Received: 31 January 2023 | Revised: 4 August 2023 | Accepted: 9 August 2023

DOI: 10.1111/ajr.13034

ORIGINAL RESEARCH

AJRH National Rural Health Alliance WILEY

An 8-year retrospective review of emergency laparotomy outcomes in a Queensland rural hospital

Dong Tony Cheng MD[1] | **Nariyoshi Miyata MD**[1,2] | **Francis Asomah MD**[2]

[1]Department of General Surgery, Mount Isa Base Hospital, Mount Isa, Queensland, Australia

[2]Mount Isa Base Hospital, Mount Isa, Queensland, Australia

Correspondence
Dong Tony Cheng, Mount Isa Base Hospital, 30 Camooweal St, Mount Isa 4825, Qld, Australia.
Email: tony.cheng@health.qld.gov.au

Abstract

Objective: Emergency laparotomy (EL) is a major operation performed in critically unwell patients. The National Emergency Laparotomy Audit (NELA), undertaken in the UK since 2013 has shown progressive improvement in clinical outcomes, specifically reduced mortality, and length of stay (LOS) through the implementation of perioperative key performance indicators (KPIs) (*ANZ J Surg*. 2021;**91**:2575, *Br J Surg*. 2015;**102**:57, *Br J Surg*. 2017;**104**:463, *JAMA Surg*. 2019;**154**:e190145). The objective is to generate a rural hospital EL audit (MELA) to evaluate local outcomes and clinical standards of practice with regional, national, and international benchmarks.

Methods: A review of medical records between January 2014 and December 2021 of patients who undergo an EL. Data collected include patient demographics, clinical information, compliance to KPIs and the primary outcomes of 30-day mortality and LOS.

Design: This is a descriptive quantitative study. The inclusion and exclusion criteria were similar to those defined in NELA and ANZELA-QI.

Setting and Participants: The general surgeons at the rural hospital provide emergency surgery services for the North-West Queensland community.

Main Outcome Measures: To review local clinical outcomes of 30-day mortality, LOS, and adherence to perioperative KPIs.

Results: Overall, 84 patients met inclusion criteria. The median age (IQR) was 61 (48.8–70.3) years. The 30-day mortality was 3.6% and mean LOS was 12.8 (±13.4) days which was secondary to the low-risk patients within the data set. Compliance to KPIs (≥80%) was achieved in five of eight standards assessed.

Conclusion: Local outcomes appear to be comparable to national and international benchmarks and a similar rural setting. The audited cohort outperformed the national standard in adherence to perioperative KPIs.

KEYWORDS

emergency surgery, laparotomy, outcomes, quality improvement, rural

1 | INTRODUCTION

Emergency laparotomy (EL) is a major operation in general surgery that is often performed in critically unwell patients.[1–4] In Australia and New Zealand (NZ), it is estimated that approximately 20 000 people undergo EL each year[5,6] and these are associated with a high morbidity and mortality rate.[7,8] The most common indications for EL in Australia and NZ are intestinal obstruction and viscus perforation.[6,9,10] The National Emergency Laparotomy Audit (NELA) undertaken in the UK since 2013 collects prospective data on approximately 25 000 ELs each year.[11] Since its initiation, there has been a progressive improvement in clinical outcomes, specifically reduced mortality, and length of stay (LOS) through the implementation of perioperative key performance indicators (KPIs).[1–4]

The most recent seventh annual NELA audit (2019–2020) reported a reduced 30-day mortality rate of 8.7% (11.8% in Year 1) and average LOS of 15.1 days (19.2 days in Year 1).[11] The success of NELA in identifying areas requiring improvement in both management and clinical outcomes has encouraged similar audits in Australia which subsequently reported a 30-day mortality of 5.2%–8.4%, LOS of 15.5 days, but poor compliance with the recommended KPIs.[1,5,6,12] The Australian and New Zealand Emergency Laparotomy Audit Quality Improvement (ANZELA-QI) pilot study was thus developed to evaluate the perioperative care and outcomes of Australian patients undergoing EL against international benchmark standards.

