
THE IMPACT OF INTER-HOSPITAL TRANSFERS IN ACUTE CORONARY SYNDROME, IN PERTH WA

Rene Forsyth

PhD Candidate, Curtin University

Associate Professor Rachael Moorin

Associate Professor Jan McKay



Curtin University

OVERVIEW

- Part of a larger study
 - 1st set of results
 - Phase 1 of 4

- Definitions
 - Door-to-balloon times
 - Door-to-ECG times
 - Percutaneous Coronary Intervention (PCI)
 - Transfer Status = “Direct Presentations” verse “Transfers”

MORBIDITY AND MORTALITY- CORONARY HEART DISEASE

- in 2000
 - CVD accounted for 17% of the total disease burden, as measure by Disability Adjusted Life Years (DALYs)
- in 2011:
 - CHD leading cause of death for males and females across Australia
 - Accounted for 15% of all deaths
 - 75% deaths occurred in people aged 75 and over; 5% death occurs in people under 55 years
 - Estimated 69 900 people, aged 25 or older, suffered from a heart attack = 190 per day

CORONARY HEART DISEASE

ST-segment-elevation Acute
Myocardial Infarction
(STEMI)

Non-ST-segment-elevation
Acute Coronary Syndrome
(nSTEACS)

Other CHD: angina; sudden
cardiac death; complications
post-AMI

***ACUTE
CORONARY
SYNDROMES***

Non-ST-segment-
elevation Myocardial
Infarction (nSTEMI)

Unstable Angina

KEY PERFORMANCE INDICES IN ACS

“A patient with **acute chest pain** or other symptoms suggestive of an acute coronary syndrome receives a 12-lead electrocardiogram (ECG) and the results analysed by a clinician experienced in interpreting an **ECG within 10 minutes of the first emergency clinical contact.**”

“A patient with an acute **ST-segment-elevation myocardial infarction (STEMI)**, for whom emergency reperfusion is clinically appropriate, is offered timely percutaneous coronary intervention (PCI) or fibrinolysis in accordance with the time frame recommended in the current National Heart Foundation of Australia/Cardiac Society of Australia and New Zealand Guidelines for the Management of Acute Coronary Syndromes”. In general, primary PCI is recommended if the time from **first medical contact to balloon inflation is anticipated to be less than 90 minutes**, otherwise the patient is offered fibrinolysis.”

(Australian Commission on Safety and Quality in Health Care 2014)

POPULATION DEMOGRAPHICS

- At June 2012
 - 70% Major Cities
 - 18% Inner Regional
 - 9% Outer Regional
 - 1% Remote and Very Remote (AIHW 2014; ABS 2013m; AIHW 2013a)
- Logistical challenges
 - Less access to health services
 - More transient health services
 - Great distances to reach medical intervention
 - Higher rates of ill health

A WORD ON DATA TYPES

Hospital Data (Phase 1)

- Advantages
 - Includes minute data, including times
- Disadvantages
 - Less complete
 - Lacks depth
 - Smaller sample size

Linked Data (Phase 2-4)

- Advantages
 - Longitudinal, whole-population
 - HMDS, EDDC, Mortality and PACS data
 - Key Demographic Items
 - Dates, ICD Codes (diagnosis, treatment, cause of death)
- Disadvantages
 - Lacks minute data, particularly times

AIM

- Impact of being transferred to a tertiary hospital capable of percutaneous primary interventions 24/7 on key performance indexes, most notably
 - Door-to-balloon times
 - Door-to-ECG times
 - In-hospital mortality

METHODS

- 01/06/2013 and 31/12/2013
 - De-identified primary hospital data, 1 Tertiary Perth Hospital
 - Ethics Approval obtained May 2013
 - Analysis:
 - SPSS and STATA
 - Individual analysis discussed with each result
- Age
 - Sex
 - Postcode of residence
 - Mode of Arrival
 - Primary diagnosis
 - Primary procedure
 - Procedure length
 - Date of presentation
 - Date of Discharge
 - Mode of Disposal
 - Length of Stay
 - *Time of symptom onset*
 - *Time of arrival to referral hospital*
 - *Time departed referral hospital*
 - *Time of arrival to tertiary hospital*
 - *Time of ECG*
 - *Time of activation of CCL*
 - *Procedure start time*
 - *Time of first balloon inflation*
 - *Procedure end time*

