

Length of stay and cost impact of hospital acquired diagnoses - a multiplicative model for SESLHD

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What is CHADx?

- The Classification of Hospital Acquired Diagnoses (CHADx) classification groups over **4,500** ICD- 10-AM diagnosis codes into a manageable hierarchy of 17 classes and 145 sub-classes to characterise **hospital acquired complications**.
- The CHADx “allow(s) Australian hospitals to monitor the range of hospital-acquired diagnoses coded in routine data in support of quality improvement efforts”.
- CHADx is intended for use **within** hospitals, and not as a means for external monitoring of hospital performance and holding hospitals to account.
- The occurrence of a hospital acquired complication is identified using the condition-onset flag, which is applied to each ICD10-AM diagnosis code. New data item in NSW in 2011/12.

What is CHADx?

The 17 CHADx categories

- 1. Post-procedural complications
- 2. Adverse drug events
- 3. Accidental injuries
- 4. Specific infections
- 5. Cardiovascular complications
- 6. Respiratory complications
- 7. Gastrointestinal complications
- 8. Skin conditions
- 9. Genitourinary complications
- 10. Hospital-acquired psychiatric states
- 11. Early pregnancy complications
- 12. Labour, delivery & postpartum complications
- 13. Perinatal complications
- 14. Haematological disorders
- 15. Metabolic disorders
- 16. Nervous system complications
- 17. Other complications

Source: <http://www.safetyandquality.gov.au/our-work/information-strategy/health-information-standards/classification-of-hospital-acquired-diagnoses-chadx/>

The SESLHD project

Purpose:

To test the feasibility of using CHADx to identify issues relating to safety and quality and assess the impact.

Features and benefits of CHADx;

- Routine data has the advantage of being **comprehensive, timely** and available at **no additional cost** .
- With 144 classes, CHADx allows better understanding of the **full range** of hospital-acquired conditions.
- Ability to estimate the marginal contribution of events to patient treatment **costs** to aid in **priority setting** for patient safety programs on the basis of system costs.
- Allows hospitals to identify any **changes** associated with local patient safety strategies in near “**real time**”.
- Ability to monitor changes in rates for particular complication types.

Source: Jackson, T., Michel, J. L., Roberts, R. F., Jorm, C. M., and Wakefield, J. G. 2009. A classification of hospital-acquired diagnoses for use with routine hospital data

The SESLHD Dataset

ICD-10-AM:

2011/12 - 582,833

2012/13 - 636,820

Subset COF =1, validated:

2011/12 - 45,608 (7.8%)

2012/13 - 44,607 (7.0%)

Number of CHADx*:

2011/12 - 29,554

2012/13 - 29,820

Episodes w CHADx**:

2011/12 - 14,832

2012/13 - 15,391

* Some CHADx codes do not need COF=1

** Episodes with one or more CHADx

- Diagnoses codes grouped into classes and sub-classes according to CHADx (Jackson et al., 2009a).
- Utilized COF validation algorithm (Jackson et al., 2009b)
- Utilised SAS grouper for CHADx Version 4.1 provided by Queensland Health (Utz et al., 2012)

