Impact of Electronic Medical Record Implementation on Hospital Coding for Pneumonia as a Healthcare-associated Complication

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Acknowledgement to country

- I would like to acknowledge that this meeting is being held on the traditional lands of the Wurundjeri people.
- I would like to pay my respects to their Elders both past and present and to any Elders from other communities who are here today.

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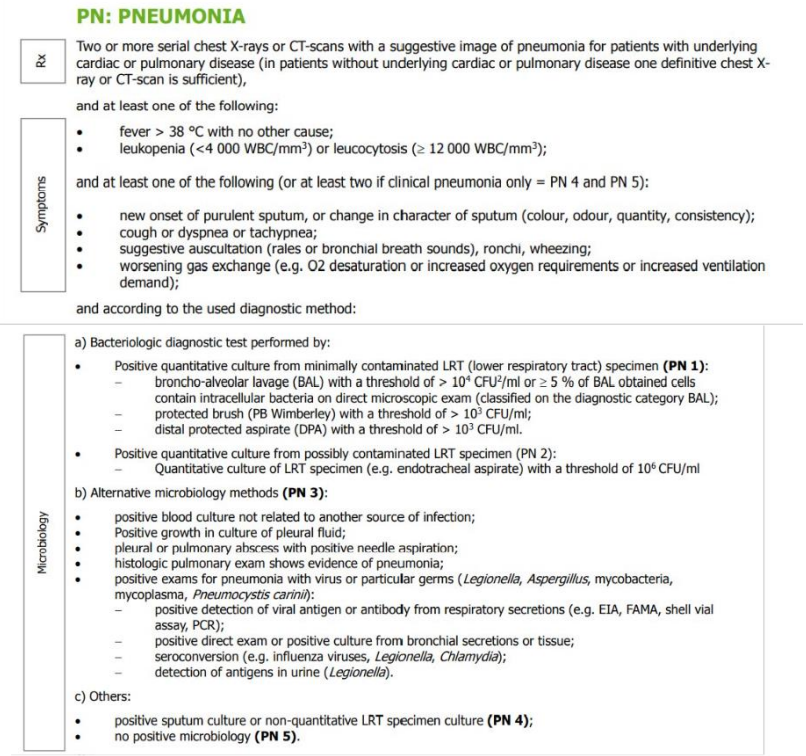
Disclosures

- Nil to disclose

Background

- Non-ventilator HAP is a frequent, but often neglected HAI
- Ranks in top 2-3 of HAIs in most surveys[1,2]
- Increased morbidity, mortality and healthcare costs
- Regular surveillance and reporting lacking
  - Time consuming
  - Complex definitions, multiple definitions…
  - Subjective
- Recent interest in automated surveillance and coding-based methods[3,4,5,6]
  - Automated surveillance moderate-high correlation with reference definitions
    - Improved efficiency for IP practitioners
    - Improved consistency
  - Coding methods variable correlation with reference definitions
    - Easier to implement



PN: PNEUMONIA

Rx

Two or more serial chest X-rays or CT-scans with a suggestive image of pneumonia for patients with underlying cardiac or pulmonary disease (in patients without underlying cardiac or pulmonary disease one definitive chest X-ray or CT-scan is sufficient),

and at least one of the following:

Symptoms

- fever > 38 °C with no other cause;
- leukopenia (<4 000 WBC/mm³) or leucocytosis (≥ 12 000 WBC/mm³);

and at least one of the following (or at least two if clinical pneumonia only = PN 4 and PN 5):

- new onset of purulent sputum, or change in character of sputum (colour, odour, quantity, consistency);
- cough or dyspnea or tachypnea;
- suggestive auscultation (rales or bronchial breath sounds), ronchi, wheezing;
- worsening gas exchange (e.g. O2 desaturation or increased oxygen requirements or increased ventilation demand);

and according to the used diagnostic method:

Microbiology

a) Bacteriologic diagnostic test performed by:

- Positive quantitative culture from minimally contaminated LRT (lower respiratory tract) specimen **(PN 1)**:
  - broncho-alveolar lavage (BAL) with a threshold of > 10^4 CFU²/ml or ≥ 5 % of BAL obtained cells contain intracellular bacteria on direct microscopic exam (classified on the diagnostic category BAL);
  - protected brush (PB Wimberley) with a threshold of > 10^3 CFU/ml;
  - distal protected aspirate (DPA) with a threshold of > 10^3 CFU/ml.
- Positive quantitative culture from possibly contaminated LRT specimen (PN 2):
  - Quantitative culture of LRT specimen (e.g. endotracheal aspirate) with a threshold of 10^6 CFU/ml

b) Alternative microbiology methods **(PN 3)**:

- positive blood culture not related to another source of infection;
- Positive growth in culture of pleural fluid;
- pleural or pulmonary abscess with positive needle aspiration;
- histologic pulmonary exam shows evidence of pneumonia;
- positive exams for pneumonia with virus or particular germs (*Legionella*, *Aspergillus*, mycobacteria, mycoplasma, *Pneumocystis carinii*):
  - positive detection of viral antigen or antibody from respiratory secretions (e.g. EIA, FAMA, shell vial assay, PCR);
  - positive direct exam or positive culture from bronchial secretions or tissue;
  - seroconversion (e.g. influenza viruses, *Legionella*, *Chlamydia*);
  - detection of antigens in urine (*Legionella*).

c) Others:

- positive sputum culture or non-quantitative LRT specimen culture **(PN 4)**;
- no positive microbiology **(PN 5)**.

1. Russo, PL et al. (2019). Antimicrob Resist Infect Control, 8:114.
2. Lydeamore, MY et al (2022). Antimicrob Resist Infect Control, 11: 69.
3. Baker, D et al (2018). Am J Infection Control, 46: 2.
4. Wolfensberger A, et al (2019). Clin Microbiol Infect, 25(11): 1428.
5. Stern SE, et al (2023). Infect Control Hosp Epidemiol, 8:1–7.
6. Wolfensberger A, et al (2018). J Hosp Infect, 99: 81.

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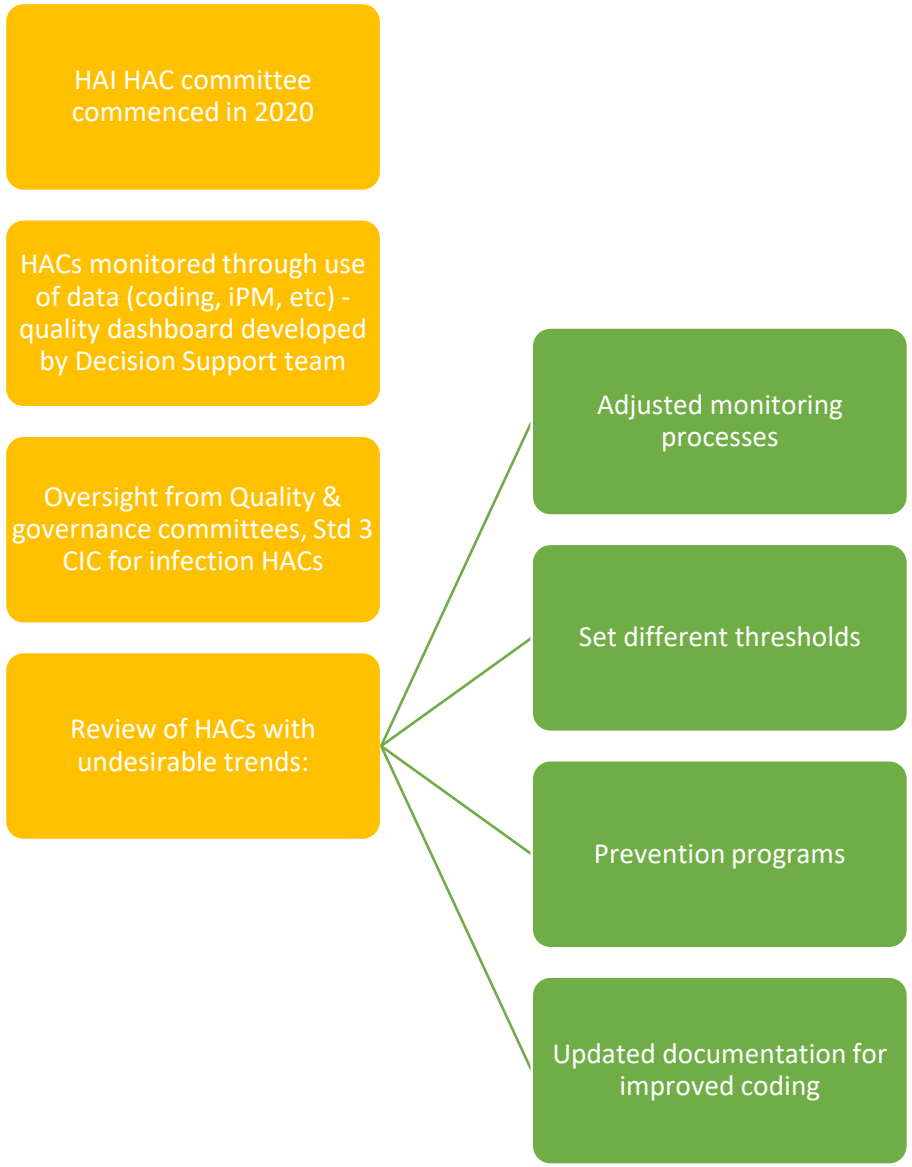
HACs

