-tail	1.646596934	
P(T<=t) two-tail	0.162918423	
t Critical two-tail	1.962678842	

t-Test: Two-Sample Assuming Equal Variances for Outpatient Orthopedic Surgery Procedures

	<i>tot_or_min_ortho_op_m</i>	<i>tot_or_min_ortho_op_f</i>
Mean	95.2005277	84.36320755
Variance	3039.356508	2086.175097
Observations	379	424
Pooled Variance	2535.991044	

Hypothesized Mean Difference	0
df	801
t Stat	3.044337564
P(T<=t) one-tail	0.001204116
t Critical one-tail	1.646758176
P(T<=t) two-tail	0.002408231
t Critical two-tail	1.962930026

t-Test: Two-Sample Assuming Equal Variances for Inpatient Thoracic Surgery Procedures

	<i>tot_or_min_thor_inp_m</i>	<i>tot_or_min_thor_inp_f</i>
Mean	165.5	174.3544974
Variance	22152.10233	15594.97473
Observations	216	189
Pooled Variance	19093.19417	
Hypothesized Mean Difference	0	
df	403	
t Stat	-0.643361227	
P(T<=t) one-tail	0.260177825	
t Critical one-tail	1.648643451	
P(T<=t) two-tail	0.520355651	
t Critical two-tail	1.965867932	

t-Test: Two-Sample Assuming Equal Variances for Outpatient Thoracic Surgery Procedures

	<i>tot_or_min_thor_op_m</i>	<i>tot_or_min_thor_op_f</i>
Mean	82.92810458	77.86592179
Variance	1224.093481	1041.172933
Observations	153	179
Pooled Variance	1125.427246	
Hypothesized Mean Difference	0	
df	330	
t Stat	1.370510286	
P(T<=t) one-tail	0.08572959	
t Critical one-tail	1.649484178	
P(T<=t) two-tail	0.171459179	
t Critical two-tail	1.967178675	

t-Test: Two-Sample Assuming Equal Variances for Inpatient Urology Procedures

	<i>tot_or_min_urol_inp_m</i>	<i>tot_or_min_urol_inp_f</i>
Mean	244.7684211	213.1

Variance	24453.11601	20424.38116
Observations	95	70
Pooled Variance	22747.70065	
Hypothesized Mean Difference	0	
df	163	
t Stat	1.332988826	
P(T<=t) one-tail	0.092197805	
t Critical one-tail	1.654255585	
P(T<=t) two-tail	0.18439561	
t Critical two-tail	1.974624621	

t-Test: Two-Sample Assuming Equal Variances for Outpatient Urology Procedures

	<i>tot_or_min_urol_op_m</i>	<i>tot_or_min_urol_op_f</i>
Mean	88.50914634	65.97163121
Variance	2179.681873	1010.470618
Observations	328	141
Pooled Variance	1829.168863	
Hypothesized Mean Difference	0	
df	467	
t Stat	5.232860873	
P(T<=t) one-tail	1.26309E-07	
t Critical one-tail	1.648123038	
P(T<=t) two-tail	2.52619E-07	
t Critical two-tail	1.965056762	



## 8 RESULTS AND DISCUSSION

Based on the results of the t-test, we failed to reject the null hypothesis for eight of the ten procedure types examined. This means that for these eight procedure types, there is no statistically significant difference between the operating room procedure time for male and female patients. For orthopedic surgery outpatient procedures and urology outpatient procedures however, the null hypothesis did end up being rejected, meaning that there is statistically significant difference in operating room time between male and female patients with the procedures for male patients taking longer for both instances.

Procedure	T-Test Results
Acute Care Surgery Inpatient	Fail to Reject Null Hypothesis
Acute Care Surgery Outpatient	Fail to Reject Null Hypothesis
Colon & Rectal Surgery Inpatient	Fail to Reject Null Hypothesis
Colon & Rectal Surgery Outpatient	Fail to Reject Null Hypothesis
Orthopedic Surgery Inpatient	Fail to Reject Null Hypothesis
Orthopedic Surgery Outpatient	Reject Null Hypothesis
Thoracic Surgery Inpatient	Fail to Reject Null Hypothesis
Thoracic Surgery Outpatient	Fail to Reject Null Hypothesis
Urology Inpatient	Fail to Reject Null Hypothesis
Urology Outpatient	Reject Null Hypothesis

Looking back on the results retrieved, our group was not surprised with the urology outpatient procedure case rejecting the null hypothesis. Since urology focuses treating diseases within the urinary tract and reproductive organs, we concluded that there would be noticeable time differences between male and female procedures due to the biological differences between the two genders that would impact how the physician would need to conduct their operation. For the orthopedic surgery outpatient case on the other hand, our group did not expect the null hypothesis to be rejected, as orthopedic surgery revolves around the musculoskeletal system.

Unlike with urology where we knew in advance that the two genders have different organs, we assumed before conducting the analysis that musculoskeletal system between men and women were similar enough to where procedural time would not be impacted. This turned out not to be the case as male outpatient procedures take noticeably longer than female outpatient procedures. This could be due to male patients being taller on

average than female patients and males typically having more muscle mass than females, but what is important for this analysis is that the male outpatient orthopedic procedures take longer than female procedures.

Moving forward, the analysis results can be used by physicians to ensure that enough time is scheduled for their patient's procedures. With the mission of Beth Israel Deaconess Medical Center (BIDMC) being to deliver the highest quality care and experience to their patients, ensuring that each patient has an appropriate amount of time scheduled for their operating room visit is important. By using the analysis conducted through this project, physicians can determine whether the gender of their patients need to be considered when determining how many minutes in the OR should be reserved for their procedure.