The North-West Queensland health service district has a core catchment population of over 32 000 across an area of approximately 300 000 square kilometres. It services many of the peripheral hospitals and remote community health centres within North-Western Queensland and the Gulf of Carpentaria including Doomadgee, Normanton, Mornington Island, Cloncurry and Julia Creek. Surgical care is provided in a Clinical Services Capability Framework (CSCF) Level 4 Specialist Service Base hospital with 80 beds. The Emergency Department treats almost 8000 patients quarterly. The general surgical department is serviced by a single resident general surgeon along with a rotating roster of visiting general surgeons. The health service maintains basic intensive care facilities but does not possess tertiary level interventional radiology, sub-specialty surgical or physician support services. Patients requiring these services are transferred by the Royal Flying Doctor Service to the nearest tertiary referral centre in Townsville, approximately 900 km away. There is limited information on clinical outcomes following EL in rural hospitals with only one previous audit, the Rural Emergency Laparotomy Audit (RELA).[13] The objective of this study was to generate a rural EL audit (MELA) to evaluate local outcomes and clinical standards of practice with regional, national and international benchmarks based on those reported in RELA, ANZELA-QI and NELA respectively. Additionally, it will help to identify specific evidence based perioperative KPIs that may be recommended for implementation in the local setting.

What is already known about this subject

- The success of NELA has prompted similar studies in Australia to utilise perioperative KPIs to reduce mortality and average length of stay.
- Australian EL mortality rates compare favourably with similar international studies but clinical outcomes from rural hospitals are poorly represented in large-scale multicentre Australian studies.

What this study adds

- Clinical outcomes in the MELA cohort appear to be comparable to national and international benchmarks and outperforms the national standard in perioperative KPIs.
- Implementing key recommendations utilising existing resources may have significant benefits in perioperative care and aid complex decision making in challenges specific to the rural setting.

2 | METHODS

This clinical audit uses de-identified patient data collected from existing paper and electronic charts over an 8-year period (January 2014 to December 2021) at a single site. Data prior to this date were unavailable for review due to missing operative records. Human Research Ethics Committee (HREC) approval with waiver of patient consent and Site-Specific Application (SSA) was obtained through the local district health service via the Ethical Review Manager platform (HREC/QTHS/89809). The inclusion and exclusion criteria were similar to those defined in NELA and ANZELA-QI (detailed in Appendix S1 for review)[11]: (a) emergency admissions for patients over the age of 18 undergoing an EL during the specified time period for surgery involving the stomach, small or large bowel or rectum and (b) for conditions involving perforation,

ischaemia, abdominal abscess, bleeding or obstruction. The following conditions were also excluded: (c) any EL where the primary pathology involves the appendix, oesophagus, spleen, liver, gallbladder, biliary tree, pancreas, genitourinary or gynaecological organ, (d) any pathology caused by blunt or penetrating trauma and (e) non-elective hernia repair without bowel resection or adhesiolysis.[14]

The data collected include (a) demographics such as age, sex and Indigenous status, (b) clinical information such as the emergency booking category (EBS) as per the Australian Department of Health Emergency Surgery Access Guideline (A, requiring immediate surgery <1 h; B, requiring critical surgery <4 h; and C, requiring priority surgery <24 h), the American Society of Anaesthesiologists (ASA) score, indications for EL and the operative management provided. The primary outcomes assessed were the 30-day post-operative mortality rate and total LOS. In cases where the patient was transferred to a tertiary facility and back transferred to the peripheral hospital, the total LOS was calculated and defined as the total number of days spent as an inpatient until safe discharge to a home destination. Secondary outcomes such as unplanned returns to theatre and post-operative transfer to a tertiary facility were also analysed. These results are tabulated against regional, national and international figures seen in Table 1.

The KPIs analysed were: (a) preoperative reporting of any computed tomography (CT) scan by a consultant radiologist, (b) preoperative mortality risk assessment (PRA), (c) timely access to theatre appropriate for urgency of surgery, (d) consultant surgeon and anaesthetist presence in theatre, (e) critical care admission commensurate with preoperative risk and (f) involvement of a

TABLE 1 Comparison of overall results MELA, ANZELA-QI, NELA 7th Year (2019–2020) and RELA.

