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Trauma quality improvement: The Pietermaritzburg Metropolitan Trauma Service experience with the development of a comprehensive structure to facilitate quality improvement in rural trauma and acute care in KwaZulu-Natal, South Africa

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Before 2006, Damian Clarke was a surgeon at Durban's South Beach, also known as Addington Hospital. Since fleeing the ongoing attempts to gentrify and 'Disneyfy' the beachfront, he has tried to reinvent himself as a faux Midlands farmer and member of the landed gentry in the misty foothills of the Drakensberg.

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Improving the delivery of efficient and effective surgical care in rural South Africa is a mammoth task bedevilled by conflict between the stakeholders, who include rural doctors, surgeons, ancillary staff, researchers, educators and administrators. Management training is not part of most medical school curricula, yet as they progress in their careers, many clinicians are required to manage a healthcare system and find the shift from caring for individual patients to managing a complex system difficult. Conflict arises when management-type interventions are imposed in a top-down manner on surgical staff suspicious of an unfamiliar field of study. Another area of conflict concerns the place of surgical research. Researchers are often accused of not being sufficiently focused on or concerned about the tasks of service delivery. This article provides an overview of management theory and describes a comprehensive management structure that integrates a model for healthcare systems with a strategic planning process, strategic planning tools and appropriate quality metrics, and shows how the Pietermaritzburg Metropolitan Trauma Service in KwaZulu-Natal Province, South Africa, successfully used this structure to facilitate and contextualise a diverse number of quality improvement programmes and research initiatives in the realm of rural acute surgery and trauma. We have found this structure to be useful, and hope that it may be applied to other acute healthcare systems.

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The strategic planning process and healthcare systems

Strategic planning is a systematic process designed to assist organisational decision-making by taking account of the microenvironment(s) within an organisation, as well as the macroenvironment in which the organisation exists.^[1-5] Healthcare systems are complex and tightly coupled. Strategic planning within such a system, without an overarching framework to provide a structure for quality improvement programmes, risks becoming *ad hoc*, haphazard, ineffectual and even counterproductive. The strategic planning process must identify the organisation's vision and mission or the system's aims and objectives. The mission statement explains the reasons for the healthcare system's existence. The vision statement identifies a potential more ideal 'future state' that the system aspires to achieve. Situational analysis follows and analyses the external environment to identify threats and opportunities, then looks inwards to assess the organisation's resources and capabilities.^[1-6]

The stage of synthesis follows, in which the strategic plan is crafted. The plan must then be implemented, and after that outcomes must be audited. There are a number of generic strategic planning tools that are of relevance to developing a structured systemic approach to quality improvement programmes. These

include the SWOT analysis, the balanced scorecard, and strategic drift and gap analysis.

SWOT

This acronym stands for Strengths, Weaknesses, Opportunities and Threats (SWOT) and identifies internal strengths and weaknesses, and threats and opportunities in the external environment, that may affect the organisation.

The balanced scorecard

The balanced scorecard is a forward-looking management system that views the organisation from four perspectives, namely learning and growth, process, the customer point of view, and results.

Strategic drift and gap analysis

The final outcome of a strategic plan is a result of the interaction of the external environment and three internal factors, namely the plan, the leadership and the culture of the organisation. A gap analysis model helps identify reasons for the strategic gap.

A healthcare system model

There is a well-established model for thinking about healthcare systems (Table 1) that breaks a healthcare system down into inputs,

Table 1. The components of a healthcare system (Donabedian^[5])

Inputs	Process	Outcome
Macroeducational programmes	Application process	Newly qualified staff
University funding	Admission process	Doctor/nurse/paramedic to patient ratios
Nursing colleges	Academic support for disadvantaged students	
Ambulance training colleges	Type of education	
Microeducational programmes at hospital level	Staff attending	Improvement in patient care
	Staff completing course	Compliance with guidelines
Hospital morbidity and mortality meetings	Staff attending	Decreased rates of adverse events
	Cases discussed	
CT scanner	Call list	Patients scanned
Radiology staffing	Protocols for use	Treatment influenced
	Waiting time	Accuracy of reporting
ICU beds	Triage policy	Patients treated
ICU staffing	Referral system	Mortality rates
		Length of stay
		Readmission rate