- 2016 – ACSQHC released list of potentially preventable high impact HACs
  - 9 infections including HAP
- HAC policy introduced to incentivize prevention by discontinuing funding
- Definition for pneumonia based on 33 codes and COF=1

3. Pneumonia	J100	J10.0	Influenza with pneumonia, other influenza virus identified
	J110	J11.0	Influenza with pneumonia, virus not identified
	J120	J12.0	Adenoviral pneumonia
	J121	J12.1	Respiratory syncytial virus pneumonia
	J122	J12.2	Parainfluenza virus pneumonia
	J123	J12.3	Human metapneumovirus pneumonia
	J128	J12.8	Other viral pneumonia
	J129	J12.9	Viral pneumonia, unspecified
	J13	J13	Pneumonia due to Streptococcus pneumoniae
	J14	J14	Pneumonia due to Haemophilus influenzae
	J150	J15.0	Pneumonia due to Klebsiella pneumoniae
	J151	J15.1	Pneumonia due to Pseudomonas
	J152	J15.2	Pneumonia due to staphylococcus
	J153	J15.3	Pneumonia due to streptococcus, group B
	J154	J15.4	Pneumonia due to other streptococci
	J155	J15.5	Pneumonia due to Escherichia coli
	J156	J15.6	Pneumonia due to other aerobic Gram-negative bacteria
	J157	J15.7	Pneumonia due to Mycoplasma pneumoniae
	J158	J15.8	Other bacterial pneumonia
	J159	J15.9	Bacterial pneumonia, unspecified
	J160	J16.0	Chlamydial pneumonia
	J168	J16.8	Pneumonia due to other specified infectious organisms
	J170	J17.0	Pneumonia in bacterial diseases classified elsewhere
	J171	J17.1	Pneumonia in viral diseases classified elsewhere
	J172	J17.2	Pneumonia in mycoses
	J173	J17.3	Pneumonia in parasitic diseases
	J178	J17.8	Pneumonia in other diseases classified elsewhere
	J180	J18.0	Bronchopneumonia, unspecified
	J181	J18.1	Lobar pneumonia, unspecified
	J182	J18.2	Hypostatic pneumonia, unspecified
	J188	J18.8	Other pneumonia, organism unspecified
	J189	J18.9	Pneumonia, unspecified
	J22	J22	Unspecified acute lower respiratory infection