RESULTS TABLE 1 – DEMOGRAPHICS

FREQUENCY DISTRIBUTIONS FOR WHOLE COHORT | CHI SQUARED FOR TRANSFER STATUS

		Whole Population n=106		Direct Presentations n=59		Transfers n=43		
		n	%	n	%	n	%	p
Age	Mean	59.7	-	60.1	-	59.1	-	0.343
	Standard Deviation	11.5	-	11.7	-	11.7	-	
	Range	35 - 87	-	37 - 87	-	35 - 83	-	
Sex	Male	86	81.1	50	84.7	32	74.4	0.296
	Female	20	18.9	9	15.3	11	25.6	
SEIFA	Highest Disadvantage	7	6.6	5	8.5	2	4.7	0.241
	High Disadvantage	9	8.5	2	3.4	7	16.3	
	Moderate Disadvantage	11	10.4	6	10.2	4	9.3	
	Less Disadvantage	17	16	10	16.9	6	14	
	Least Disadvantage	62	58.5	36	61	24	55.8	
Health Service Area	North Metro	95	89.6	53	89.8	38	88.4	0.079
	South Metro	8	7.5	6	10.2	2	4.7	
	WA Country	3	2.8	0	0	3	7	

RESULTS – OUTCOMES

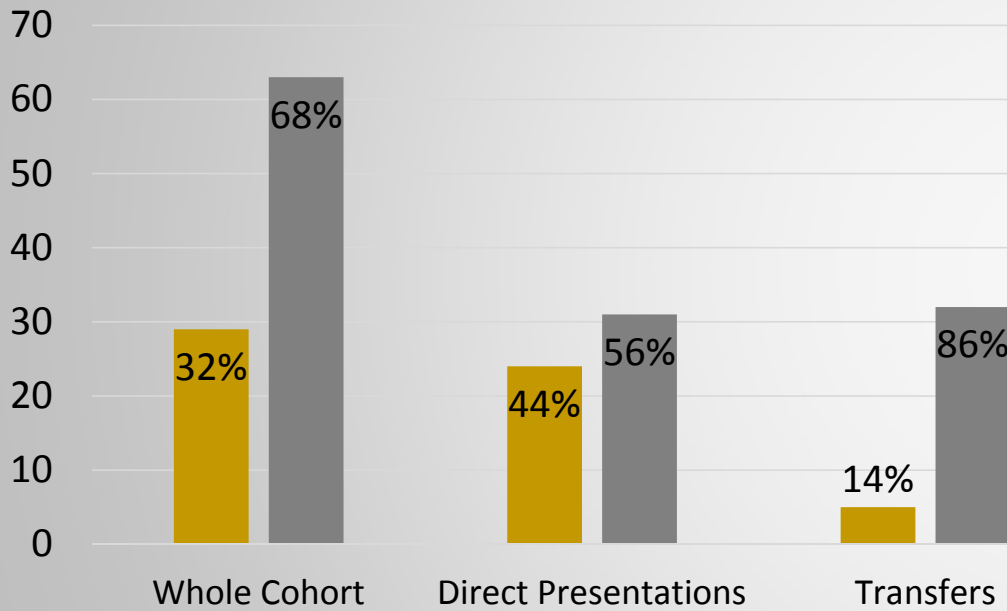
FREQUENCY DISTRIBUTIONS FOR WHOLE COHORT | CHI SQUARED FOR TRANSFER STATUS

		Whole Population		Direct Presentations		Transfers		p
		n=106		n=59		n=43		
		n	%	n	%	n	%	
Principal Diagnosis	ACS	94	88.7	50	84.7	41	95.3	0.198
	Reinfarction	10	9.4	7	11.9	2	4.7	
	Other Cause	2	1.9	2	3.4	0	0.0	
Acute Coronary Syndromes	Unstable Angina	1	1.1	0	0.0	1	2.4	0.295
	STEMI	86	91.5	46	92.0	38	92.7	
	nSTEMI	6	6.4	4	8.0	1	2.4	
	AMI NOS	1	1.1	0	0.0	1	2.4	
Principal Procedure	PCI with stent	102	96.2	58	98.3	40	93.0	0.336
	PCI balloon only	3	2.8	1	1.7	2	4.7	
	PCI attempted	1	0.9	0	0.0	1	2.3	
Length of Stay, days	<i>Median</i>	3	-	3	-	3	-	0.480
	<i>Standard Deviation</i>	4.0	-	2.2	-	5.1	-	
	<i>Range</i>	0-32	-	0-16	-	1-32	-	
Disposal Code	Home/Other Institution	100	94.3	55	93.2	41	95.3	1.000
	Deceased	6	5.7	4	6.8	2	4.7	

