Appendix: Narrative Review Results

Hospital-level influences on patient safety-Empiric data

	Hospitals	Staff	Patients	Comments
Patient Safety Culture				
Wang 2014 A multi-site study in China, that surveyed nursing staff, identified differences in the domains of patient safety culture and different nursing-sensitive adverse events.(1)	7	463		
Singer 2009 A one standard deviation improvement in safety climate resulted in a 10% lower risk of patient safety indicators in a study across 91 hospitals.(2)	91	18223		
Mardon 2010 Better patient safety culture was associated with reduced adverse events; after controlling for hospital characteristics a 1 standard deviation change in patient safety culture resulted in a reduced rate of adverse events of 0.64 per 1000 patients.(3)	179	56480		
Kline 2008 A study looking at a variety of factors that predict adverse event and adverse event severity found that while patient factors predict the occurrence of an AE, the severity of AEs were better predicted by organization safety culture. (4)	3	298		
Leonard 2018 In radiation departments internationally ranged from 50-79% (n=222). Statistically significant differences between professions (physician and technicians) were detected.(5)		266		
Hansen 2011 Low patient safety culture as perceived by front line staff (no association when looking at management perceived safety culture) was associated with increased rates of readmission for those with heart failure and acute myocardial infarct.(6)	67	36375		
Patient Safety Strategies				
Shojania 2001 A critical analysis of quality improvement strategies, commissioned by the AHRQ identified 40 definition of patient safety strategies.(7)				
Shekelle 2013 The AHRQ commissioned a review of the literature on patient safety strategies and found sufficient evidence of the success of 22 patient safety strategies to encourage the adoption of these strategies into clinical practice.(8)				
Bradley 2018 A study looking at the success of patient safety strategies at reducing standardized mortality ratio found that certain characteristics of the organization were important to the success of patient safety strategies – audit and education about incidents, organizational environment that encourage team problem solving, staff training and champions.(9)	10	393		

Appendix: Narrative Review Results

Table 1 Hospital-level influences on patient safety-Empiric data

	Hospitals	Staff	Patients	Comments
Staff and Staffing				
Kumar 2009 Having a 24-hour intensivist present in the ICU associated fewer adverse events.(10)			1467	
Pronovost 2002 ICU physician to patient ratios are inversely related to occurrence of adverse events.(11)				Systematic review 26 studies
Parshuram 2015 Our randomized controlled trial evaluating 12, 16, and 24-hour overnight schedules for residents in ICU found no significant differences in the rate of adverse events. However, 7 or 8 preventable adverse events were in the 12-hour overnight schedule.(12)	1	47	5894	Canadian RCT
Hall 2016 A systematic review of studies on staff wellbeing and patient safety found that 16/27 studies found that poor staff wellbeing was associated with poorer patient safety.(13)				Systematic review 27 studies
Aiken 2008 A pre-post study of nursing staff satisfaction and perceived quality of patient care found that after implementing accreditation processes (and being awarded accreditation) nursing satisfaction with work environment and perceived quality of patient care improved significantly.(14)	1	109		
Aiken 2011 A study looking at the impact of nursing staffing, education and work environment on mortality and failure-to-rescue found that decreasing workload (patient to nurse ratio) only improves patient outcomes if the work environment is considered good.(15)	665	39038	1.3M	
Aiken 2013 The study examined the effect of using supplemental nurses on hospital mortality and failure-to-rescue and found that using supplemental nurses was associated with both outcomes, but this association was modified by the work environment (no association if work environment was good).(16)	665	40356		
Ausserhofer 2013 In a Swiss study looking at the association between patient safety climate and patient outcomes, the most prominent predictor of patient outcomes was rationing of nursing staff; after controlling for other organizational variables rationing was associated with decreased patient satisfaction and increased medication errors, bloodstream infection and pneumonia. Patient safety climate was not a predictor of patient outcomes.(17)	35	1630	1.3M	
Borg 2015 A study looking at the effect of organizational culture on infection prevention and control behaviours among healthcare workers, found that positive scores on change facilitation and change readiness were related to lower incidence of infection.(18)	7	140		

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Table 1 Hospital-level influences on patient safety-Empiric data

