Development and Use of Clinical Performance Indicators for Ambulance Services and Prehospital Care: A Discussion Paper for a Clinical Quality Improvement Framework for Ambulance Services

Professor A Niroshan Siriwardena
Associate Clinical Director, East Midlands Ambulance Service NHS Trust
Professor of Primary Care, University of Lincoln

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Summary

- Clinical Performance Indicators for ambulance services should be developed in line with best evidence, in partnership with clinicians and service users, and linked to national structures for knowledge and evidence, clinical expertise and research and development. Their development should be guided by a performance monitoring protocol.

- Clinical Performance Indicators for ambulance services should be meaningful, measurable and realistic, aiming to address issues that matter to patients and clinicians, to benchmark performance, to reduce variations within and between health services and to bring about improvements in care for patients and users. Indicators should function as part of a planned clinical quality improvement framework that draws on modern improvement principles, methods, tools and techniques.

- Clinical Performance Indicators for ambulance services should be designed to provide safe, effective, patient centred, timely, efficient and equitable healthcare. Importantly, they should support clinicians and services in providing better care to their patients.

- Resources should be made available to trusts to undertake such measurements, to contribute to the national data set, to participate in future development and to deliver the aims of quality improvement.

Introduction

A performance indicator is an assessment tool used to monitor and evaluate important governance, management, clinical, and support functions that affect patient outcomes (Joint Commission on Accreditation of Healthcare Organizations 1992). A performance indicator can be used to signal successes and deficiencies in quality of care, to monitor continuing performance of organisations and to measure the result of process improvement. High quality care is safe (no needless harm), effective (evidence-based), patient centred (no feelings of helplessness and in accordance with patients reasonable expressed wishes), timely (no needless delay), efficient (no waste and with realistic outcomes) and equitable (fair to all patients).

Performance indicators are usually based on either rates measured in defined populations or on significant (critical) incidents. Indicators can measure structures, processes or outcomes of health care (Donabedian 1966). Although process measures are often more sensitive to changes in the quality of care (Rubin *et al.* 2001b; Rubin *et al.* 2001a; Mant 2001), intermediate outcomes (i.e. process measures which are known to have an effect on the true outcome, for example aspirin or thrombolysis in acute myocardial infarction) are appropriate and often superior to simple process measures, e.g. ECG capture in acute myocardial infarction (AMI).

This paper seeks to describe the principles, rationale and process for developing Clinical Performance Indicators (CPIs) for quality improvement in ambulance and unscheduled (prehospital) care suitable for one or more services. Indicators will depend to some extent on geographical and resource considerations as well as outcomes (MacFarlane and Benn 2003).

A number of widely accepted terms are used in the paper. Criteria are “the elements of care that can be counted or measured in order to assess quality” (Donabedian 1982). Standards are “the precise count or quantity (of criteria) that specify an acceptable level of care” (Donabedian 1980). Guidelines or clinical practice guidelines are “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances” (Effective Health Care 1994). Quality improvement is arguably a better term than clinical audit because it describes what is intended as an outcome of the process of development of Clinical Performance Indicators and is less liable to be confused with simply counting events which can be frustratingly ineffective at bringing about change (Thomson O'Brien *et al.* 2000a). There are few validated clinical measures of effectiveness and quality in prehospital care that have been used nationally (Moore 1999) and this is partly due to the absence of a clear and agreed process for their development.

This discussion paper provides the basis for a detailed protocol for future development of ambulance service Clinical Performance Indicators. (Working Party on Performance Monitoring in the Public Services 2005)

Principles underlying Clinical Performance Indicator development

In developing a set of indicators a number of principles need to be considered (MacKinnon and McCaffrey 2004). The basis for this should be the recognition that ‘every system is perfectly designed to get the results it achieves’ (Nolan 1998); put another way ‘if you do what you did you’ll get what you got’.

- The performance measurement system must be linked to health strategies and take a systems approach
- Broad stakeholder consultation is required in developing indicators (Tregunno *et al.* 2004)
- Indicators should demonstrate how decisions are made and priorities are determined
- Indicators should take into account the impact of their adoption on health
- Incentives (not necessarily financial) are needed for ongoing innovation
- Resources are required to create the infrastructure for improvement
- There is a role for better practices and benchmarking measurement even when comprehensive information is not available.

Such principles have formed the basis for development of indicators in North America (Sobo *et al.* 2001) and some elements have been included in early developments in this area in the United Kingdom (The Joint ASA JRCALC Clinical Effectiveness Programme 2005).