CT = computed tomography; ICU = intensive care unit.

process and outcome.^[4,5] Table 1 attempts to give examples of the various constituents of a healthcare system and to categorise them according to which component they reflect. The system comprises two variables and a product of those two variables. Healthcare outcomes are a direct product of the interaction between inputs and processes. The only components of the healthcare system that planners can directly influence are the inputs and the processes. The relationship between inputs and process is not linear, and increasing inputs without altering process will not necessarily improve outputs. Conversely, improving the process of care without increasing the resources available may result in a dramatic improvement in outcomes.

Metrics to measure outcomes of a healthcare system

A good quality indicator provides a platform to improve processes and outcomes and can be classified according to type or according to which component of a healthcare system it measures. Table 2 attempts to contextualise the type of quality indicators against the component of the healthcare system being analysed.^[5,6]

A comprehensive strategic planning structure for healthcare systems

I have developed an overarching structure or grid (Table 3) that allows planners to contextualise the strategic planning process against the various components of the healthcare system, to plan accordingly, and to evaluate improvements over time. It integrates the planning process, the components of the system, and quality metrics. The structure comprises a composite grid with an *x* axis and a *y* axis. Along the *y* axis are the components of the strategic planning process (analysis, synthesis and implementation), and along the *x* axis are the three components of a healthcare system (inputs, processes, outcomes). Within each cell of the grid there is room for the appropriate strategic planning tool as well as the specific quality improvement intervention, and for the appropriate metric. The model allows a planner to identify each metric according to its role in the strategic planning process and according to the component of the system it is measuring. Above and below the grid are columns for the mission and vision of the organisation. These should inform each grid. Table 3 attempts to

Table 2. Examples of types of indicators available

Generic and disease-specific indicators	Injury per capita
Rate-based indicators	Caseload
Sentinel indicators	Wrong-site surgery
Input/structural indicators	Ambulance-to-patient ratio
Process indicators	Time to theatre
	Time till admission
Outcome indicators	Mortality rates
	Length of stay

show how the grid could be used to situate each tool, intervention or metric according to the stage of the strategic planning process and the component of the healthcare system it is addressing. Planners can situate each planning tool in its appropriate grid. Each proposed intervention can also be placed in a grid according to whichever component of the system it is intended to address. Table 4 illustrates how such a structure may be used in practice to contextualise data from a number of sources in rural trauma and acute care.

Applying the grid to the Pietermaritzburg Metropolitan Trauma Service (PMTS)

Since its inception in 2006, the PMTS in KwaZulu-Natal Province, South Africa (SA), has run a research and a quality improvement programme aimed at uplifting trauma care at Edendale Hospital and in the rural Sisonke health district. This programme is a multifaceted one, as it is obvious that no single intervention will address all the deficits in trauma and acute surgical care in our system. The grid structure has helped to contextualise all programmes within an overarching structure. This is represented in Table 4, which places a number of research projects into context. Commencing by measuring the resources available to deal with trauma and the burden of disease,^[7] I then adopted a number of theoretical constructs, taken from fields outside surgery, and used them to both measure quality of care and to inform potential interventions. These theoretical constructs included error theory and the idea of developing a suitable quality

Table 3. Comprehensive structure for a quality improvement programme looking at improving the quality of care of acute trauma patients in a rural health district in SA