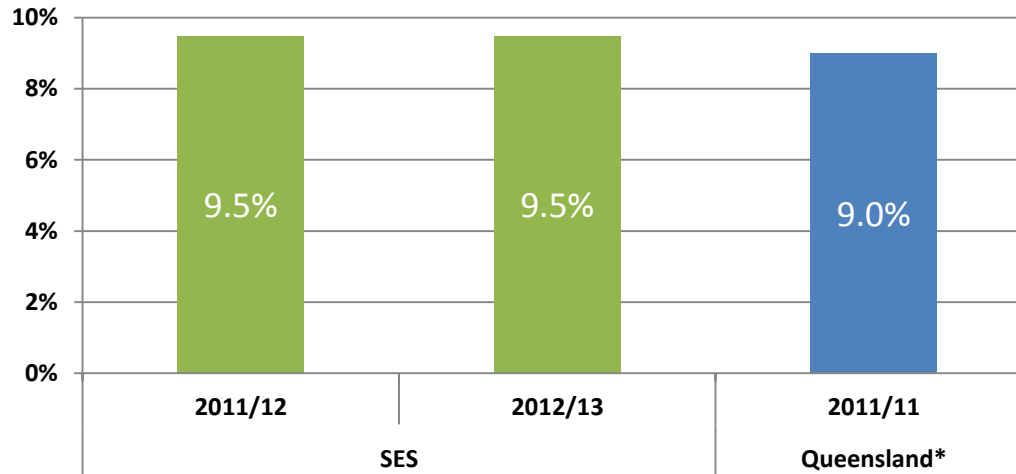
Descriptive analysis

Hospital	Episodes without CHADx code		Episodes with CHADx code	
	N	Mean LOS	N	Mean LOS
A	20,235	2.1	376	10.1
B	12,796	3.3	1,465	21.2
C	67	1.0		
D	1,231	19.6	5	14.8
E	81,032	3.5	5,669	18.2
F	103,138	3.1	9,446	11.0
G	46,776	3.6	5,966	10.7
H	22,999	2.3	7,301	6.5
Total	288,274	3.2	30,228	11.7

- Basic statistics with *Winsorization* procedure applied to account for extreme values in LOS
- 2011/12 and 2012/13 (includes same day episodes)

Descriptive analysis

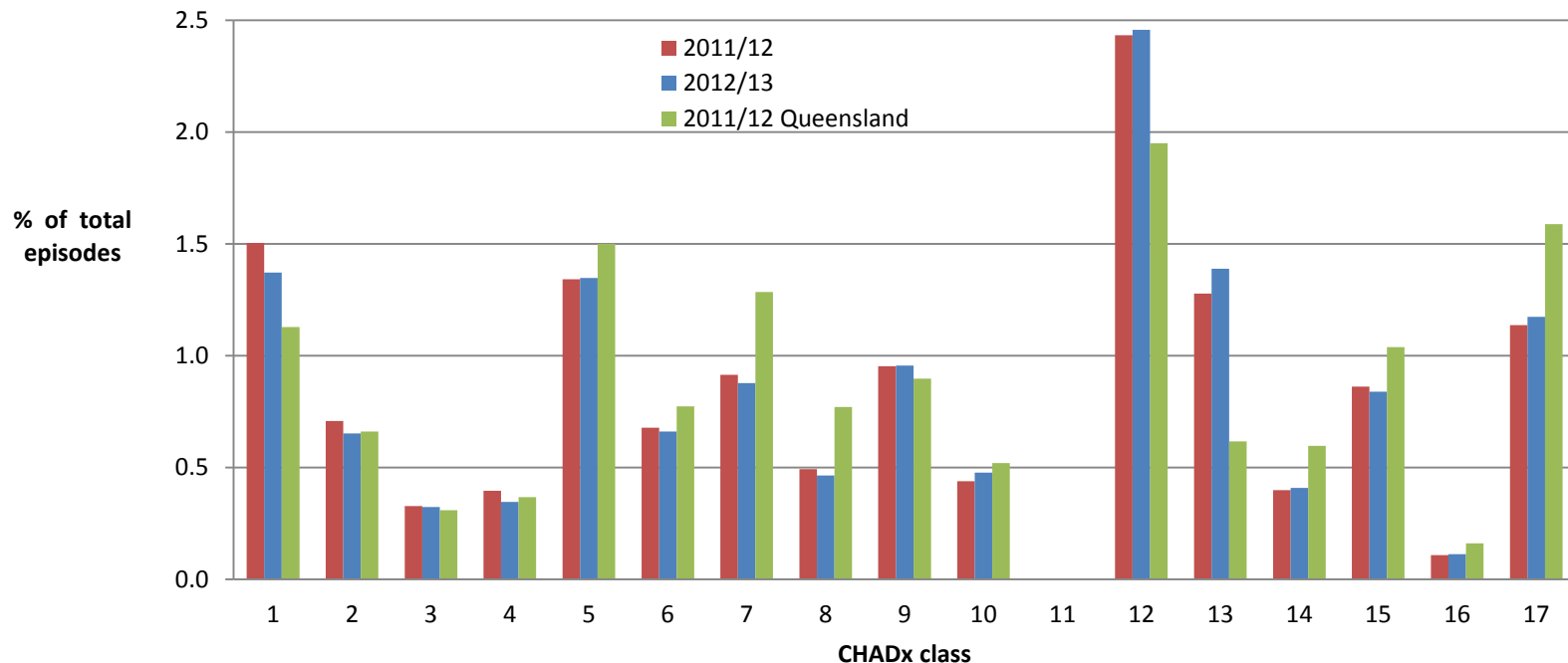
Percentage of episodes with at least one CHADx code