HACs at NH – what have we been doing



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Northern Health | Hospital Acquired Complications (HAC) Monitor (QUA105)

Source: iPM | Updated: Nightly

Financial Year: 2020/21

Month: April 2021

Care Type: All

Specialty Group: All

Specialty Unit: All

Ethnicity: ATSI | Non-ATSI

Hospital Acquired Complications - Performance Scorecard

Complication	Status	HACs	Separations	Rate per 10,000 Separations	Baseline Rate	Previous Month Rate	Variance Previous Month
Cardiac complications		**12**	**6,111**	**19.6**		**18.1**	
Delirium		**25**	**6,111**	**40.9**		**37.7**	
Endocrine complications		**38**	**6,111**	**62.2**		**43.7**	
Falls resulting in fracture or other intracranial injury		**4**	**6,111**	**6.5**		**7.5**	
Gastrointestinal bleeding		**6**	**6,111**	**9.8**		**9.0**	
Healthcare associated infection		**53**	**6,111**	**86.7**		**78.3**	
Blood stream infection	Normal (Within control limits)	1	6,111	1.6	1.9	1.5	
Gastrointestinal infections	Normal (Within control limits)	0	6,111	0.0	2.3	6.0	
Infection associated with prosthetics/ implantable devices	Normal (Within control limits)	0	6,111	0.0	1.9	1.5	
Infections or inflammatory complications associated with peripheral/ce...	Normal (Within control limits)	6	6,111	9.8	3.4	6.0	
Multi-resistant organism	Normal (Within control limits)	1	6,111	1.6	5.3	0.0	
Other high impact infections	Undesirable - Large Shift (Rate outside upper control limit)	14	6,111	22.9	13.1	19.6	
Pneumonia	Normal (Within control limits)	18	6,111	29.5	29.3	22.6	
Surgical site infection	Normal (Within control limits)	2	6,111	3.3	4.3	4.5	
Urinary tract infection	Normal (Within control limits)	11	6,111	18.0	14.5	16.6	
Incontinence		**2**	**6,111**	**3.3**		**4.5**	
Medication complications		**2**	**6,111**	**3.3**		**3.0**	
Total		**173**	**5,260**	**283.1**		**248.5**	