Vision*	Quality metric	Quality metric	Quality metric	
Mission†	Inputs	Processes	Outcomes cannot be directly targeted but must be audited	
Analysis	What is the load of trauma?	What is the delay from injury to arrival at the district hospital?	What is the mortality rate compared with elsewhere?	Metrics
SWOT	What is the capacity of the rural hospitals to deal with this load?	What is the delay from district hospital to regional hospital?	What is the error rate compared with elsewhere?	
Strategic drift	Can we develop new metrics?	Quality of documentation	What is the length of stay?	
Balanced scorecard	Can we use new constructs to help us?	Quality of care	What is the cost?	
Synthesis and implementation	Can we decrease the load? (injury prevention)	Should we change the referral patterns?	Have we improved the mortality rate?	Develop targeted quality improvement programmes
Generic quality improvement strategies	Can we increase the number of staff available?	Should specific trauma patients bypass the small district hospital?	Have we reduced the error rate? Have we reduced the length of stay?	
Increase resources	Can we improve the quality of the staff available with educational programmes?	Can we change the way we deliver care?	Have we improved cost?	
Improve process	Can we improve monitoring systems?	Restructuring morbidity and mortality meetings		
	Will better reporting and feedback to staff improve care?			
Vision	Quality metric	Quality metric	Quality metric	

*Vision: To have a single high standard of care for urban and rural trauma patients.
 †Mission: To identify deficits in care and provide pragmatic and sustainable interventions to address these deficits.
 Note: Planners may need to develop innovative quality metrics. Using the comprehensive structure will help them think about what they wish to measure and how they should measure it.

marker for surgery.^[8,9] These systems were used to assess the quality of care in the area.^[10-15]

Once this situational analysis was done, I moved on to the stage of synthesis of strategies and interventions, introducing educational programmes and refinement of morbidity and mortality meetings with the intention of driving quality improvement.^[16,17] a number of innovative registries, which allowed us to capture data for research and to quantify the burden of disease and the outcome more accurately;^[18,19] use of the data from these registries to further inform morbidity and mortality meetings and educational initiatives; and a surgical outreach programme (that has run for over a decade), designed to uplift surgical care in the rural hospitals of western KwaZulu-Natal.^[20]

The grid structure helped in understanding the role of this latter programme and auditing its efficacy in transferring skills to the district hospitals. There are ongoing efforts to refine the process of care by developing burns teams, trauma teams and acute physiological support teams.^[21,22] The last introduction was an innovative attempt to provide improved care to surgical patients who were deemed to be too sick for the general ward but too well for the intensive care unit.^[22]

Ongoing audit has revealed some successes and some failures.^[23,24] The grid enabled contextualisation of each research project and each intervention within the overarching system, and closure of the loop between research and strategy.

Conclusion

I have developed a grid structure that integrates the strategic planning process, the associated strategic planning tools, a model of the healthcare system, and the many quality metrics available to measure components of the system as they relate to acute care. As shown, each step in the strategic planning process and each individual quality metric can be placed within the grid to provide a system-wide overview. I believe that this grid will facilitate the development and

implementation of successful quality improvement programmes in a variety of settings in the SA healthcare system.