RESULTS – PRE-HOSPITAL OUTCOMES

FREQUENCY DISTRIBUTIONS FOR WHOLE COHORT | CHI SQUARED FOR TRANSFER STATUS

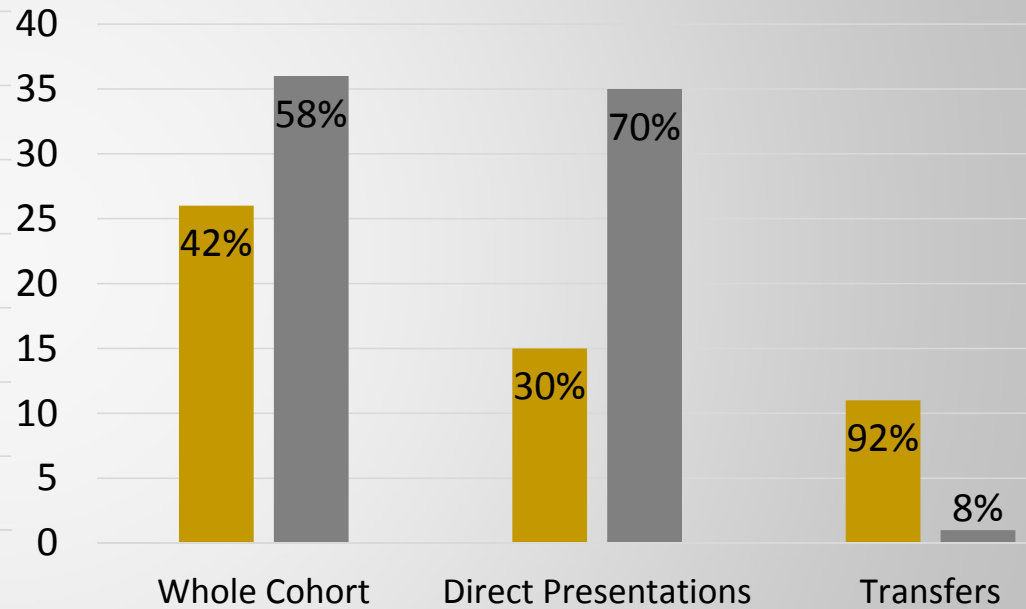
Rate of Pre-Hospital ECGs



p=0.003

■ Pre-Hospital ECG ■ In-Hospital ECG

Rate of Pre-Hospital Activations



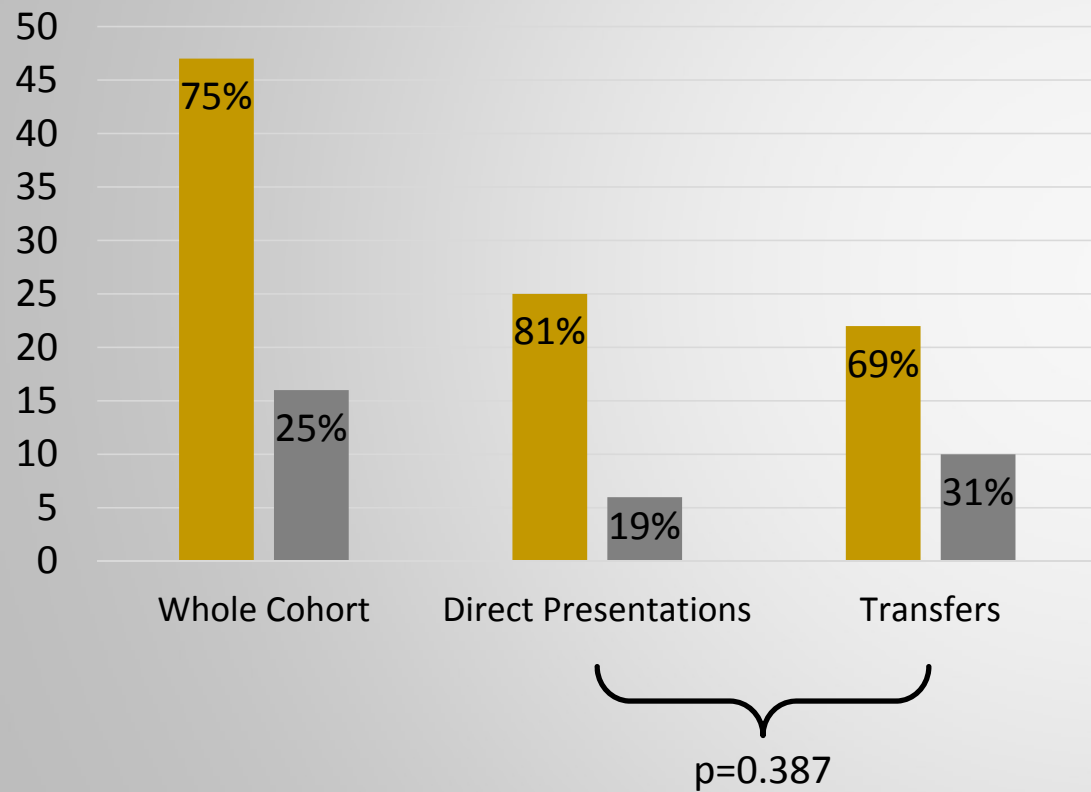
p≤0.0009

■ Pre-Hospital Activation ■ In-Hospital Activation

RESULTS – DTB AND DTE TIMES

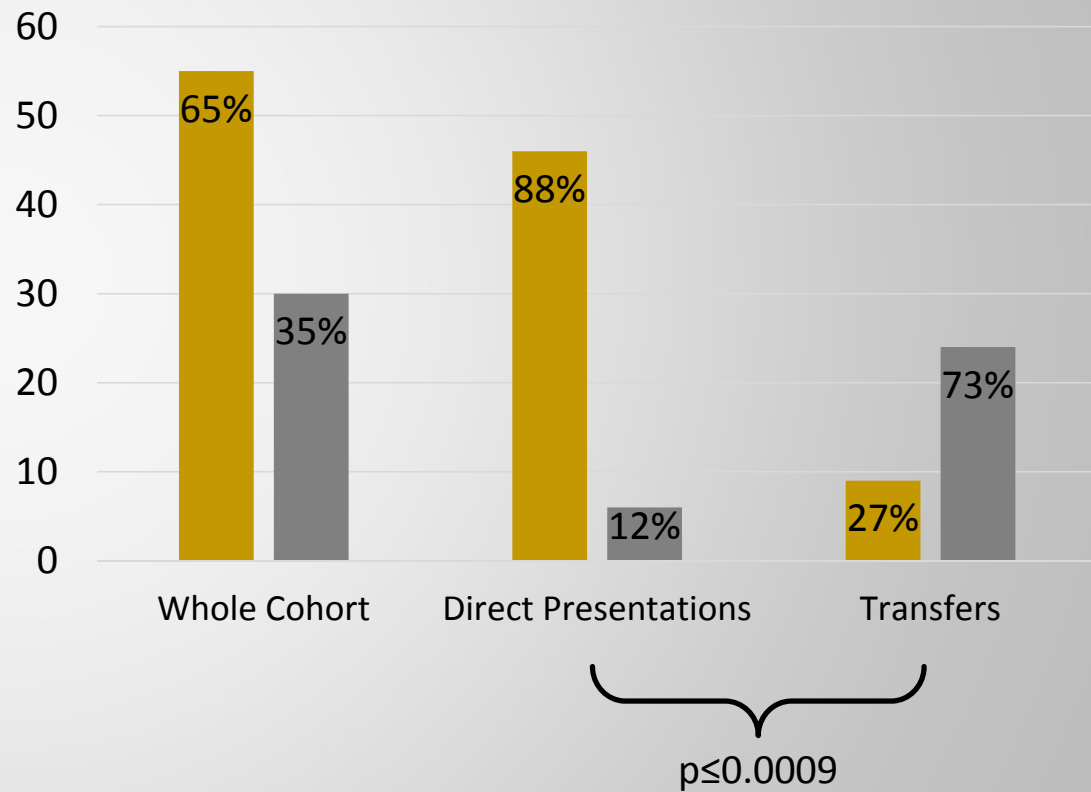
FREQUENCY DISTRIBUTIONS FOR WHOLE COHORT | CHI SQUARED FOR TRANSFER STATUS

Door-to-ECG Times



■ Within 10 minutes of arrival ■ More than 10 minutes after arrival

Door-to-Balloon Times



■ 90 minutes or less ■ Greater than 90 minutes

RESULTS – TIME TO EVENTS

KRUSKAL WALLIS

		All														
		n	Mean	Median	Std. Dev	Min	Max	Mean Rank	n	Mean	Median	Std. Dev	Min	Max	Mean Rank	p
Transfer Status		Direct to Tertiary Hospital						Transferred from Referral Hospital								
	Activation-to-Balloon Time	50	54.18	54.50	16.32	29	102	31.24	35	76.74	73.00	19.92	41	121	59.80	0.000
	Door-to-Balloon Time	59	75.73	59.00	65.12	21	386	43.69	37	86.65	83.00	45.70	24	189	56.18	0.032
	ECG-to-Activation Time	46	45.24	15.50	99.54	0	615	37.68	35	39.97	26.00	41.60	1	182	45.36	0.146