Development of Clinical Performance Indicators

Clinical Performance Indicators (CPIs) should be based on ‘review criteria’ which are rate based quality improvement measures defined as ‘systematically developed statements that can be used to assess the appropriateness of specific healthcare decisions, services and outcomes’ (Hearnshaw *et al.* 2001).

CPIs need to be:

- Relevant, meaningful and practicable.
- Precisely defined, clear and unambiguous preventing rather than encouraging perverse behaviours.
- Consistent over time ideally but if a change is needed this should be clearly documented.
- Limited in number particularly when comparing teams and services, these will be critical clinical performance indicators (CCPIs).
- Based on evidence or evidence informed clinical experience that their use will lead to patient benefit – the level of evidence needs to be clearly stated.
- Goal-orientated for health gain in terms of clinical process and outcomes (both positive and negative), patient outcomes (such as patient satisfaction) and economic outcomes
- Assessed against their usefulness in comparing performance, reducing variation and improving care
- Excluded from measurement when they are no longer seen to be useful.
- Cognisant of geographical (time to nearest hospital) and resource (clinical attending) factors as well as outcomes such as hospital admission, morbidity and survival including post-discharge and longer term outcomes.
- Acceptable and understandable for clinicians.
- Cost-effective in terms of value for money in collecting and analysing data in relation to potential benefits.

Criteria can be derived from:

- Current national guidelines, e.g. JRCALC (Joint Royal Colleges Ambulance Liaison Committee and Ambulance Service Association 2006), NICE (National Institute for Health and Clinical Excellence), NSFs (National Service Frameworks) etc.
- Robust research evidence including systematic reviews, e.g. Cochrane reviews

There are a number of other factors that are likely to ensure that the criteria or indicators chosen will lead to benefit. These are summarised by the following questions (Hearnshaw *et al.* 2002):

1.1 Were the quality improvement criteria based on the following?
(a) Searching the research literature?
(b) Consultation with experts?
(c) Consultation with patients or carers?
(d) Criteria used in previous quality improvements?
1.2
(a) How up to date was the literature review?
Was the following information recorded (by you or the authors of the review):
(b) The sources/databases used to identify the literature?
(c) Whether the validity of the research was appraised?
(d) The methods used to assess validity?
1.3 Is the method of combining evidence from the literature and expert opinion made explicit?
1.4 Is the method used to select the quality improvement criteria described in enough detail to be repeated?
1.5 Were the quality improvement criteria pilot tested for practical feasibility?
1.6 Were the quality improvement criteria prioritised on:
(a) Impact on health outcome?
(b) Quality of supporting evidence?
1.7 Were the relative values of harms and benefits associated with treatment options considered in selecting criteria?
2.1 Do the criteria:

(a) State the patient populations to which they apply?
(b) State the clinical settings to which they apply?
(c) Give clear definitions of the variables to be measured?
(d) Use unambiguous terms?
2.2 Are the criteria linked to improving health outcomes (rather than, say, to reducing costs or increasing throughput)?
2.3 Do the criteria enable you to differentiate between appropriate and inappropriate care?
3.1 Did the criteria have information on:
(a) How the demands of the quality improvement on patients might be minimised?
(b) How the demands of the quality improvement on staff might be minimised?
3.2 Did the criteria have clear instructions for using them?
3.3 Were patients consulted about the acceptability of these criteria for them?
3.4 Were staff consulted about the acceptability of these criteria for them?

By scoring criteria on the questions above giving 1 to each 'Yes' response, 0.5 for 'Partly' and 0 for 'No' and 'Don't know' we can get a measure of the usefulness of the criterion as part of a Clinical Performance Indicator.

Implementing and Measuring Change

For change to occur it is not enough to provide written guidance alone (Freemantle *et al.* 2000) or passive methods to individuals or teams (Grimshaw *et al.* 2001). It is the front line clinicians that have the clinical knowledge, ability and power to improve the care for patients (the 'inverted pyramid') and there is ample evidence that this is the key priority for clinical staff (Ham 2003). We therefore need to systematically ensure the following:

- We need to begin with existing well tried-and-tested criteria to ensure that the process is understood and owned by clinicians and clinical leaders.
- Indicators should be assessed initially and regularly thereafter for appropriateness with patients and staff. This will enable staff and patients to have ownership of this information and the processes that are likely to lead to improvement
- Indicators should have the potential to exhibit, or identify, change within a planned timescale which requires prior assessment of how much improvement it is plausible to achieve within the timescale, taking account of research evidence, local initiatives, organizational culture, resources and ceiling effects.
- Target or standard setting should take account prior (or emerging) knowledge about essential variation.
- A simple risk assessment should undertaken at the outset to predict possible adverse or perverse outcomes relating to specific criteria.
- Resources for quality improvement should be identified – a key resource is the clinical time required to feed into the process and to bring about change. Resources should be made available to trusts to undertake such measurements, to contribute to the national data set, to participate in future development and to deliver the aims of quality improvement. Previous failures have been a consequence of underinvestment in this area.
- New indicators should be piloted before full release and adoption.
- Information should ideally be fed (as close to real time as possible) to the quality improvement team by or on behalf of small organisational units or teams and the performance of such teams against agreed standards made immediately available to teams and team leaders so that they can identify how their team is performing, how individual members of the team are contributing to this performance, whether there is any shortfall in performance compared to the standards set and whether any support needs to be provided to an individual to the team as a whole.

- Comparative feedback needs to be provided in a timely way to support improvement measures.
- In order to show real differences between units, robust techniques, for example confidence charts (funnel plots or trombonograms), should be utilised which show real differences between teams or geographical areas (Simpson *et al.* 2005) and enable excellent practice to be shared between high performing and underperforming units, whether formally or informally.
- Educational support should be engaged to link in with teams who are performing very well and those who are performing less well in order to undertake diagnostic assessment and share good practice to support teams.
- Educational interventions (this refers to education in its broadest sense) should be designed to be provide active (rather than passive) education which should be tailored to overcome barriers to change (Baker *et al.* 1999) and delivered locally or service wide depending on the nature of the issue using local opinion leaders and clinical leaders to encourage and effect change (Thomson O'Brien *et al.* 2000b).
- Comparative feedback should be made openly available and shared with Clinical Teams, Education Specialists and the Trust Board and Executive in a supportive way.
- In order to accurately demonstrate change, careful analysis (Working Party on Performance Monitoring in the Public Services 2005) robust techniques, such as statistical process control or interrupted time series methods, for demonstrating real improvement over time should be used (Balestracci 2006; Benneyan *et al.* 2003).
- High performing teams and those showing real improvement should be recognised and rewarded.

These techniques have already been used to bring about and measure real improvements in prehospital care (Siriwardena 2006).

Features required of Clinical Performance Indicators (CPIs)

The following questions should therefore be asked about CPIs (MacKinnon 1998):

1. Are the performance measures reliable, valid, and feasible to use? If previously validated measures are chosen, were they designed to be used on individual patients or at a population-based level of analysis?
2. Can the data needed for the performance measures be easily obtained from existing sources of information or will it require additional resources and pose an additional burden on patient care? If ideal data is too hard to collect, is there similar data existing already somewhere in the flow of care?
3. Are there performance measures for all the key structures, processes, and outcomes?
4. Can the performance measures chosen be used for other purposes within the organization?
5. Have performance measures been developed for each step of the management of disease?
6. Do the performance measures need to be severity-adjusted?
7. What is the target for each performance measure? Is there a benchmark available? How will statistical significance versus clinical significance be determined when the performance measure data is analysed?
8. Would sentinel or rate-based performance measures be more appropriate?

Clinical domains should relate to:

- Impact (incidence/hospitalisation/cost)

- Potential for improved outcomes (prevention of intermediate or true outcome/ reduction in morbidity or improvement of true outcome/improved user/patient or carer experience)
- Comparative performance within service (comparing clinical teams or geographical areas) or between services

In order to derive appropriate indicators the following reviews of primary and secondary evidence would provide a good starting point:
- JRCALC guidelines
- NICE and SIGN guidance and National Service Framework recommendations related to prehospital care
- Prehospital and emergency care literature for primary evidence

Clinical Performance Indicator categories

Indicators could be categorised in various ways to form a coherent set that measures quality across a range of clinical issues. The following three categories could be employed and examples (not comprehensive) of specific areas are shown:

Clinical Syndrome/Presentation Indicators (CSPIs), e.g.

- Trauma including head injury
- Pain
- Cardiac arrest
- Hypoglycaemia
- Major incidents
- Falls
- ECP

Clinical Disease Indicators (CDIs), e.g.

Coronary Heart Disease
Stroke
Diabetes Mellitus/Hypoglycaemia
Asthma
Chronic Obstructive Pulmonary Disease
Overdose

Clinical Related Indicators (CRIs), e.g.