1. Souba WW, Weitekamp MR, Mahon JF. Political strategy, business strategy, and the academic medical center: Linking theory and practice. *J Surg Res* 2001;100(1):1-10. [http://dx.doi.org/10.1006/jsre.2001.6249]
2. Glickman SW, Baggett KA, Krubert CH, et al. Promoting quality: The health-care organization from a management perspective. *Int J Qual Health Care* 2007;19(3):341-348. [http://dx.doi.org/10.1093/intqhc/mzm047]
3. Jacobs T, Shepherd J, Johnson G. Strengths, weaknesses, opportunities and threats (SWOT) analysis. In: Ambrosini V, Johnson G, Scholes K, eds. *Exploring Techniques of Analysis and Evaluation in Strategic Management*. London: Prentice Hall, 1998:122-133.
4. Kaplan RS, Norton DP. The balanced scorecard – measures that drive performance. *Harv Bus Rev* 1992;70(1):71-79.
5. Donabedian A. The quality of care. How can it be assessed? *JAMA* 1988;260(12):1743-1748. [http://dx.doi.org/10.1001/jama.260.12.1743]
6. Mainz J. Defining and classifying clinical indicators for quality improvement. *Int J Qual Health Care* 2003;15(6):523-530. [http://dx.doi.org/10.1093/intqhc/mzg081]
7. Clarke DL, Aldous C, Thomson SR. Assessing the gap between the burden of trauma in Sisonke District and the surgical capacity of the district hospitals: What are the implications for planning? *Eur J Trauma Emerg Surg* 2014;40(3):303-308. [http://dx.doi.org/10.1007/s00068-013-0369-0]
8. Clarke DL, Gouveia J, Thomson SR, Muckart DJ. Applying modern error theory to the problem of missed injuries in trauma. *World J Surg* 2008;32(6):1176-1182.
9. Clarke DL, Kong VY, Handley J, Aldous C. A concept paper: Using the outcomes of common surgical conditions as quality metrics to benchmark district surgical services in South Africa as part of a systemic quality improvement programme. *S Afr J Surg* 2013;51(3):84-86. [http://dx.doi.org/10.7196/SAJS.1476]
10. Alexander T, Fuller G, Hargovan P, Clarke DL, Muckart DJ, Thomson SR. An audit of the quality of care of traumatic brain injury at a busy regional hospital in South Africa. *S Afr J Surg* 2009;47(4):120-122, 124-126.
11. Stewart WW, Farina Z, Clarke DL, Thomson SR. Variations in levels of care within a hospital provided to acute trauma patients. *S Afr J Surg* 2011;49(4):194-198.
12. Clarke DL, Allorto NL, Thomson SR. An audit of failed non-operative management of abdominal stab wounds. *Injury* 2010;41(5):488-491. [http://dx.doi.org/10.1016/j.injury.2009.10.022]
13. Clarke DL, Aldous C, Thomson SR. The implications of the patterns of error associated with acute trauma care in rural hospitals in South Africa for quality improvement programs and trauma education. *Injury* 2013;45(1):285-288. [http://dx.doi.org/10.1016/j.injury.2013.04.011]
14. Allorto NL, Oosthuizen GV, Clarke DL, Muckart DJ. The spectrum and outcome of burns in a regional hospital in South Africa. *Burns* 2009;35(7):1004-1008. [http://dx.doi.org/10.1016/j.burns.2009.01.004]
15. Kong VY, van der Linde S, Handley J, Aldous C, Clarke DL. Quantifying the disparity in outcome between urban and rural patients with acute appendicitis in South Africa. *S Afr Med J* 2013;103(10):742-745. [http://dx.doi.org/10.7196/SAMJ.7109]
16. Aldous C, Searle R, Clarke DL. An error awareness program for junior doctors. *African Journal of Health Professions Education* 2014;6(2):161. [http://dx.doi.org/10.7196/AJHPE.350]
17. Clarke DL, Furlong H, Laing GL, Aldous C, Thomson SR. Using a structured morbidity and mortality meeting to understand the contribution of human error to adverse surgical events in a South African regional hospital. *S Afr J Surg* 2013;51(4):122-126. [http://dx.doi.org/10.7196/SAJS.1537]
18. Clarke DL, Aldous C. Surgical outreach in rural South Africa: Are we managing to impart surgical skills? *S Afr Med J* 2013;104(1):57-60. [http://dx.doi.org/10.7196/SAMJ.7252]
19. Laing GL, Bruce JL, Aldous C, Clarke DL. The design, construction and implementation of a computerized trauma registry in a developing South African metropolitan trauma service. *Injury* 2014;45(1):3-8. [http://dx.doi.org/10.1016/j.injury.2013.05.013]

Table 4. Using the comprehensive structure for quality improvement programmes to contextualise a number of diverse research projects