	ECG-to-Balloon Time	54	93.46	73.00	95.17	34	683	34.93	35	114.49	98.00	40.69	67	232	60.54	0.000
	*Door to ECG Time for initial ECG	31	9.10	6.00	11.39	1	65	33.34	32	11.28	5.50	17.06	0	87	30.70	0.567
**Door-to-Activation Time	35	37.97	17.00	56.00	0	213	18.86	1	5.00	5.00		5	5	6.00	0.229	
Day of Presentation		Weekday						Weekend								
	Activation-to-Balloon Time	63	62.03	61.00	21.57	29	121	41.66	23	67.65	61.00	18.67	45	121	48.54	0.258
	Door-to-Balloon Time	69	70.71	56.00	53.74	21	386	43.63	27	103.52	82.00	64.03	30	278	60.94	0.006
	ECG-to-Activation Time	58	38.81	19.00	85.43	0	615	38.47	23	53.43	29.00	62.40	0	199	47.39	0.123
	ECG-to-Balloon Time	64	106.75	80.50	111.43	34	683	43.13	26	111.46	88.50	59.71	49	269	51.35	0.176
	*Door to ECG Time for initial ECG	41	9.76	6.00	14.76	0	87	31.09	22	11.05	7.00	14.24	0	65	33.70	0.588
**Door-to-Activation Time	22	29.68	14.50	45.10	1	213	17.43	14	48.64	19.50	69.00	0	208	20.18	0.445	
Presentation Time		Business Hours						After Hours								
	Activation-to-Balloon Time	24	56.88	45.50	26.65	31	121	26.63	43	63.70	61.00	17.79	29	121	38.12	0.021