Record keeping
Clinical communication
Patient communication and consent
Education & training
Medicines management
Infection control
Patient experience

Clinical Performance Indicator format

The format for CPIs should be defined to promote ease and consistency of use within and across services. Although many ambulance services use similar CPIs the detailed definition, sampling strategy, exceptions and targets vary.

The most commonly used format in the United Kingdom is as follows:
An indicator is made up of 4 components:

- Aspect of care. The area of documentation that is being examined which may be basic (date) or more specific (administration of a drug)

- The standard. This is often set at 100% but the appropriateness of this needs to be examined in light of common cause or natural variation.
- Exceptions. This could be a contraindication or the state of the patient (unable to administer a drug as the patient was unconscious)
- Definitions and Instructions – This is the source or basis for the aspect of care such as a protocol, guideline, or evidence based practice..

Using aspirin administration as an example, an aspect of care is either compliant (Y) which means there is documentation, of aspirin administration. Not compliant (N) which means there is no record of aspirin administration, or that there is no documentation of an exception. Or lastly, there was an exception (E) in this case that there was documentation that there was a contraindication, the patient was unconscious, the patient refused, or the patient had already taken their own aspirin before the crew arrived.

Another more detailed format for emergency performance indicators has been developed and approved by the Open Source Emergency Service (EMS) initiative in the United States.

The format is as follows [Performance Indicator Format (version 060103)]:

- Indicator Name – Name or title of the performance indicator
- Key Process Path – Starting with one of the predefined key process names, this item shows which key process and sub-process that the indicator reflects on
- Patient or Customer / Need – Indicators are designed to reflect on how well and/or how efficiently a given patient or customer need is being met. This item shows what patient or customer / need that the indicator reflects on
- Type of Measure – Structure, process or outcome
- Objective – Describes why an indicator is useful in specifying and assessing the process or outcome of care measured by the indicator
- Indicator Formula – The equation for calculation of the indicator. If applicable, separate sections will separately address the numerator and denominator of the indicator equation.
- Indicator Formula Description – Explanation of the formula used for the indicator. Where applicable, separate descriptions detailing the numerator and denominator will be provided.

    - **Denominator Description** – Description of the population being studied or other denominator characteristics, including any equation or other key aspects that characterize the denominator
    - **Denominator Inclusion Criteria** – Additional information not included in the denominator statement that details the parameters of the denominator population
    - **Denominator Exclusion Criteria** – Information describing criteria for removing cases from the denominator
    - **Denominator Data Sources** – Sources for data used in generating the denominator
    - **Numerator Description**– Description of the subset of the population being studied or other numerator characteristics, including any equation or other key aspects that characterize the numerator
    - **Numerator Inclusion Criteria** – Additional information not included in the numerator statement that details the parameters of the numerator population
    - **Numerator Exclusion Criteria** – Information describing criteria for removing cases from the numerator
    - **Numerator Data Sources** – Sources for data used in generating the numerator

- Sampling Allowed – Indicates if sampling the study population is or is not allowed in calculation of this indicator.
- Sampling Description – If sampling is allowed, this will describe the sampling process to be used for this indicator.
- Minimum Number of Data Points – Tells how many data points are needed, at a minimum, for calculation of this indicator.
- Suggest Reporting Format: Numerical – The suggested way in which the numerical results should be expressed (i.e. decimal minutes, percentages, ratios)
- Suggest Reporting Format: Graphical – The suggested way in which reports should be presented in graphical format (i.e. pie charts, statistical process control charts, etc.)
- Suggest Reporting Frequency – Time frame, number of successive cases or other grouping strategies by which cases should be aggregated for calculating and reporting results
- Testing – Indicates if a formal structured evaluation has been performed on the various scientific properties of the indicator such as its reliability, validity, and degree of difficulty of data collection
- Stratification – Indicates if stratification has been applied to the indicator
- Stratification Options – Suggested stratification criteria for use with this indicator
- Current Development Status – Describes the amount of work completed to date relative to the final implementation of the indicator
- Additional Information – Further information regarding an indicator not addressed in other sections
- References – Citations of works used for development of the indicator
- Contributors – Listing of persons or organizations used in development and refinements to this indicator

Although there are advantages to using a familiar and simple system there are aspects of this system that may enhance current methods of defining indicators.