*Utz et al 2012 – Queensland public hospitals, financial year 2010/11, Figure 2-1

Descriptive analysis – frequencies

Frequency (%) of episodes by CHADx classes



Source Qld data: Utz et al 2012 – Queensland public hospitals, financial year 2010/11, Figure 2-2

Statistical model

Generalised linear regression analysis was performed on each hospital subset of the data to assess increases in LOS and cost for episodes with CHADx assignment compared to episodes with no CHADx assignment.

Same day episodes were excluded from modelling.

Variable*	Categories
CHADx	Model 1: number of CHADx codes/episode values 0, 1,2,3 ...9, 10+ Model 2: each of the 17 CHADx class Model 3: each of the 145 CHADx subclass
DRGs	AR-DRG v6.x (casemix)
Charlson Comorbidity Index groups	0, 1 to 6+ (weights for pre-existing conditions)
Separation type	'home', 'death', 'transfer', 'incomplete'
Age groupings	<1 , 1-16, 17-64, 65-79, 80+
Episode type	'acute', 'other'
Urgency on admission	'urgent', 'non-urgent'
COF=1 without CHADx	'yes', 'no'

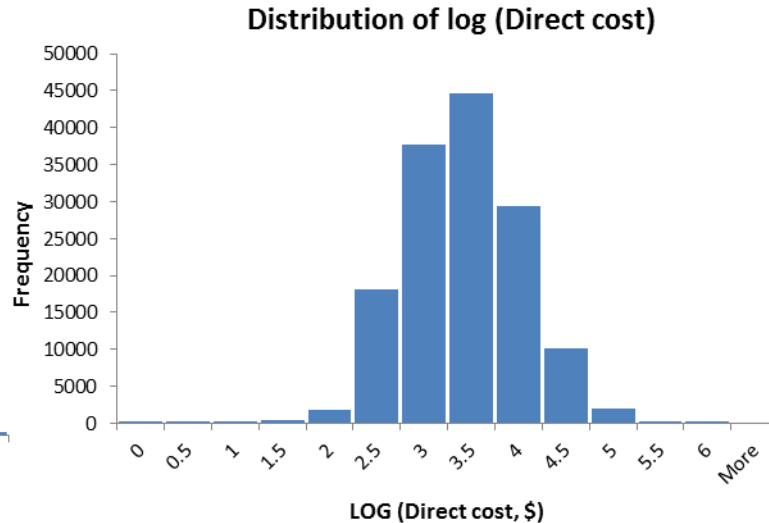
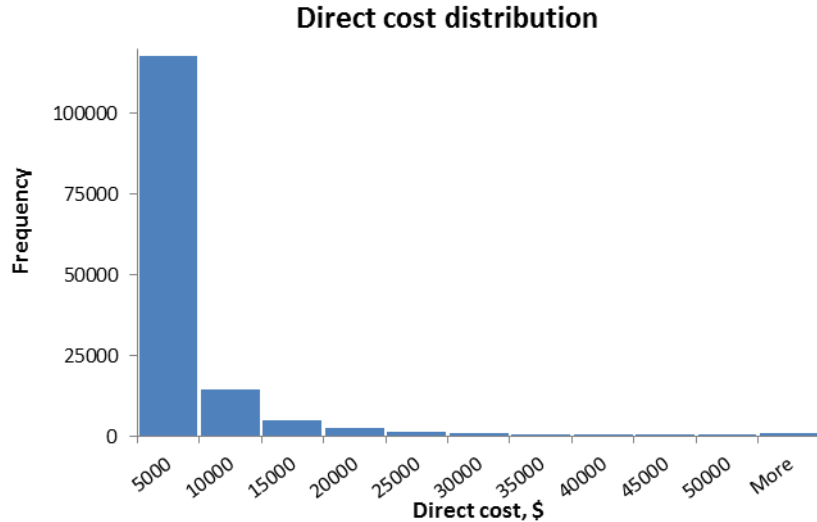
* Gender was removed as it was an uninformative variable