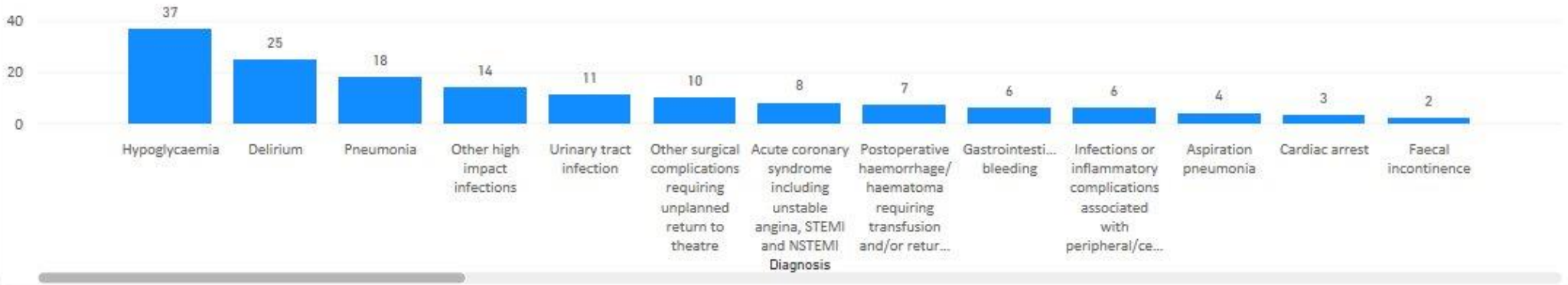
173
Total HACs - Current

165
Total HACs - Previous

283.1
HACs per 10,000 Separations - Current

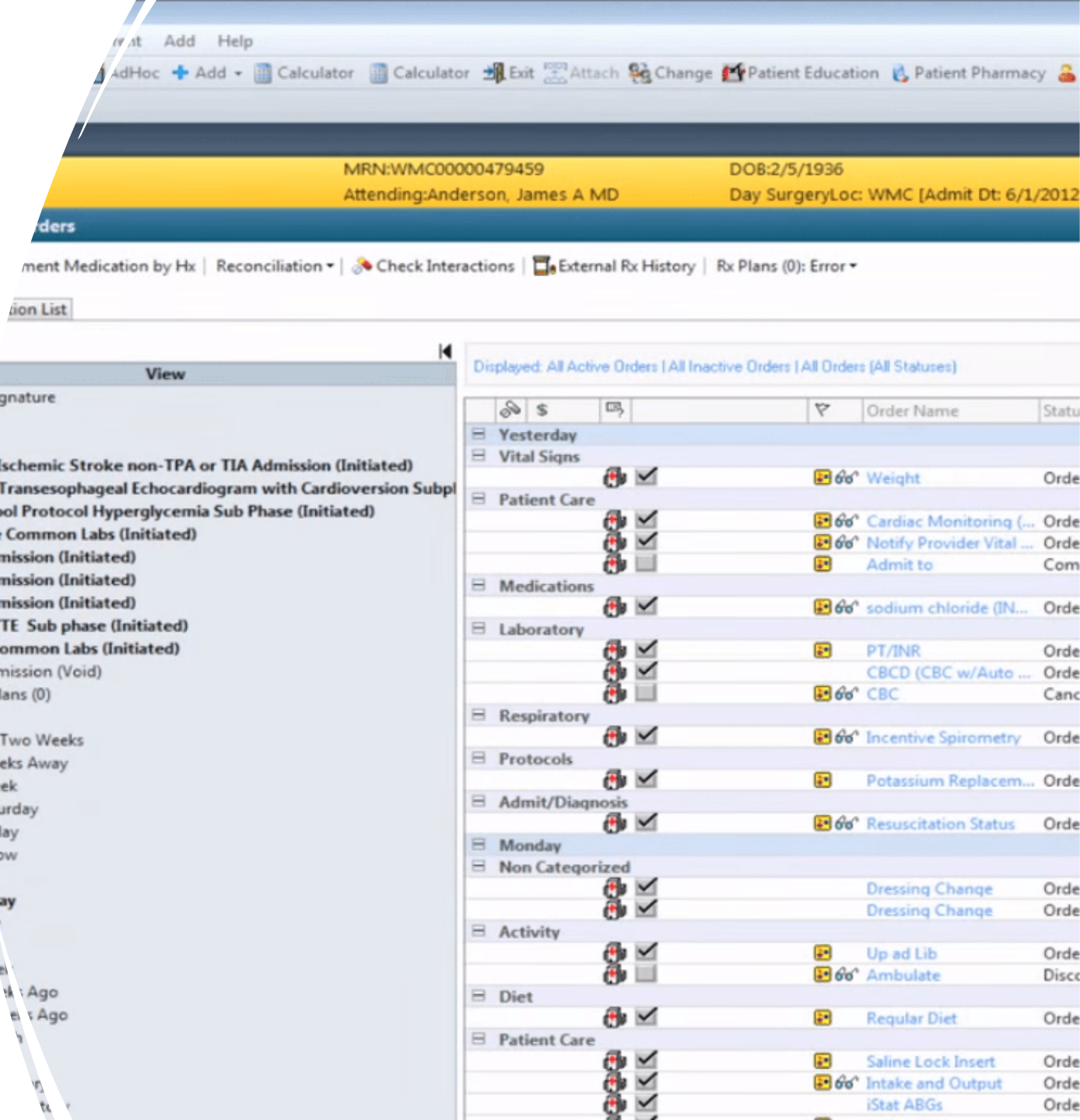
248.5
HACs per 10,000 Separations - Previous

