Root Cause Analysis Improves Patient Safety: A descriptive study of Root Cause Analysis Framework applied to clinical incident investigation in a University Affiliated Hospital

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Abstract

**Objective**: To evaluate the effectiveness of Root Cause Analysis (RCA) as a peer review error analysis method and as a tool to improve patient safety.

**Design**: A retrospective study to analyse all RCA conducted in Queen Mary Hospital (QMH) since the inception of the Hospital Authority Sentinel Event Policy in 2007. Using a Donabedian model, the structure, process and outcome were reviewed to identify the benefits, lessons learnt, and room for improvement.

**Results**: A total of 42 RCA conducted in QMH during this 5 year period were reviewed. In terms of outcome, the analysis showed that RCA does improve patient safety and bring about significant benefits to the hospital which include heightened staff awareness in reporting clinical incidents and adverse events for risk control and mitigation; identification of latent causes within system that have led to apparent rather than actual human errors; and implementation of a series of measures to prevent recurrence of similar incidents. In terms of structure and processes, the study shows there is still plenty of room for improvement. To sustain the quality improvement initiative in QMH through RCA investigation, there is need to dispel staff misconceptions and shortcomings perceived by some staff; recalibrate and reconfigure the strategy of staff engagement; expand and consolidate the expertise of RCA panel members; enhance governance to ensure appropriate and full implementation of RCA recommendations; provide adequate support to assist staff in execution of RCA recommendations; enhance
transparency in order to achieve better learning and sharing of RCA results; and ensure dissemination of RCA information to targeted stakeholders to achieve the greatest impact. In the longer term, the healthcare community would need to consider recommending to the authorities for legislative amendment to protect privileged information in RCA reports from discovery.

**Conclusion:** Our experiences and evidence in this study have led us to believe that RCA is an invaluable tool in clinical incident investigation and risk management. It is worth pursuing in our quest for sustainable improvement in service quality and patient safety.
Introduction

In response to a spate of highly publicized medical blunders which raised significant concerns on quality and safety in public hospitals, the Hong Kong Hospital Authority (HA) has launched the Sentinel Event policy in 2007, followed by the revised Sentinel Event (SE) and Serious Untoward Event (SUE) policy in 2010[1]. This policy mandates all public hospitals to report, investigate and respond to all SE and SUE promptly, and make necessary efforts to prevent similar events from recurring.

Queen Mary Hospital (QMH) is a public teaching hospital affiliated with the University of Hong Kong. It has more than 4800 staff, 19 clinical specialties, 1500 beds and an annual budget of over HK$3.0 billion. It is also a tertiary referral centre for liver, kidney, heart, lung and bone marrow transplantation, paediatric and cardiothoracic surgery, and oncology in Hong Kong.

RCA is a peer review error analysis method originally developed in aviation industry. It was first adopted in 1998 by the Veteran Affairs Patient Safety Program in the United States of America for investigating clinical incidents[2]. The Quality and Safety Department of QMH had implemented and conducted RCA for investigation of all major incidents / events for the past five years.

According to literature search, published authoritative reports have promulgated
the use of RCA [3] [4] [5] for its effectiveness in reducing clinical incidents. Somewhat disappointing is the fact that literature to date has yet to sustain such a claim as there was only anecdotal evidence to correlate RCA with reduction of clinical incidents [6]. Skeptics might say that RCA is of no benefit in enhancing patient safety because of the current dearth of *prima facie* evidence to substantiate the effectiveness of RCA. Since each RCA requires significant investment of time and resources, it is imperative for QMH to revisit and review its prevailing practice, and determine whether the use of RCA has achieved its intended purpose as a robust peer review analysis method and tool to improving patient safety.

The objective of this retrospective analysis is to scrutinize the current RCA framework using a Donabedian paradigm[7] by evaluating its achievements in terms of outcome, and identifying the lessons learnt and opportunities for improvement in terms of structure and process.
Materials and Methods

This retrospective analysis study (the study) was approved by the Hong Kong West Cluster’s Institutional Review Board (UW-11-280). All SE and SUE in QMH are identified through the Advanced Incident Reporting System (AIRS), which is the HA corporate electronic incident reporting system. According to HA policy, the nature of SE and SUE requiring RCA is listed in table 1. RCA in the form of case review are also conducted for some non SE/SUE events, such as incidents that have aroused major public or media concerns, if deemed necessary by the Hospital Chief Executive (HCE). All RCA reports in the study period were analyzed and reviewed by two researchers (AC and SK).