	Door-to-Balloon Time	29	51.66	47.00	26.28	21	132	30.26	50	90.20	71.50	73.13	26	386	45.65	0.004
	ECG-to-Activation Time	23	51.13	15.00	126.65	1	615	30.09	41	44.51	21.00	57.01	0	200	33.85	0.437
	ECG-to-Balloon Time	25	104.00	74.00	125.92	34	683	32.74	47	100.53	80.00	55.05	41	269	38.50	0.266
	*Door to ECG Time for initial ECG	11	6.55	7.00	3.39	1	11	21.95	37	13.62	7.00	17.95	0	87	25.26	0.491
**Door-to-Activation Time	13	22.62	14.00	22.12	1	83	17.08	23	45.22	17.00	66.59	0	213	19.30	0.542	
Pre-Hospital Activation		Pre-Hospital Activation						No Pre-hospital Activation								
	Activation-to-Balloon Time	25	66.08	59	23.334	35	121	36.18	36	54.25	55	16.017	29	102	27.40	0.057
	Door-to-Balloon Time	25	37.64	37	12.172	21	70	14.86	36	89.64	76	56.205	35	278	42.21	0.000
Pre-Hospital ECG		Pre-Hospital ECG						No Pre-hospital ECG								
	Activation-to-Balloon Time	25	57.84	56	17.561	35	101	35.02	57	66.05	62	22.198	29	121	44.34	0.103
	Door-to-Balloon Time	29	53.55	45	28.43	21	132	29.48	60	91.48	80	53.424	30	278	52.50	0.000
	ECG-to-Activation Time	25	56.36	19	121.69	1	615	43.60	56	36.98	19.5	51.047	0	200	39.84	0.506
	ECG-to-Balloon Time	29	110.9	84	116.15	41	683	45.95	60	97.32	82	52.78	34	269	44.54	0.810