Examples of Ambulance Clinical Performance Indicators in current use

Indicator Category	Denominator	Type of measure			Exceptions	References
and Indicator Name	**Inclusion group (whole population if not stated)**	**Structure**	**Process**	**Intermediate (proxy) outcome**	**Numerator exclusion criteria**	**Evidence for criteria or standards**
Clinical Syndrome/Presentation Indicators						
Trauma including head injury				Written head injury instructions given		(JRCALC 2006)
Pain		Verbal or visual pain score (PRF)	Initial pain score Post-treatment pain score Analgesia given	Appropriate analgesia (opiate for fracture, AMI) Extent of reduction in pain score	Unconscious	(JRCALC 2006)
Cardiac arrest	Adult	European Resuscitation Guidelines training Automated external defibrillator (AED)	GCS/AVPU ECG monitored/rhythm Cannulation Oxygen Intubation	Recovery of sinus rhythm Level of conscious (Glasgow coma scale) on admission	Recognition of Life Extinct	(JRCALC 2006) (Hassan *et al.* 1996)
Falls			Falls assessment Referral to falls pathway	Home management		(JRCALC 2006)
Major incidents			Response within agreed timeframe			
Convulsions			GCS/AVPU Blood glucose SpO2 Oxygen Rectal diazepam (single appropriate dose only)	Glucose 10% IM if hypoglycaemic		(Chin *et al.* 2004) (JRCALC 2006)
Safeguarding children	Children			Referral to social services when suspected abuse		(JRCALC 2006)
Emergency Care Practitioner (ECP)	ECP attendances			Transported A&E attendance		

Indicator Category and Indicator Name	Denominator Inclusion group (whole population if not stated)	Type of measure			Exclusions Numerator exclusion criteria	References Evidence for criteria or standards
		Structure	Process	Intermediate (proxy) outcome		
Clinical Disease Indicators						
Suspected AMI			Oxygen Cannulation Initial pain score Nitrate Post-treatment pain score Thrombolysis protocol adhered to Call to admission time	Opiate Aspirin Thrombolysis (Chase *et al.* 2006) Reduction in pain score Lives saved per 1000 patients (Norris 2001)		(JRCALC 2006)
Stroke		FAST test (PRF)	Conscious level (GCS/AVPU) BP FAST Glucose Oxygen	Admission for assessment		(JRCALC 2006)
Asthma			Conscious level Pulse Initial respiratory rate (RR) Post-treatment RR Initial PEFR Initial pulse oximetry (SpO2) Post-treatment PEFR Post-treatment SpO2	Oxygen 35% Salbutamol Post-treatment PEFR improvement Post-treatment pulse oximetry (SpO2) improvement Prednisolone given (ECP)		(JRCALC 2006) (Snooks *et al.* 2005)
Chronic Obstructive Pulmonary Disease			Pulse Respiratory rate SpO2 Initial PEFR Post-treatment PEFR	Oxygen 28% Salbutamol Post-treatment pulse oximetry (SpO2) improvement		(JRCALC 2006) (Durrington *et al.* 2005)
Overdose			GCS/AVPU Mental state/suicide risk Blood glucose			
Anaphylaxis			GCS/AVPU BP	Oxygen 35% Adrenaline IM Chlorphenamine IV		(JRCALC 2006)
Diabetes Mellitus/Hypoglycaemia			GCS/AVPU Initial blood glucose Glucagon or glucose Post-treatment blood glucose Urine ketones if glucose elevated	Glucose 10% IV		(JRCALC 2006)

Indicator Category and Indicator Name	Denominator: Inclusion group (whole population if not stated)	Type of measure			Exclusions: Numerator exclusion criteria	References: Evidence for criteria or standards
		Structure	Process	Intermediate (proxy) outcome		
Clinical Related Indicators						
Record keeping			PRF completion			
Clinical communication			Handover			(Thakore and Morrison 2001)
Patient communication and consent			Patient satisfaction			
Education & training			Appraisal Personal development plan			
Medicines management		Policy Adverse event monitoring Prescribing monitoring				
Infection control		Training				
Patient experience				Satisfaction survey		

Conclusion

Evidence is sparse for many CPIs in the prehospital setting. Previous attempts at developing national ambulance CPIs have failed through lack of resources. In order to improve stakeholder (public, practitioner and organisational) confidence in prehospital care, urgent work to develop CPIs further needs to be done. A pragmatic approach would be to select indicators on the basis of current evidence and good practice according to a clear and agreed performance monitoring protocol. Indicators selected and based on National Service Frameworks or other nationally accepted guidance should be investigated in terms of data collection, analysis, resources required and potential for quality improvement under the guidance of the national structures being set up for clinical knowledge, research and development and clinical quality improvement in ambulance services. The principles outlined in this paper should inform development of such as protocol.

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