QMH has adopted a RCA protocol which is modeled after the Joint Commission on Accreditation of Healthcare Organizations[8]. In accordance with HA corporate policy, QMH would have to assemble a RCA panel within 48 hours of a reported SE. The number and composition of members in each RCA panel would depend on the nature of the SE, but would usually consist of a RCA manager, external clinicians, a HA Head Office representative, and / or lay person(s) from the Hospital Governing Committee. To ensure transparency and fairness, the RCA panel would also include a member from the department under investigation who is not directly involved in the incident. For SUE, the RCA panel would consist only of members from the Hospital. The RCA manager act as the facilitator and perform all preparatory work for the panel. With members properly constituted,
the RCA panel would then conduct meetings to analyze the reported incident, identify root cause(s), tease out contributory factors, and suggest recommendations for improvement. The Quality and Safety Department (Q&SD) of the hospital is responsible to follow up and act on the recommendations formulated by the RCA panel (figure 1). The final RCA report would have to be approved by the Hospital Chief Executive and be submitted to HA Head Office in an anonymized format. To ensure proper follow up action, all recommendations contained in RCA reports would be reviewed six months after submission. Moreover, each RCA panel would have to review whether there was full disclosure of information to patients or their next of kin; and whether the staff involved in the incidents was given appropriate counseling and support.
Results

The reports of all 42 RCA conducted for reported incidents in QMH from the inception of the HA Sentinel Event policy in 2007 to the first quarter of 2011 (comprising 12 SE, 17 SUE and 13 case reviews) (figure 2) were analysed.

The nature of events, root causes, contributory factors and recommendations are summarized in table 2. Out of the 42 RCA conducted in QMH, 18 (42.9%) were related to medication incidents, 6 (14.3%) patient misidentification; 6 (14.3%) retained objects; 5 (11.9%) patient suicide; 3 (7.1%) loss of specimen or equipments; 2 (4.8%) wrong site surgery; and 2 (4.8%) unexpected complications.

The most common root causes as depicted by the RCA reports are communicative errors, cognitive errors, violation of existing protocols, system deficit or insufficiency, and equipment defect or failure. Most incidents usually do not occur because of a single root cause, and a multitude of contributory factors including staffing, team dynamics, process design were implicated.

The experience of RCA panel members was also evaluated. It was found that with the exclusion of some external members and the RCA manager who had formal training, only 9 out of 80 (11.3%) QMH staff who had participated as RCA panel members had received education and training before they took part in RCA investigation (table 3).

In reviewing the manpower and time consumption of each RCA panel, the study
found that each RCA comprised of 4.4 persons and its report required an average of 17.0 hours for formulation and compilation. Members of all RCA panels were healthcare workers with the exception of one who was a lay member invited to participate.
Discussion

Medical incidents, particularly SU and SUE, can be very costly and embarrassing to a healthcare organization. A silver lining exists however, if healthcare organizations can capitalize on lessons learnt to enhance and safeguard patient safety. Almost half a century ago, Donabedian described the conceptual framework of using structure, process and outcome as the dimensions for assessing health care quality[7]. His work has far-reaching impact and consequences on health administrators even up to the present day. In this study, the Donabedian framework was used to evaluate the effectiveness of RCA in improving patient safety.

Viewed in the context of the three domains in the Donabedian framework, structure is conceived as the prerequisites of which RCA is conducted, including composition of panels, qualification of panelists, classification of reportable events, and external and internal regulatory policies. Process describes how the structure is put into practice and is defined as operational activities involved in RCA implementation that would lead to a desired outcome of improved patient safety, such as recommendation enforcement, results communication and staff engagement. Outcome refers to demonstratable differences in patient safety that occurred as a result of implementing RCA. Outcome also refers to the culture transformation that was brought along by the error investigation system. These three domains are not independent but are interrelated, and should be considered
collectively rather than separately (figure 3). In this article, the outcome of RCA are first presented followed by a discussion of room for improvement identified in the structure and process constructs.