RESULTS – DTB TIMES

GENERALISED LINEAR MODEL WITH AN IDENTITY LINK FUNCTION

			Mean	95%CI	95%CI	p
Monday to Friday, In Hours	Transfer Status	Transferred	82.659	-5.494	170.813	0.066
	Sex	Female	8.423	-16.356	33.201	0.505
		45-54 Years	26.519	2.992	50.047	0.027
	Age	55-64 Years	50.323	10.427	90.218	0.013
		65-74 Years	35.406	13.089	57.724	0.002
		75-84 Years	41.138	-4.064	86.339	0.074
85 Years and older		19.900	-31.888	71.688	0.451	
Monday to Friday, Out of Hours	Transfer Status	Transferred	46.665	2.062	91.269	0.040
	Sex	Female	53.013	-8.647	114.674	0.092
		45-54 Years	-34.026	-92.422	24.371	0.253
	Age	55-64 Years	-25.424	-93.436	42.587	0.464
		65-74 Years	-43.716	-101.117	13.684	0.136
		75-84 Years	-81.496	-175.648	12.656	0.090
Saturday and Sunday, In Hours	Transfer Status	1.transfer	25.000	-49.218	99.218	0.509
	Sex	0.sex (omitted)				
		45-54 Years	-2.333	-45.595	40.928	0.916
	Age	55-64 Years	-2.000	-59.687	55.687	0.946
		65-74 Years	15.000	-38.702	68.702	0.584
		75-84 Years	(omitted)			
Saturday and Sunday, Out of Hours	Transfer Status	Transferred	71.853	34.726	108.981	0.000
	Sex	Female	-38.312	-93.884	17.260	0.177
		45-54 Years	20.961	-26.391	68.312	0.386
	Age	55-64 Years	8.514	-33.711	50.740	0.693
		65-74 Years	37.711	-2.545	77.967	0.066
		75-84 Years	67.848	-3.170	138.866	0.061