Charlson Comorbidity Index (Sundararajan et al, 2004)

Used as an IV to adjust for impact of **comorbidities** on LOS and cost

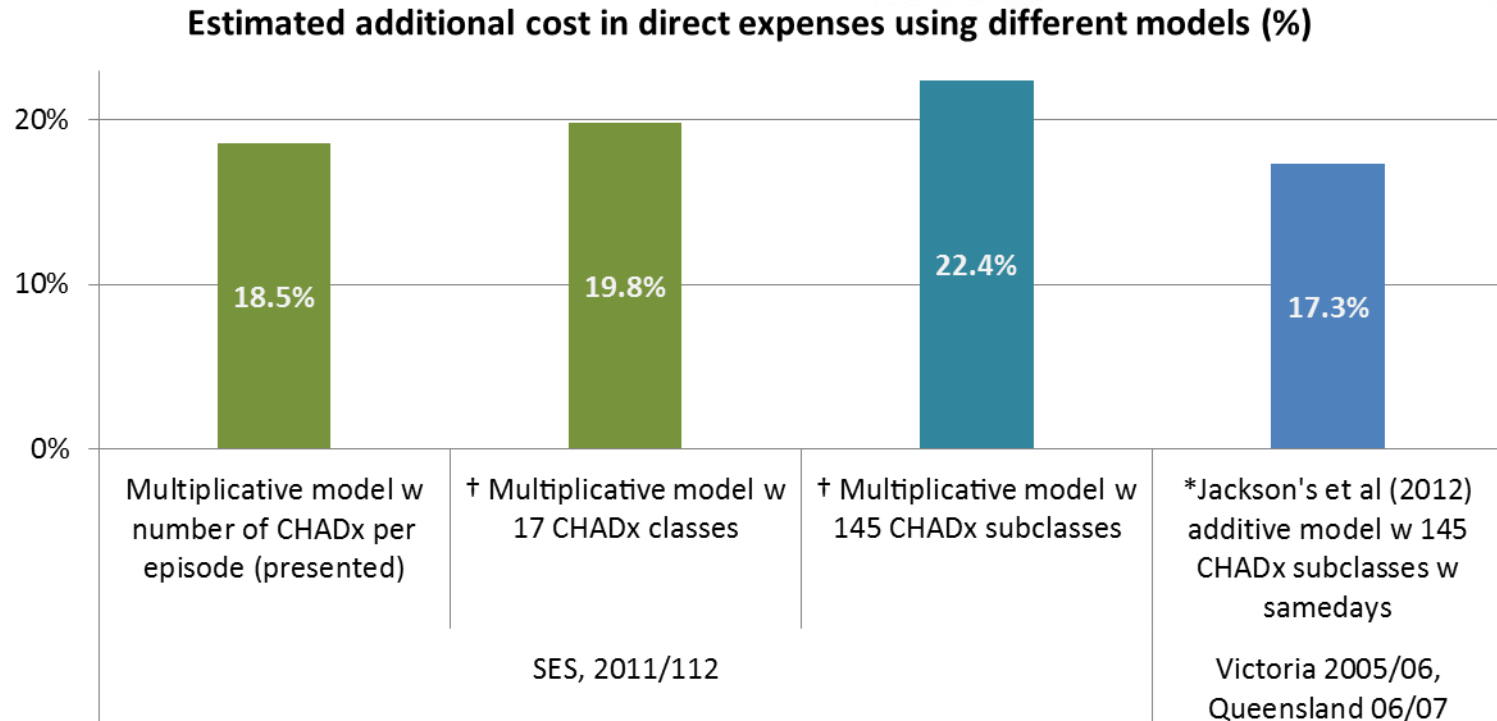
Diagnosis category	Weight	ICD-10-AM
Acute myocardial infarction	1	I21, I22, I252
Congestive heart failure	1	I50
Peripheral vascular disease	1	I71, I790, I739, R02, Z958, Z959
Cerebral vascular accident	1	I60, I61, I62, I63, I65, I66, G450, G451, G452, G458, G459, G46, I64, G454, I670, I671, I672, I674, I675, I676, I677, I678, I679, I681, I682, I688, I69
Dementia	1	F00, F01, F02, F051
Pulmonary disease	1	J40, J41, J42, J44, J43, J45, J46, J47, J67, J44, J60, J61, 500, 501, 502, 503, 504, 505, J62, J63, J66, J64, J65
Connective tissue disorder	1	M32, M34, M332, M053, M058, M059, M060, M063, M069, 71481(now 5171), 725, M050, M052, M051, M353
Peptic ulcer	1	K25, K26, K27, K28
Liver disease	1	K702, K703, K73, K717, K740, K742, K746, K743, K744, K745
Diabetes	1	E109, E119, E139, E149, E101, E111, E131, E141, E105, E115, E135, E145
Diabetes complications	2	E102, E112, E132, E142, E103, E113, E133, E143, E104, E114, E134, E144
Paraplegia	2	G81, G041, G820, G821, G822
Renal disease	2	N03, N052, N053, N054, N055, N056, N072, N073, N074, N01, N18, N19, N25
Cancer	2	C0, C1, C2, C3, C40, C41, C43, C45, C46, C47, C48, C49, C5, C6, C70, C71, C72, C73, C74, C75, C76, C80, C81, C82, C83, C84, C85, C883, C887, C889, C900, C901, C91, C92, C93, C940, C941, C942, C943, C9451, C947, C95, C96
Metastatic cancer	2	C77, C78, C79, C80
Severe liver disease	2	K729, K766, K767, K721
HIV	2	B20, B21, B22, B23, B24