	MELA	ANZELA-QI	NELA	RELA
Patient characteristics				
Number of cases (*N*)	84	2886	21 846	51
Median age (years)	61	–	67[b]	62
Median PRA using risk prediction tool[a] (%)	2.3	–	6.3[b]	3.5
Operative indication (*N*, %)				
Obstruction	51 (60.7%)	–	13 357 (61.1%)	–
Sepsis	20 (23.8%)	–	8841 (40.5%)	–
Other	13 (15.5%)	–	174 (0.8%)	–
Operative access (*N*, %)				
Open	75 (89.2%)	–	17 604 (80.6%)	30 (58.8%)
Laparoscopic converted to open	9 (10.7%)	–	1660 (7.6%)	19 (19.6%)
Laparoscopic/laparoscopic assisted	N/A	–	2582 (11.8%)	11 (21.6%)
Procedure performed (*N*, %)				
Adhesiolysis	26 (31.0%)	–	4109 (18.8%)	11 (21.6%)
Small bowel resection	19 (22.6%)	–	3163 (14.5%)	10 (19.6%)
Right colectomy	14 (16.7%)	–	3000 (13.7%)	15 (29.4%)[c]
Exploratory laparotomy	2 (2.4%)	–	398 (1.8%)	–
Complications (*N*, %)				
Unplanned return to theatre	4 (4.8%)	23 (0.9%)	1043 (4.8%)	7 (13.7%)
Post-operative inter-hospital transfers	10 (11.9%)	–	–	8 (15.7%)
Outcomes				
Mean LOS (days)	12.8[d]	15.5	15.1	10.0[d]
30-day post-operative mortality (%)	3.6	7.1	8.7	0
90-day post-operative mortality (%)	2.4	–	12.6	–

[a]MELA risk prediction tool used the NRPC, whereas both NELA and RELA used the Portsmouth-Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (P-POSSUM).

[b]Median age and predicted 30-day post-operative mortality using the risk prediction tool of the NELA cohort is based on 4th Year Patient Report (2016–2017), current 7th Year data were not reported.[13]

[c]RELA patient cohort was inclusive of all colectomies and did not differentiate the type of colectomy performed.

[d]Includes the length of inpatient stay following post-operative transfer to another hospital.

specialist physician for patients ≥65 years old. These standards were chosen on the basis to allow comparison between ANZELA-QI and had also been identified by NELA to be of value.[1] The PRA was calculated retrospectively using the NELA risk prediction calculator (NRPC) to determine the 30-day risk of mortality. Compliance to KPIs is shown using 'traffic' light graphics (green ≥80%, amber ≥50%–80% and red <50%) and are outlined in Table 2 against ANZELA-QI and NELA benchmarks.

All statistical analyses were conducted using Microsoft Excel (Microsoft, Redmond, WA, USA) and Jamovi Statistics (Jamovi, Newcastle, Australia). Data collected were stored within a password-protected Microsoft Excel spreadsheet on an encrypted USB. Each patient entry was deidentified and allocated a unique numerical indicator to be used as a reference aid. All data will be deleted within 7 years of project completion.

3 | RESULTS

During the 8-year period, there was a total of 157 patients who underwent an EL, of which 84 were eligible for inclusion in the audit and 73 patients were excluded based

TABLE 2 Comparison of compliance to recommended care standards.