Hospital Acquired Complications - Complication/Diagnosis



EMR introduction details

- August, 2023 – introduction of EMR at TNH
- Rolled out over 2 months at different campuses
- Cerner Millenium platform with Powerchart as main clinical documentation module
- Immediately after implementation
  - Delay in coding
  - Decrease in HACs noted



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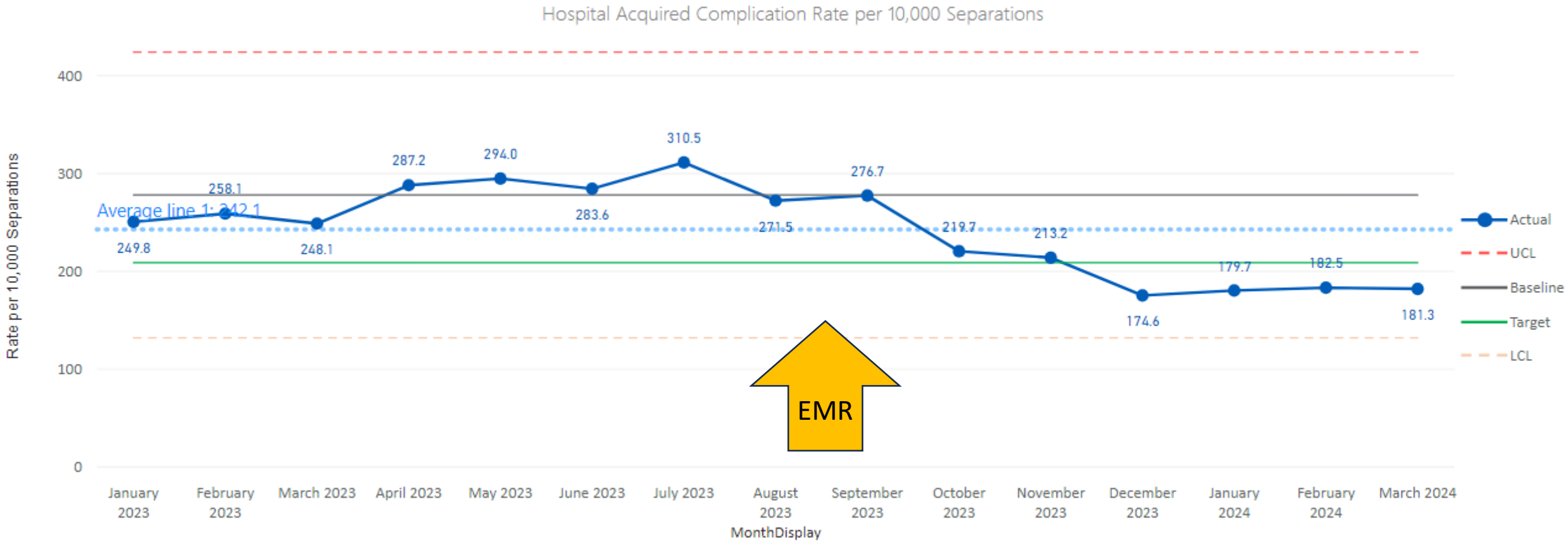
Trend in HACs, pre and post-EMR implementation



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Study Aims

- What was the impact of EMR introduction?
- (Overall aim is to set up a prevention bundle to drive down numbers of our biggest HAC)

Methods

- All hospital admissions included with ICD-10-AM code attributing HAP as per ACSQHC definition
  - pre-EMR (1st January - 30th April, 2023)
  - post-EMR (1st January - 30th April, 2024)

- Differences observed in following parameters:
  - HAC incidence
  - HAP incidence according to coding (ICD-10-AM, 12th Edition)
  - HAP according to standard definitions (ECDC, CDC, TG), as a proportion of coded cases (PPV)
  - Diagnostic criteria (e.g. timing of onset, presence of radiological, clinical or microbiological criteria)