Statistical model – choice of distribution



- Standard Ordinary Least Squares regression assumes that “data” are distributed normally, at least symmetrically.
- Cost and LOS data are right skewed. Taking log of the data, makes distribution symmetrical.
- An alternative distribution, such as gamma distribution for cost and zero-truncated negative binomial for LOS, and multiplicative model (log link) are appropriate for a skewed dataset.

Cost impact assessment – 4 models



† rejected by Bayesian Information Criterion

- fitted to the residuals after subtraction of the DRG means over episodes without CHADx; expected to provide a low estimation of impact.



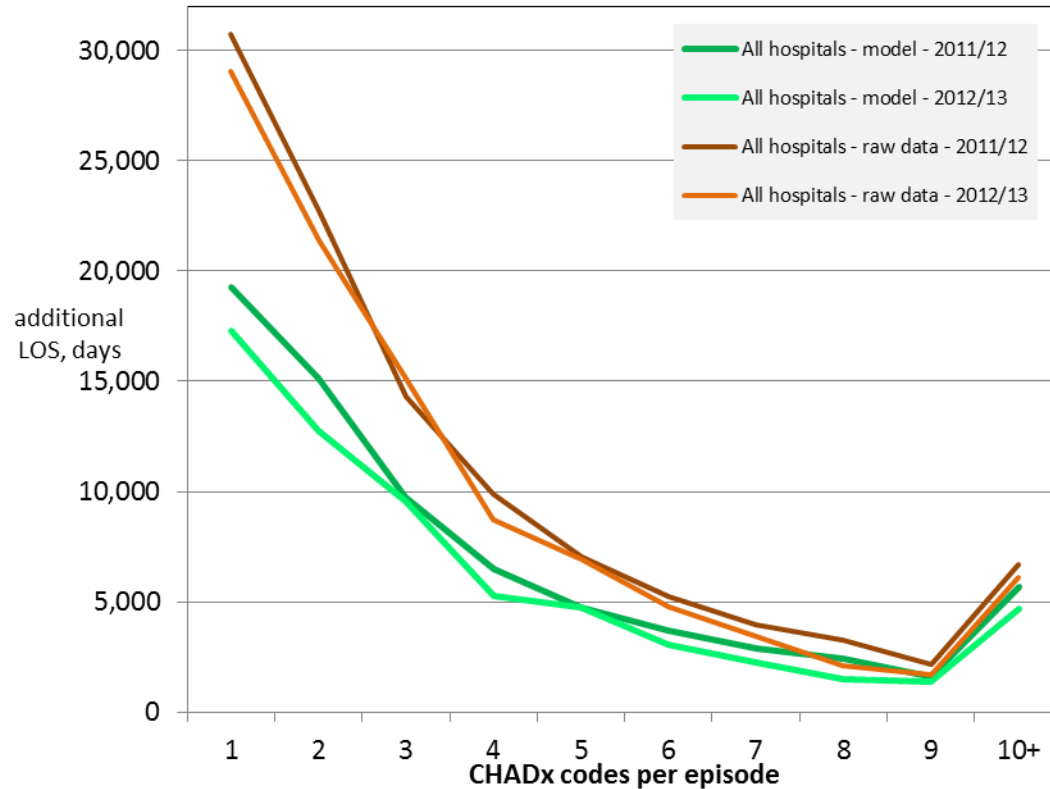
Modelled impact cost and LOS

Study results			Activity (days), year 1	Activity (days), year 2	Direct cost (\$), year 1	Direct cost (\$), year 2
Raw data	Mean LOS and cost per episode	Overall	6.2	6.0	6,213	6,843
		Without CHADx	5.1	4.9	4,791	5,298
		With CHADx	12.3	11.5	14,058	15,471
	Extra beddays and cost for episodes with CHADx	Mean per episode	7.3	6.6	9,266	10,173
		Sum over episodes	105,958 days	99,261 days	\$123,716,172	\$128,416,408
Model, adjusted for confounders	Extra beddays and cost for episodes with CHADx	Mean per episode	4.9	4.1	6,333	6,343
		Sum over all episodes with CHADx	71,697 (14% extra)	62,483 (12% extra)	\$84,558,109 (19% extra)	\$80,073,512 (16% extra)
		N episodes	14,600	15,107	13,351	12,623
		Sum over 6+ CHADx episodes	16,294	12,870	\$29,677,527	\$25,439,402
		N episodes with 6+ CHADx	607	560	560	530

LOS (days) for five WA hospitals, (Trentino et al, 2013)