Number achieved care standards, *n* (%)				
Key standard	**KPI**	***MELA***	***ANZELA-QI***	***NELA***
Hospitals admitting patients as emergencies must have access to CT scanning 24 h per day	KPI 1: Proportion of all EL patients who received a preoperative CT scan which was reported on by a consultant radiologist preoperatively	76 (92.7%) *N* = 82	1747 (68.1%) *N* = 2565	14 394 (65.9%) *N* = 21 846
An assessment of mortality risk should be made explicit to the patient and recorded clearly on the consent form and in the medical records	KPI 2: Proportion of patients with risk assessment documented preoperatively	0 (0%) *N* = 84	1331 (46.1%) *N* = 2887	18 569 (85.0%) *N* = 21 846
Hospitals should ensure theatre access matches need and ensure prioritisation of access is given to emergency surgical patients ahead of elective patients	KPI 3: Proportion of patients arriving in theatre within a time appropriate for the urgency of surgery	7 (26.0%) *N* = 27	1351 (59.7%) *N* = 2263	12 822 (80.9%) *N* = 15 849
Each high-risk case should have the active input of a consultant surgeon or anaesthetist	KPI 4: Proportion of patients with a calculated preoperative risk of death ≥5% for whom both a consultant surgeon and consultant anaesthetist were present in the theatre	22 (88.0%) *N* = 25	445 (75.2%) *N* = 592	9483 (90.1%) *N* = 10 525
	KPI 5: Proportion of patients with a calculated preoperative risk of death ≥5% for whom a consultant surgeon was present in the theatre	25 (100.0%) *N* = 25	498 (84.1%) *N* = 592	10 136 (96.3%) *N* = 10 525
	KPI 6: Proportion of patients with a calculated preoperative risk of death ≥5% for whom a consultant anaesthetist was present in the theatre	25 (88.0%) *N* = 40	535 (90.4%) *N* = 592	9799 (93.1%) *N* = 10 525
Highest risk patients should be admitted to critical care	KPI 7: Proportion of patients with a preoperative risk of death ≥10% who were directly admitted to critical care post-operatively	17 (100.0%) *N* = 17	296 (69.7%) *N* = 425	4906 (87.6%) *N* = 5600
Patients ≥65 years old should have multidisciplinary input including early involvement of geriatrician teams	KPI 8: Proportion of patients aged 65 years or over who were assessed by a specialist in elderly medicine	12 (34.3%) *N* = 35	271 (17.7%) *N* = 1531	1675 (27.1%) *N* = 6175[a]

Abbreviations: CT, computed tomography; *N*, total sample size.

[a]NELA defined patients aged 65 and frail or over 80 years old. Frailty scoring is defined according to the Clinical Frailty Scale (CFS). NELA classified patients with a score between 1 and 4 as not frail and frail where the CFS ≥5.

on the above exclusion criteria outlined in Figure 1. There was no available data for patients transferred for tertiary care pre-operatively or the proportion who declined or were not offered surgery. Within the EL cohort, there were 47 (56.0%) males and 37 (44.0%) females with a median (IQR) age of 61 (48.8–70.3) years. At the time of presentation, 37 patients (44.0%) were ≥65 years of age. PRA for EL was not routine standard practice within the rural hospital, and therefore data related to this was lacking and thus calculated retrospectively. The mean (±SD) and median (IQR) calculated PRA was 5.1 (±7.2) % and 2.3 (0.6–6.4) % respectively. Fifty-nine patients (70.2%) had a low mortality risk of ≤5%, 10 patients (11.9%) had a high risk of 5%–10% and 15 patients (17.9%) with the highest mortality risk category of ≥10%. The median ASA score was 3 (2, 3). The most common indications for EL in descending order were bowel obstruction (60.7%), sepsis (23.8%) and other (15.5%). The surgical approach was open in 75 cases (89.2%) and laparoscopic converted to open in nine cases (10.7%). The three most commonly performed procedures for EL in descending order were adhesiolysis (26; 31.0%), small bowel resection (19; 22.6%) and right colectomy (14; 16.7%). Four patients (4.8%) had an unplanned return to theatre (URTT) and 10 patients (11.9%) required a post-operative inter-hospital transfer (Table 1). The 30-day mortality of the audited ELs was three cases (3.6%), including one patient with an URTT, and was post-operatively transferred for tertiary level care. The mean and median post-operative LOS, excluding patients who died within 30 days, was 12.8 (±13.4) and 10 (6–12) days respectively.