			Mean	95%CI	95%CI	p
Monday to Friday	Transfer Status	Transferred	61.182	16.578	105.785	0.007
	Sex	Female	13.873	-18.476	46.222	0.401
		45-54 Years	1.546	-27.326	30.419	0.916
	Age	55-64 Years	30.512	-12.187	73.212	0.161
		65-74 Years	2.494	-25.473	30.461	0.861
		75-84 Years	4.373	-40.468	49.213	0.848
85 Years and older		-14.947	-78.859	48.965	0.647	
Saturday and Sunday	Transfer Status	Transferred	68.159	37.725	98.592	0.000
	Sex	Female	-6.836	-48.347	34.675	0.747
		45-54 Years	17.664	-14.282	49.609	0.278
	Age	55-64 Years	13.355	-21.716	48.427	0.455
		65-74 Years	35.180	2.868	67.492	0.033
		75-84 Years	29.516	-10.969	70.001	0.153
In Hours	Transfer Status	Transferred	73.297	18.962	127.632	0.008
	Sex	Female	5.597	-14.883	26.078	0.592
		45-54 Years	32.846	13.907	51.785	0.001
	Age	55-64 Years	48.187	17.826	78.547	0.002
		65-74 Years	40.579	21.400	59.758	0.000
		75-84 Years	43.545	14.688	72.402	0.003
85 Years and older	22.339	-22.308	66.986	0.327		
Out of Hours	Transfer Status	Transferred	59.905	22.805	97.004	0.002
	Sex	Female	21.640	-22.934	66.213	0.341
		45-54 Years	-17.303	-61.889	27.282	0.447
	Age	55-64 Years	-1.393	-57.344	54.557	0.961
		65-74 Years	-13.417	-56.966	30.132	0.546
		75-84 Years	-16.636	-83.752	50.479	0.627

RESULTS – SNAPSHOT OF RURAL PARTICIPANTS

➤ Patient A

➤ 59; Male

➤ Arrival Code = RFDS; Diagnosis = STEMI; LOS = 5 days; Disposal Code = Home/Other Institution

➤ Patient B

➤ 49; Male

➤ Arrival Code = RFDS; Diagnosis = STEMI; LOS = 3 days; Disposal Code = Home/Other Institution

➤ Patient C

➤ 51; Female

➤ Arrival Code = RFDS; Diagnosis = STEMI; LOS = 3 days; Disposal Code = Home/Other Institution

DISCUSSION

- No statistically significant differences between patients who present directly or were transferred (demographics)
 - *ie all things being equal*
- *Pre-hospital Activation is occurring in 92% of transferred patients (p≤0.0009)*
- *Door-to-Balloon times within 90 minutes of less in 88% of Direct, verse 27% of Transfers (p≤0.0009)*
- Median DTB times significantly shorter in direct presentations, on weekdays, between 8am – 5pm and if there has been pre-hospital ECG or pre-hospital activation

CONCLUSIONS

- Those who are transferred are more likely to experience longer median DTB times
 - Reduction of DTB times has proven morbidity and mortality outcomes in previous literature
 - All rural patients must be transferred – providing emergency PCI services in rural and remote areas will remain challenging
 - Need to streamline the transfer process
 - Reasons for delays in transfers
 - Patients less critical?
- Percutaneous Coronary Intervention vs Fibrinolysis
 - Treatment pathways and outcomes to be further evaluated in next stage of study

THE PATH AHEAD...

- Next 3 phases
 - Analysis Phase 1 – Rates and Patterns of Admission and Readmission for STEMI, nSTEACS, MACE
 - Analysis Phase 2 – Multivariate Logistic Regression for odds and risk factors associated with 30-day readmission for MACE, repeat PCI
 - Analysis Phase 3 – Multivariate Cox Proportional Regression for survival patterns across different health regions
- Whole WA Population
 - Aligned study underway specific to Aboriginal or Torres Strait Islander People