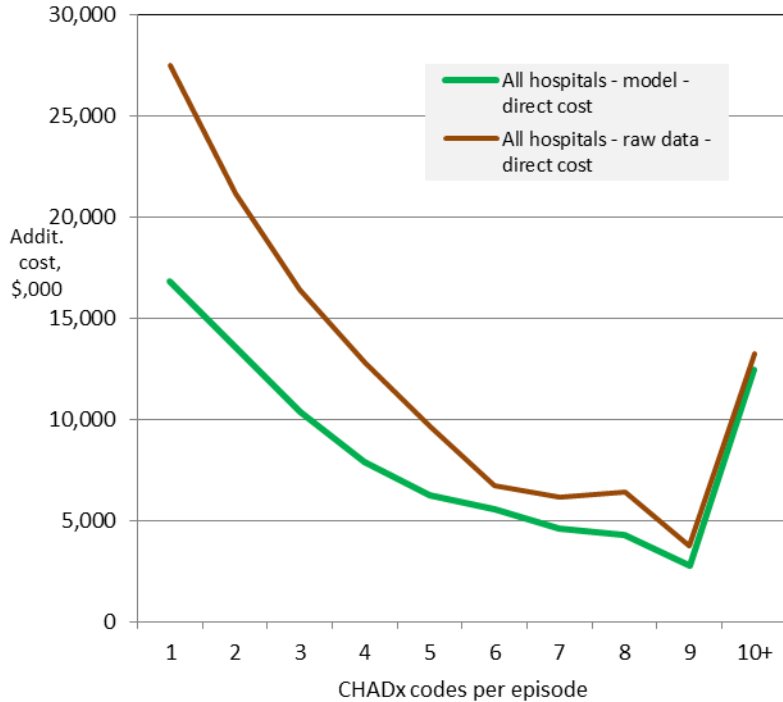
- w/o CHADx 5.4
- with CHADx 17.4

Additional bed days, adjusted

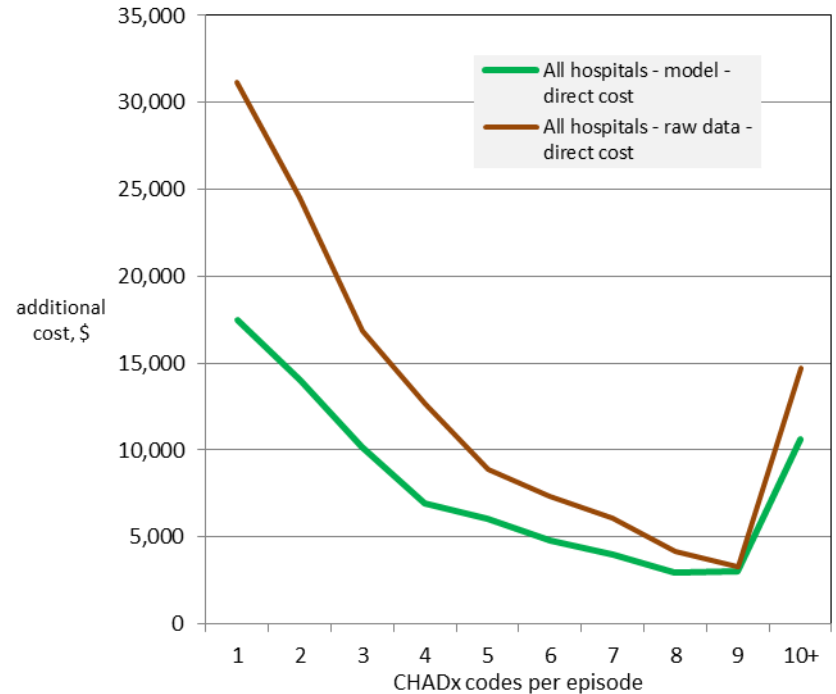


Total direct cost impact, adjusted

Additional total direct cost, 2011/12



Additional total direct cost, 2012/13



OPPORTUNITIES FOR APPLICATION IN SESLHD

Results by hospital- Top 5 specialties

		2011/2012		2012/2013	
Hospital	AMO speciality	No of CHADx codes	AMO speciality	No of CHADx codes	
Hospital F	Obstetrics	2,153	Obstetrics	2,207	
	Aged Care	939	Paediatrics	1,014	
	Paediatrics	933	Aged Care	982	
	Hepatology	410	Hepatology	487	
	Cardiothoracic	402	Colorectal Surgery	332	
	Percent of total	51.5%	Percent of total	53.5%	
	Total	9,393	Total	9,388	
Hospital H	Obstetrics	4,752	Obstetrics	4,788	
	Paediatrics	1,896	Paediatrics	2,147	
	Oncology	330	Oncology	284	
	Gynaecology	164	Gynaecology	124	
	Breast Surgery	22	Breast Surgery	41	
	Percent of total	100.0%	Percent of total	100.0%	
	Total	7,164	Total	7,384	

Top 3 CHADx classes by specialty

Top 5 AMO speciality at Hospital F	Number of CHADX codes, 2012/13		CHADx class name
	Total	Top 3 CHADx classes	
Obstetrics	2,207	1,958	12-Labour, Delivery & Postpartum complications
		95	17-Other complications
		24	9-Genitourinary complications
Paediatrics	1,014	977	13-Perinatal complications
		10	17-Other complications
		10	8-Skin Conditions
Aged Care	982	120	9-Genitourinary complications