Overall compliance with the KPIs for the 8-year period is shown in Table 2. It can be seen that high compliance with the standard (green) was achieved in five of the eight KPIs assessed. This included preoperative reporting of any CT scan by a consultant radiologist, a consultant surgeon and anaesthetist presence in theatre for patients with a calculated preoperative risk of death ≥5%, and direct critical care admission of patients with a preoperative risk of death ≥10% (KPI 1, 4–7). There was poor compliance (<50%) in three standards including, preoperative documentation of risk assessment (KPI 2), patient arrival in theatre within the appropriate timeframe in accordance with the Emergency Surgery Access Guideline (KPI 3), and post-operative assessment by a specialist physician team when age was greater than 65 years (KPI 8). There was missing data relating to KPI 3 and KPI 8 with 57 (67.9%) and 2 (1.7%) incomplete patient records respectively.

4 | DISCUSSION

The outcomes of ELs performed in the rural setting are poorly reported in existing literature. To date, this is only the third paper focusing on the results of rural

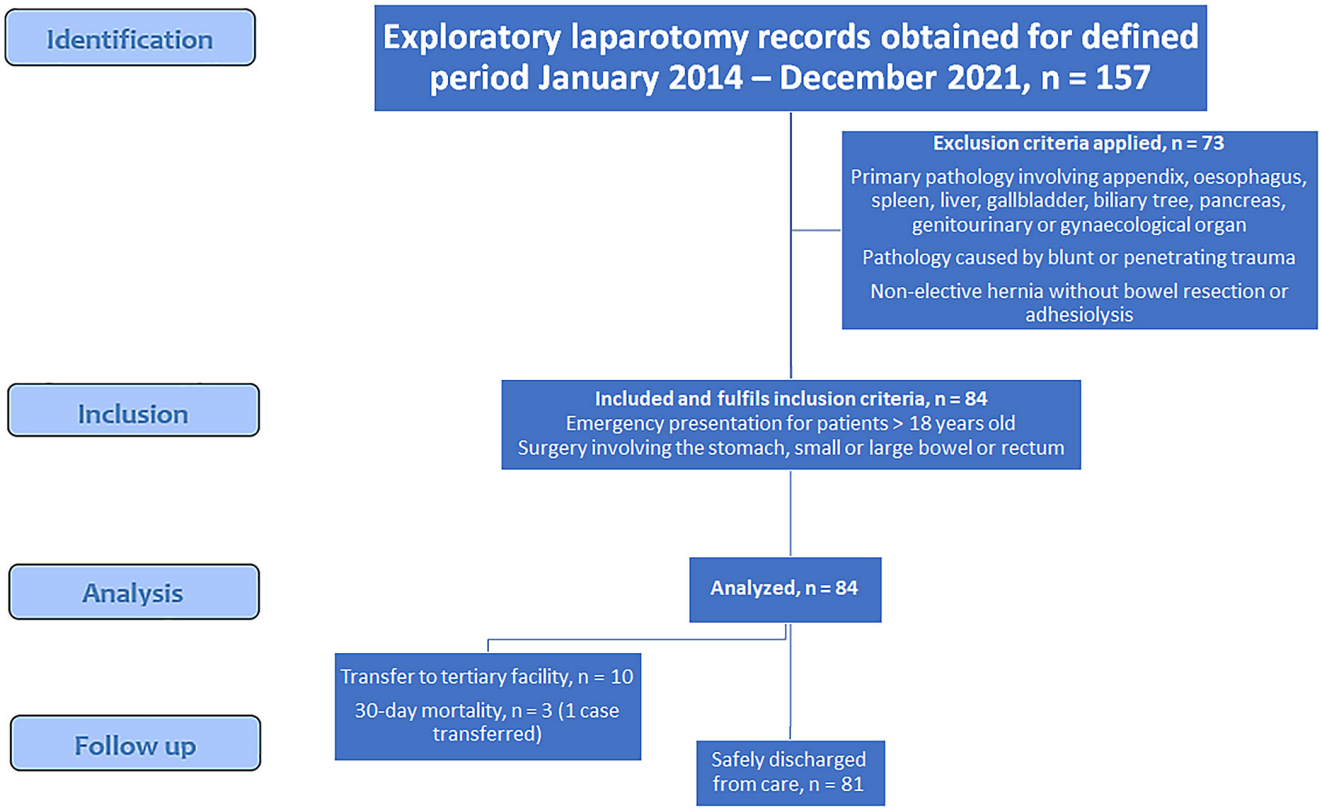

FIGURE 1 STROBE flowchart (STROBE, Strengthening the Reporting of Observational Studies in Epidemiology).