- Other data:
  - Antibiotic use
  - Sex
  - Age
  - Hospital LOS
  - Treating unit and location
  - Major medical comorbidities
  - Medical reason for admission

Results

- Overall HAC incidence declined
  - 224.6/10,000 separations (95% CI: 207.5-242.6) vs 167.7/10,000 separations (CI: 153.4-182.9)
  - IRR 1.34 (CI: 1.19-1.51, $p < 0.0001$)
- HAP incidence (coding) also declined
  - 29.8/10,000 separations (CI: 23.8-36.8) vs 18.8/10,000 separations (CI: 14.2-24.3)
  - IRR 1.59 (CI:1.12-2.26, $p = 0.0067$)
- No significant differences in terms of treating unit or location, major comorbidities, sex, age, LOS
- Overwhelming majority treated with antibiotics (98.8% pre-EMR and 94.7% post-EMR, p = NS)

PPV of coding before & after EMR implementation

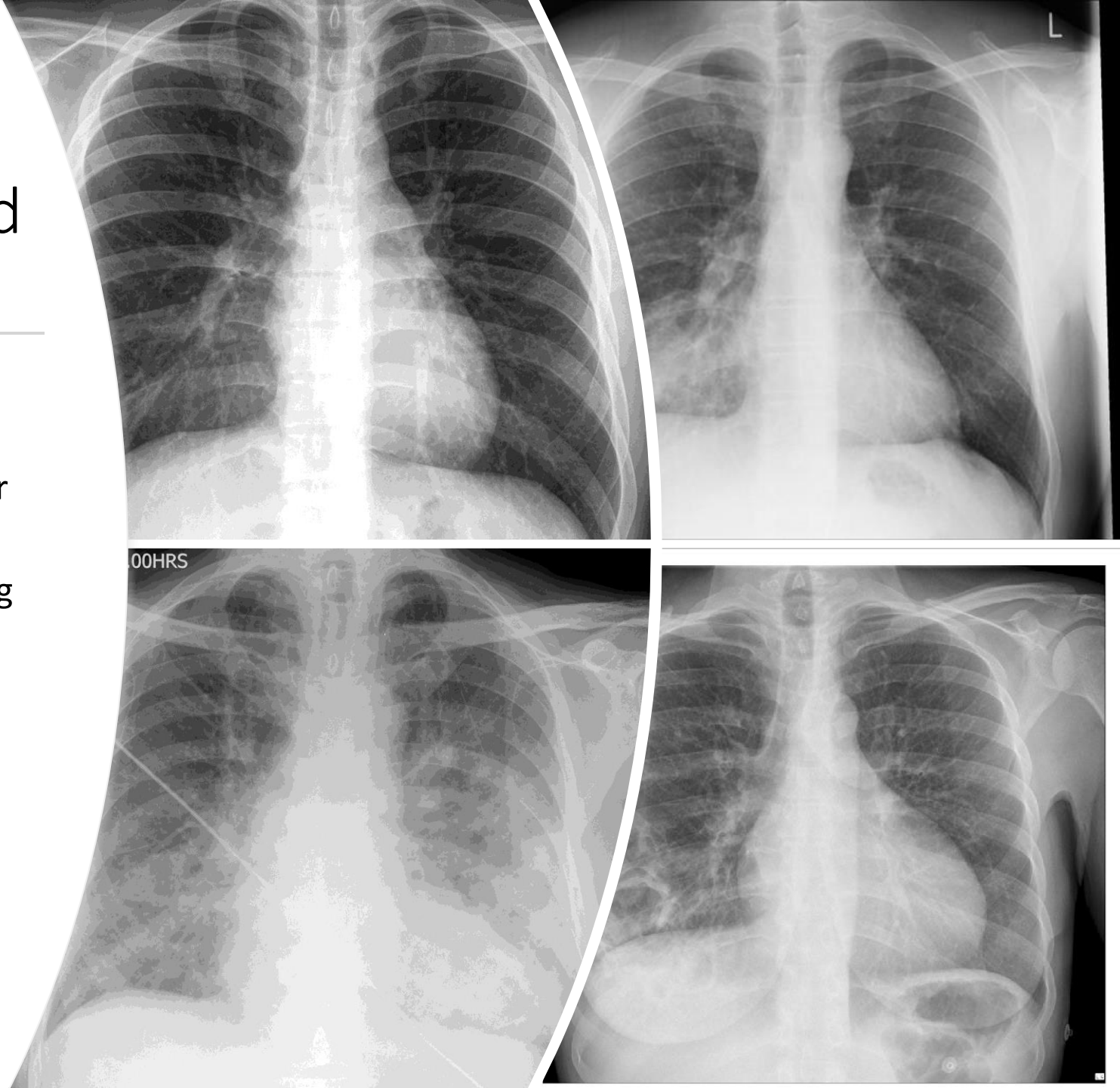
Reference definition	PPV pre-EMR (95% CI)	PPV post-EMR (95% CI)	p-value
ECDC	0.11 (0.03-0.19)	0.14 (0.07-0.21)	0.54
CDC	0.15 (0.06-0.24)	0.12 (0.05-0.19)	0.62
TG	0.37 (0.24-0.50)	0.3 (0.20-0.40)	0.41