	Hospitals	Staff	Patients	Comments
Bradley 2012 A cross-sectional study found that certain safety strategies were associated with lower standardized mortality rates in acute myocardial infarct patients: holding monthly multi-professional case review meetings, having a cardiologist on-site 24hours a day, an environment that encouraged problem solving, training nurses in a specific clinical area and having a nurse-physician champion.(19)	533			
Cho 2015 A South Korean study examined the relationship between mortality and nurse staff, work environment and education. This study found a positive association between these variables and mortality – each additional patient per nurse increased the odds of mortality by 5% and mortality was 50% lower in hospitals with a good work environment. (20)	14	1024	76036	
Davenport 2007 When examining the association between organizational safety climate and surgical morbidity and mortality, the authors found that reported levels of communication between residents and attendings was correlated with risk-adjusted morbidity using the National Surgical Quality Improvement Program.(21)	52	6083		
Dubois 2013 A study looking at nursing care models and their effect on patient safety outcomes found significant differences between models – models that had greater support for nursing professional practice were associated with decreased safety events (medication errors, falls, pneumonia, urinary tract infection, unjustified restraints and pressure ulcers).(22)	11		2699	
Estabrooks 2015 A retrospective study of Canadian nursing homes found the prevalence of dementia, delirium and urinary tract infections was lower among residents in nursing homes with better organizational context.(23)	36		2635	
Fagerstrom 2018 A one-year study looking at the effect of nursing workload on patient safety identified that an above average workload was associated with an increased odds (1.24) of experiencing a patient safety incident.(24)	4		12475	
Kelly 2014 This cross-sectional study examined the variation in ICU nursing characteristics (staffing, work environment, education and work experience) and their association with mortality. The authors found a 11% reduced risk of mortality in better work environments, but staffing and work experience was not associated with mortality.(25)	303		55159	
Hospital capacity and volume				
Baker 2004 The Canadian Adverse Event Study found that teaching hospitals, that tend to be larger, experienced more adverse events after controlling for patient factors.(26)	20		37845	

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Table 1 Hospital-level influences on patient safety-Empiric data

	Hospitals	Staff	Patients	Comments
Mardon 2010 A study examining hospital patient safety culture, found larger teaching hospitals had more adverse events.(3)	179	56480		
Stelfox 2012 We found in a cohort study of hospitalized patients with sudden clinical deterioration that zero ICU bed availability resulted in a 33% decreased chance of appropriately being admitted to ICU but did not result in changes in mortality.(27)	3		3494	
Sauro 2018 We found that adjusted rates of adverse events varied by ICU suggesting hospital characteristics/variables were associated with adverse events.(28)			49447	
Sauro 2019 We found that that adverse events were associated with bed occupancy on the day of discharge from ICU. (29)	10		451	
Important Reviews				
Shekelle 2013 The AHRQ commissioned a review of the literature on patient safety strategies and found sufficient evidence of the success of 22 patient safety strategies to encourage the adoption of these strategies into clinical practice.(8)				
Kaplan 2010 A systematic review of literature on contextual factors that might be associated with the success of quality improvement initiatives found the length of time an organization had been conducting quality improvement initiatives and the amount of resources dedicated to quality improvement initiatives were associated with the success of quality improvement initiatives.(30)				
Okuyama 2018 Systematic review found 59 studies evaluating patient safety culture using AHRQ patient safety culture survey. Found significant heterogeneity between reported values on all domains with a mean positive response of 54% (95% CI=51-56%) for the overall domain.(31)				
Shojania 2001 A critical analysis of quality improvement strategies, commissioned by the AHRQ identified 40 definition of patient safety strategies.(7)				