emergency surgery in Australia, with two previous studies both originating from the same regional area in South Australia.[13,15] The most recent large-scale multicentre study (ANZELA-QI) evaluating these outcomes included 24 Australian hospitals contributing a total of 2866 patient cases with less than half of the participating hospitals originating from a regional or rural location.[1] The MELA cohort compares favourably with a reduced mean LOS (12.8 vs. 15.5 vs. 15.1 days), and 30-day post-operative mortality (3.6% vs. 7.1% vs. 8.7%) to both national (ANZELA-QI) and international (NELA) benchmarks respectively. The lower-than-expected mortality may be explained by the lower median age with a retrospectively calculated PRA and the missing data related to patients transferred preoperatively or were not offered surgery.

The MELA cohort has a median age and PRA difference of 6 years and 4% respectively when compared to NELA. This is significant, as a younger age cohort is more likely to be associated with less comorbidities, lower risk and mortality and a reduced LOS. The different PRA calculations used in MELA (NPRC) vs. P-POSSUM (NRPC vs. P-POSSUM) was not a major confounding factor as both are equally sensitive and useful tools for predicting 30-day mortality in high-risk patients.[9] In the rural setting, the MELA cohort was younger in median age (61 vs. 62 years) with a lower PRA (2.3% vs. 3.5%) when compared with RELA. Patient selection is also an important variable. For presentations with severe pathology, some patients are not offered a surgical option leading to palliation or an opinion that surgical care should be definitively provided by a tertiary level centre at the first instance. Overall, this is suggestive that the MELA cohort of patients are undergoing emergency general surgery at a younger age with a lower preoperative risk profile in comparison to a similar rural setting, national and international cohorts.

Five of eight KPIs were met by the majority (≥80%) of patients in MELA as opposed to only two in ANZELA-QI, but similarly, six of eight were met by the majority for NELA. The care standards directly controlled by surgeons and anaesthetists were the KPIs achieved by the majority that was common to all three cohorts.[1] The key care standard to improve upon appears to be PRA documentation. This has downstream implications on the other KPIs as it may help to dictate timely access to theatre, prescribe the on-site presence of a consultant surgeon and anaesthetist for high-risk patients and their post-operative disposition (i.e. need to be transferred and/or monitored in an intensive care unit). This preoperative, quantitative identification of high-risk patients and their predicted mortality is invaluable to the perioperative team during the informed consent process. One possible method to improve compliance with routine PRA documentation may include incorporating the risk assessment score as a mandatory field in the emergency surgery booking form. This would allow high-risk patients to be clearly flagged to the perioperative team to ensure the patient receives the appropriate key standards.[12] The incomplete data set of 57 patient records (67.9%) relating to KPI 3 (timeliness to theatre) was due to a combination of inadequate chart documentation and the recent implementation of an electronic emergency surgery booking software. Consequently, the low percentage (26.0%) of seven patients achieving KPI 3 may not be a true representation given the large proportion of missing data points.

The second recommendation is that patients over the age of 65 should be reviewed by a specialist physician or geriatrician to facilitate patient-centred interventions that have been shown to result in improved patient outcomes.[16,17] NELA defines this criterion additionally, by frailty the Clinical Frailty Score (CFS) ≥5 as it is associated with greater risks of postoperative mortality and morbidity and is independent of age.[18] Similar to the utility of the PRA, frailty scoring should be considered. The MELA cohort performed better than the national and international benchmarks, but it remains a care standard that is poorly lacking worldwide, with compliance <50%, and only one Australian hospital reaching the 80% threshold (ANZELA-QI).[1] For a rural setting such as the MELA cohort, this is equivalent to approximately 4–5 patients over the age of 65 undergoing EL per year requiring additional multidisciplinary and physician team input, which would not pose a significant burden on existing resources.