Vision	Quality metric	Quality metric	Quality metric	
Mission	Inputs	Processes	Outcomes	
Analysis	Grid 1	Grid 2	Grid 3	Metrics
SWOT Strategic drift Balanced scorecard	Assessing the gap between the acute trauma workload and the capacity of a single rural health district in SA. What are the implications for systems planning? ^[7] A concept paper: using the outcomes of common surgical conditions as quality metrics to benchmark district surgical services in SA as part of a systemic quality improvement programme ^[8] Applying modern error theory to the problem of missed injuries in trauma ^[9]	An audit of the quality of care of traumatic brain injury at a busy regional hospital in SA ^[10] Variations in levels of care within a hospital provided to acute trauma patients ^[11]	An audit of failed non-operative management of abdominal stab wounds ^[12] The implications of the patterns of error associated with acute trauma care in rural hospitals in SA for quality improvement programmes and trauma education ^[13] The spectrum and outcome of burns in a regional hospital in SA ^[14] Quantifying the disparity in outcome between urban and rural patients with acute appendicitis in SA ^[15]	
Synthesis and implementation Generic quality improvement strategies Increase resources Improve process	Grid 4 An educational programme for error awareness in acute trauma for junior doctors ^[16] Using a structured morbidity and mortality meeting to understand the contribution of human error to adverse surgical events in an SA regional hospital ^[17] Surgical outreach in rural SA: are we managing to impart surgical skills? ^[18] The design, construction and implementation of a computerised trauma registry in a developing SA metropolitan trauma service ^[19] Development, implementation and evaluation of a hybrid electronic medical record system specifically designed for a developing-world surgical service ^[20]	Grid 5 Tick-box admission forms improve the quality of documentation of surgical emergencies, but have limited impact on clinical behaviour ^[21] The introduction of an acute physiological support service for surgical patients is an effective error reduction strategy ^[22]	Grid 6 A multifaceted quality improvement programme results in improved outcomes for the selective non-operative management of penetrating abdominal trauma in a developing world trauma centre ^[23] Challenges and merits of improving burn care in SA ^[24]	Develop targeted quality improvement programmes
Vision	Quality metric	Quality metric	Quality metric	

Grid 1 represents projects analysing the inputs of care; Grid 2 represents projects analysing the process of care; Grid 3 represents projects analysing the outcomes of the process of care and the inputs of care; Grid 4 represents projects designed to improve the inputs of care; Grid 5 represents projects designed to improve the process of care; Grid 6 represents projects designed to measure the outcomes after inputs and processes have been improved.

20. Laing GL, Bruce JL, Skinner DL, Allorto NL, Clarke DL, Aldous C. Development, implementation and evaluation of a hybrid electronic medical record system specifically designed for a developing world surgical service. *World J Surg* 2014;38(6):1388-1397. [http://dx.doi.org/10.1007/s00268-013-2438-2]

21. Laing GL, Bruce JL, Clarke DL. Tick-box admission forms improve the quality of documentation of surgical emergencies, but have limited impact on clinical behavior. *S Afr Med J* 2014;104(6):435-438. [http://dx.doi.org/10.7196/SAMJ.7673]

22. Clarke DL, Kong VY, Naidoo LC, Furlong H, Aldous C. The introduction of an acute physiological support service for surgical patients is an effective error reduction strategy. *Int J Surg* 2013;11(9):989-992. [http://dx.doi.org/10.1016/j.ijsu.2013.06.003]

23. Laing GL, Skinner DL, Bruce JL, Bekker W, Oosthuizen GV, Clarke DL. A multi faceted quality improvement programme results in improved outcomes for the selective non-operative management of penetrating abdominal trauma in a developing world trauma centre. *Injury* 2014;45(1):327-332. [http://dx.doi.org/10.1016/j.injury.2013.08.021]

24. Allorto N, Clarke DL. Merits and challenges in the development of a dedicated burn service at a regional hospital in South Africa. Published online 20 August 2014. [http://dx.doi.org/10.1016/j.burns.2014.07.021]

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