Taking ECDC criteria as reference standard:

- Reasons for discordance:
  - Not hospitalized >48hrs (12.9% pre-EMR, 7.1% post-EMR)
  - Did not meet radiological criteria (50.6% pre-EMR, 57.9% post-EMR)
  - Did not meet clinical criteria (67.1% pre-EMR, 61.4% post-EMR)
  - Did not meet microbiological criteria (95.3% pre-EMR, 94.7% post-EMR)

Common themes identified

- Subjective interpretation of chest x-rays
- CRP-itis is almost always attributed to HAP or UTI (our 2 biggest HAI HACs by far)
- “HAP” was frequently documented (including majority of discharge summaries)
- Most commonly used codes were J18.2 (hypostatic pneumonia, unspecified) and J18.9 (Pneumonia, unspecified)
- The stroke ward didn’t have many HAPs at all… they were coded as aspiration pneumonia in another category of HAC



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Discussion - findings

- Coding overestimates HAP compared to standard definitions
- Similar to previous studies (in Australia and elsewhere)[1,2,3]
  - PPV variable due to mixed methodologies (e.g. reference standard, finding of cases)
  - ICD-10-AM coding method and standard definitions are not aligned
  - Poor documentation is the issue rather than the coding per se
  - Use of NOS codes – widely used in our cohort
- Are we also missing cases?

1. Bartley et al (2021). Infect Dis Health, 26: 67
2. Valentine et al (2024). Health Inf Manag, 53: 112
3. Wolfensberger A, et al (2018). J Hosp Infect, 99: 81.

How to measure HAP?

How can we prevent HAP if we cannot measure it?

Which reference definition to use?

Subjectivity even within the gold standard definitions[1]

- Especially around radiological & clinical interpretations
- Interrater reliability problematic

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1. Stern SE, et al (2023). Infect Control Hosp Epidemiol, 8:1–7.

Discussion – impact of the EMR

- We saw that EMR lead to reduced coding of HAC/HAP but no improvement in PPV of coding for reference definitions
  - Documentation noticeably deteriorated
  - Have we just missed a whole bunch of cases?
- In theory EMR could be very useful for surveillance activities
- Cerner platform vs others?
- Productivity is known to decrease following EMR implementation and then increase

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Conclusion

- EMR implementation lowered detection of HAP cases according to ACSQHC methods
- PPV of coding-based surveillance remained low (compared to reference definitions for HAP)
- Root cause is in documentation and clinical and radiological diagnosis of HAP
- We expect incidence to rise again as coders adjust to the new system!
- Planning to implement a prevention bundle in 2025 that will address diagnostic and documentation issues, along with other evidence-based strategies

Thank you

Questions?

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