Appendix: Narrative Review Results

Table 1 Hospital-level influences on patient safety-Empiric data

Reference Citations

1. Wang X, Liu K, You LM, Xiang JG, Hu HG, Zhang LF, et al. The relationship between patient safety culture and adverse events: a questionnaire survey. International journal of nursing studies. 2014;51(8):1114-22.
2. Singer S, Lin S, Falwell A, Gaba D, Baker L. Relationship of Safety Climate and Safety Performance in Hospitals. Health services research. 2009;44(2p1):399-421.
3. Mardon RE, Khanna K, Sorra J, Dyer N, Famolaro T. Exploring relationships between hospital patient safety culture and adverse events. Journal of patient safety. 2010;6(4):226-32.
4. Kline TJB, Willness C, Ghali WA. Determinants of Adverse Events in Hospitals—The Potential Role of Patient Safety Culture. Journal for Healthcare Quality. 2008;30(1):11-7.
5. Leonard S, O'Donovan A. Measuring safety culture: Application of the Hospital Survey on Patient Safety Culture to radiation therapy departments worldwide. Practical radiation oncology. 2018;8(1):e17-e26.
6. Hansen LO, Williams MV, Singer SJ. Perceptions of Hospital Safety Climate and Incidence of Readmission. Health services research. 2011;46(2):596-616.
7. Shojania KG, Duncan BW, McDonald KM, Wachter RM, Markowitz AJ. Making health care safer: a critical analysis of patient safety practices. Evidence report/technology assessment (Summary). 2001(43):i-x, 1-668.
8. Shekelle PG, Pronovost PJ, Wachter RM, McDonald KM, Schoelles K, Dy SM, et al. The top patient safety strategies that can be encouraged for adoption now. Annals of internal medicine. 2013;158(5 Pt 2):365-8.
9. Bradley EH, Brewster AL, McNatt Z, Linnander EL, Cherlin E, Fosburgh H, et al. How guiding coalitions promote positive culture change in hospitals: a longitudinal mixed methods interventional study. BMJ quality & safety. 2018;27(3):218-25.
10. Kumar K, Zarychanski R, Bell DD, Manji R, Zivot J, Menkis AH, et al. Impact of 24-Hour In-House Intensivists on a Dedicated Cardiac Surgery Intensive Care Unit. The Annals of Thoracic Surgery. 2009;88(4):1153-61.
11. Pronovost PJ, Angus DC, Dorman T, Robinson KA, Dremsizov TT, Young TL. Physician Staffing Patterns and Clinical Outcomes in Critically Ill PatientsA Systematic Review. JAMA. 2002;288(17):2151-62.
12. Parshuram CS, Amaral AC, Ferguson ND, Baker GR, Etchells EE, Flintoft V, et al. Patient safety, resident well-being and continuity of care with different resident duty schedules in the intensive care unit: a randomized trial. CMAJ. 2015;187(5):321-9.
13. Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare Staff Wellbeing, Burnout, and Patient Safety: A Systematic Review. PloS one. 2016;11(7):e0159015.
14. Aiken LH, Buchan J, Ball J, Rafferty AM. Transformative impact of Magnet designation: England case study. Journal of clinical nursing. 2008;17(24):3330-7.
15. Aiken LH, Cimiotti JP, Sloane DM, Smith HL, Flynn L, Neff DF. Effects of nurse staffing and nurse education on patient deaths in hospitals with different nurse work environments. Med Care. 2011;49(12):1047-53.
16. Aiken LH, Shang J, Xue Y, Sloane DM. Hospital use of agency-employed supplemental nurses and patient mortality and failure to rescue. Health services research. 2013;48(3):931-48.
17. Ausserhofer D, Schubert M, Desmedt M, Blegen MA, De Geest S, Schwendimann R. The association of patient safety climate and nurse-related organizational factors with selected patient outcomes: a cross-sectional survey. International journal of nursing studies. 2013;50(2):240-52.
18. Borg MA, Waisfisz B, Frank U. Quantitative assessment of organizational culture within hospitals and its relevance to infection prevention and control strategies. The Journal of hospital infection. 2015;90(1):75-7.
19. Bradley EH, Curry LA, Spatz ES, Herrin J, Cherlin EJ, Curtis JP, et al. Hospital strategies for reducing risk-standardized mortality rates in acute myocardial infarction. Annals of internal medicine. 2012;156(9):618-26.
20. Cho E, Sloane DM, Kim EY, Kim S, Choi M, Yoo IY, et al. Effects of nurse staffing, work environments, and education on patient mortality: an observational study. International journal of nursing studies. 2015;52(2):535-42.
21. Davenport DL, Henderson WG, Mosca CL, Khuri SF, Mentzer RM, Jr. Risk-adjusted morbidity in teaching hospitals correlates with reported levels of communication and collaboration on surgical teams but not with scale measures of teamwork climate, safety climate, or working conditions. Journal of the American College of Surgeons. 2007;205(6):778-84.
22. Dubois CA, D'Amour D, Tchouaket E, Clarke S, Rivard M, Blais R. Associations of patient safety outcomes with models of nursing care organization at unit level in hospitals. Int J Qual Health Care. 2013;25(2):110-7.

Appendix: Narrative Review Results

Table 1 Hospital-level influences on patient safety-Empiric data

23. Estabrooks CA, Hoben M, Poss JW, Chamberlain SA, Thompson GN, Silvius JL, et al. Dying in a nursing home: treatable symptom burden and its link to modifiable features of work context. Journal of the American Medical Directors Association. 2015;16(6):515-20.
24. Fagerstrom L, Kinnunen M, Saarela J. Nursing workload, patient safety incidents and mortality: an observational study from Finland. BMJ Open. 2018;8(4):e016367.
25. Kelly DM, Kutney-Lee A, McHugh MD, Sloane DM, Aiken LH. Impact of critical care nursing on 30-day mortality of mechanically ventilated older adults. Critical care medicine. 2014;42(5):1089-95.
26. Baker GR, Norton PG, Flintoft V, Blais R, Brown A, Cox J, et al. The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. CMAJ. 2004;170(11):1678-86.
27. Stelfox HT, Hemmelgarn BR, Bagshaw SM, Gao S, Doig CJ, Nijssen-Jordan C, et al. Intensive Care Unit Bed Availability and Outcomes for Hospitalized Patients With Sudden Clinical Deterioration. Archives of internal medicine. 2012;172(6):467-74.
28. Sauro KM, Soo A, Quan H, Stelfox HT. Adverse events among hospitalized critically ill patients: A retrospective cohort study using administrative data. 2018.
29. Sauro KM, Soo A, deGrood C, Yang M, Wiestra B, Benoit L, et al. How safe is the transition from ICU to hospital ward? A multi-centre prospective cohort study. in preparation. 2019.
30. Kaplan HC, Brady PW, Dritz MC, Hooper DK, Linam WM, Froehle CM, et al. The influence of context on quality improvement success in health care: a systematic review of the literature. The Milbank quarterly. 2010;88(4):500-59.
31. Okuyama JHH, Galvao TF, Silva MT. Healthcare Professional's Perception of Patient Safety Measured by the Hospital Survey on Patient Safety Culture: A Systematic Review and Meta-Analysis. The Scientific World Journal. 2018;2018:9156301.