The relatively under-resourced rural setting proposes a unique challenge during the management of patients who are at higher risk of post-operative morbidity and mortality. In addition, the decision for and timeliness of interhospital transfer is subject to multiple unpredictable factors such as distance, mode and availability of transport, weather conditions and receiving hospital bed availability. Delayed transfer to a tertiary centre when indicated is also an independent predictor of morbidity and mortality, as well as the associated increased LOS in acute surgical patients.[19] The proportion of post-operative inter-hospital transfers in MELA was similar to RELA at approximately 15% which is a measurable variable for the consultant surgeon to consider, as planning these transfers are often time critical and yet unpredictable.

Limitations to this audit include its retrospective nature, the small relatively low-risk sample size from a rural single-centre and the missing data that limit the ability to match our data with those of other studies. This precludes further data assessment and comparisons using more comprehensive statistical analysis to determine statistical

significance of calculated differences. Prospective collection of data would also be beneficial for outcome measurement that can provide supporting evidence to the benefits of adopting perioperative KPIs in similar rural settings. This could encourage an increased representation of rural surgery outcomes and allow further participation in collaborative, larger multicentre prospective studies to yield results similar to the ANZELA-QI and NELA. Anticipated barriers to this include funding sources, gaining appropriate HREC and site-specific approval. The National Clinical Quality Registry (CQR) is responsible for navigating these challenges and a proactive leadership approach is required to transform the success of the ANZELA-QI pilot project into the improved clinical outcomes derived from the yearly NELA report.

5 | CONCLUSION

MELA has helped to identify that local EL outcomes appear to be comparable to national and international benchmarks, as well as another rural setting. Recommended KPIs in the MELA cohort outperformed the national standard and the key recommendation is the documentation of preoperative risk assessment that may have direct consequences on subsequent care standards. This information will provide important information in planning the appropriate use of finite resources and aid complex decision making for interhospital transfers, a unique challenge specific to the rural and regional settings. Rural surgical audits and ongoing acquisition of high-quality data should be encouraged to allow benchmarking for clinical outcomes in the rural population. Our reported outcomes are encouraging, but additional benefits may be derived from prospective evaluation and participation in a national emergency laparotomy project to improve surgical care in the rural setting.

AUTHOR CONTRIBUTIONS

Dong Tony Cheng: Conceptualization; data curation; writing – original draft; writing – review and editing; methodology; formal analysis; supervision; project administration. **Nariyoshi Miyata:** Methodology; data curation. **Francis Asomah:** Conceptualization; writing – review and editing; supervision; project administration.

ACKNOWLEDGEMENTS

The authors sincerely thank the in-kind support provided by the North-West Hospital and Health Service staff members. Open access publishing facilitated by The University of Queensland, as part of the Wiley - The University of Queensland agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

All authors declare there is no financial support or relationships involved and have no conflicts of interest (perceived or actual) to report in the publication of this manuscript.

ETHICS STATEMENT

This project was reviewed by the Townsville Hospital and Health Service Human Research Ethics Committee (HREC) and has granted approval of this low-risk research project, including a waiver of consent. The research proposal meets the requirements of the National Statement on Ethical Conduct in Human Research 2007 (updated 2018) (HREC/QTHS/89809).