		106	10-Hospital-acquired Psychiatric states
		104	3-Accidental injuries
Hepatology	487	206	1-Post-procedural complications
		56	2-Adverse drug events
		39	15-Metabolic Disorders
Colorectal Surgery	332	103	1-Post-procedural complications
		39	5-Cardiovascular complications
		36	15-Metabolic Disorders

Top 3 CHADx classes by specialty

Top 5 AMO speciality at Hospital H	Number of CHADx codes, 2012/13		CHADx class name
	Total	Top 3 CHADx classes	
Obstetrics	4,788	3,435	12-Labour, Delivery & Postpartum compls
		669	13-Perinatal complications
		141	17-Other complications
Paediatrics	2,147	2,047	13-Perinatal complications
		29	4-Specific infections
		23	1-Post-procedural complications
Oncology	284	71	1-Post-procedural complications
		46	15-Metabolic Disorders
		42	2-Adverse drug events
Gynaecology	124	31	1-Post-procedural complications
		21	5-Cardiovascular complications
		17	17-Other complications
Breast Surgery	41	14	1-Post-procedural complications
		8	5-Cardiovascular complications
		5	17-Other complications

Discussion: Next Steps for SESLHD

- Confirmation & Program of Work
 - ✓ Presentation to Executive – LHD & Sectors
- Clinical champions engagement
 - ✓ Clinical Governance Program Team
 - Presentation to LHD Clinical & Quality Council
- Roadshow
 - Sector Clinical Council & Performance Meetings
 - Clinical Groups
- Establish detailed program plan

References

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