ORCID

Dong Tony Cheng https://orcid.org/0000-0003-4884-3157

REFERENCES

1. Party A-QW, James Aitken R, Griffiths B, Van Acker J, O'Loughlin E, Fletcher D, et al. Two-year outcomes from the Australian and New Zealand emergency laparotomy audit-quality improvement pilot study. ANZ J Surg. 2021;91(12):2575–82.
2. Huddart S, Peden CJ, Swart M, McCormick B, Dickinson M, Mohammed MA, et al. Use of a pathway quality improvement care bundle to reduce mortality after emergency laparotomy. Br J Surg. 2015;102(1):57–66.
3. Tengberg LT, Bay-Nielsen M, Bisgaard T, Cihoric M, Lauritsen ML, Foss NB, et al. Multidisciplinary perioperative protocol in patients undergoing acute high-risk abdominal surgery. Br J Surg. 2017;104(4):463–71.
4. Aggarwal G, Peden CJ, Mohammed MA, Pullyblank A, Williams B, Stephens T, et al. Evaluation of the collaborative use of an evidence-based care bundle in emergency laparotomy. JAMA Surg. 2019;154(5):e190145.
5. Burmas M, Aitken RJ, Broughton KJ. Outcomes following emergency laparotomy in Australian public hospitals. ANZ J Surg. 2018;88(10):998–1002.
6. Fagan G, Barazanchi A, Coulter G, Leeman M, Hill AG, Eglinton TW. New Zealand and Australia emergency laparotomy mortality rates compare favourably to international outcomes: a systematic review. ANZ J Surg. 2021;91(12):2583–91.
7. Symons NR, Moorthy K, Almoudaris AM, Bottle A, Aylin P, Vincent CA, et al. Mortality in high-risk emergency general surgical admissions. Br J Surg. 2013;100(10):1318–25.
8. Saunders DI, Murray D, Pichel AC, Varley S, Peden CJ, Network UKEL. Variations in mortality after emergency laparotomy: the first report of the UK Emergency Laparotomy Network. Br J Anaesth. 2012;109(3):368–75.
9. Hunter Emergency Laparotomy Collaborator Group, Hunter Emergency Laparotomy Collaborator Group. High-risk emergency laparotomy in Australia: comparing NELA, P-POSSUM, and ACS-NSQIP calculators. J Surg Res. 2020;246:300–4.
10. Stevens CL, Brown C, Watters DAK. Measuring outcomes of clinical care: Victorian emergency laparotomy audit using quality investigator. World J Surg. 2018;42(7):1981–7.

11. National Emergency Laparotomy Audit. The seventh patient report of the National Emergency Laparotomy Audit (NELA). 2021 [cited 2022 Aug 10]. Available from: https://www.nela.org.uk/reports?newsid=1047
12. Broughton KJ, Aldridge O, Pradhan S, Aitken RJ. The Perth emergency laparotomy audit. ANZ J Surg. 2017;87(11):893–7.
13. Watson MM, Maddern GJ, Mudalige VPK, Pradhan CP, Wichmann MW. Rural emergency laparotomy audit. ANZ J Surg. 2019;89(6):666–71.
14. Team NP. Seventh patient report of the National Emergency Laparotomy Audit. London: Royal College of Anaesthetists; 2021. Available from: https://www.nela.org.uk/reports?newsid=1047
15. Tocaciu S, Thiagarajan J, Maddern GJ, Wichmann MW. Mortality after emergency abdominal surgery in a non-metropolitan Australian Centre. Aust J Rural Health. 2018;26(6):408–15.
16. Eamer G, Taheri A, Chen SS, Daviduck Q, Chambers T, Shi X, et al. Comprehensive geriatric assessment for older people admitted to a surgical service. Cochrane Database Syst Rev. 2018;1:CD012485.
17. Peden CJ, Aggarwal G, Aitken RJ, Anderson ID, Bang Foss N, Cooper Z, et al. Guidelines for perioperative care for emergency laparotomy enhanced recovery after surgery (ERAS) society recommendations: part 1-preoperative: diagnosis, rapid assessment and optimization. World J Surg. 2021;45(5):1272–90.
18. Parmar KL, Law J, Carter B, Hewitt J, Boyle JM, Casey P, et al. Frailty in older patients undergoing emergency laparotomy: results from the UK observational emergency laparotomy and frailty (ELF) study. Ann Surg. 2021;273(4):709–18.
19. Young E, Khoo TW, Trochsler MI, Maddern GJ. Factors influencing interhospital transfer delays in emergency general surgery: a systematic review and narrative synthesis. ANZ J Surg. 2022;92(6):1314–21.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Cheng DT, Miyata N, Asomah F. An 8-year retrospective review of emergency laparotomy outcomes in a Queensland rural hospital. Aust J Rural Health. 2023;31:991–998. https://doi.org/10.1111/ajr.13034