**Outcome**

In this study, we have adopted a qualitative approach and decided on a few empirical criteria which we believed a good RCA outcome should possess:

1. The outcome has identified potential patient safety hazard
2. The outcome has addressed system vulnerabilities rather than individual performance
3. The outcome strengthens the due diligence of staff and enhances culture transformation
4. The outcome measures are capable of minimizing incident recurrence
5. The outcome can be leveraged to produce organization wide changes.

Based on the above criteria, we have identified the following beneficial outcomes derived from RCA:

(I) Improving Medication Safety

In this study, it has shown that staff bypassing pharmacy verification processes/procedures is one of the commonest causes for serious medication errors. The mistake committed would often appear to be an active error on the part of the frontline healthcare workers. However, on critical review by RCA, there is often evidence to indicate that latent error or underlying constraints, such
as the long waiting time for medication to be delivered from pharmacy to wards, could explain why staff would choose to circumvent normal proper dispensing procedures. As a result, many staff would prefer to stock drugs in their own wards in an effort to expediting treatment for their patients. With the identification of such problems through RCA, QMH was able to take follow up remedial actions to mitigate the medication risks by revising the workflow and increasing the number of portering and dispensing staff to help accelerate the medication delivery process. To solve the problem in the longer term, QMH is considering more improvement measures to enhance medication safety by modernizing its medication delivery system using advanced information technology.

(II) Preventing Wrong Site Surgery

Wrong site surgery is a universal problem championed by the World Health Organization (WHO) as a global safety challenge [9]. In this study, two cases of wrong site surgery were identified. Although these were apparently caused by protocol violation, subsequent RCA revealed that QMH did not have a robust protocol or adequate monitoring to prevent wrong site surgery. Responding to these two incidents, QMH has established a working group led by a consultant anesthetist to promote the use of WHO Surgical Safety Checklist [10] in its operation theatres since 2008. To date, the checklist has been expanded to cover all radiological interventions, cardiac catheterization, radiotherapy treatment, endoscopic procedures and electroconvulsive therapy. The checklist has also been introduced into general wards for procedures like chest drain and central line
insertion. Subsequent audit findings revealed that the initial results were promising and comparable with international findings[11];

(III) Preventing Patient Suicides
In this study, there were five patient suicide incidents. Though the rate is not high, its impact is catastrophic. Patient suicide poses not only a tragedy to the deceased's family but also creates a detrimental effect on morale of the staff involved as it is not uncommon for staff to seek post-incident psychological help. Following in-depth RCA into these 5 cases, QMH has implemented various suicide preventive measures, including but not limited to reviewing and adding safety in the design of ward facilities (such as safety features for windows and railings to reduce the risk of patient from jumping and hanging); reviewing and revising the trial discharge policy for mental patients by the department of psychiatry (to reduce patient suicides during home leave); and introducing a screening tool in the nursing assessment form in all clinical departments to identify potential high risk patients by evaluating their suicidal risks.

(IV) Identifying Equipment Failure
Equipment failure leading to incidents is not uncommon in our series. Causes of equipment failure in this study included malfunction of infusion pump leading to drug administration greater than the prescribed dosage; poorly designed identification bracelet that can come off easily from a newborn child leading to patient misidentification; and fragility of surgical instruments and consumables
leading to dislodgement of equipment / device fragments retained inside patient body after operation. Since the impact of equipment failure could potentially be far reaching, the RCA panel would promptly notify and alert the Hospital and HA corporate procurement office to see if the same malfunctioning equipments or consumables are being used by other departments or HA hospitals. Appropriate follow up mitigation action would be taken if similar risks exist outside QMH.

(V) Reducing Communicative Errors

Misunderstanding, misinterpretation and failure to communicate are common communicative errors [12]. In this study, another form of communicative errors that is found to be of particular significance is hesitance to speak up because of authority gradient[13]. This occurs commonly between doctors and nurses or between senior and junior staff. The authors suspected that this may be of particular significance because of our Confucian culture where hierarchy is highly respected. To counter this authority gradient, “Crew Resource Management” [14] training programme aimed at changing staff attitude and improving team mechanics is now being contemplated at the HA corporate level. The objective is to prevent communicative errors by optimizing communication and reducing misunderstanding among staff.

(VI) Promoting open disclosure

One important aspect of our RCA is to assure prompt and open disclosure of incidents to patients and their families. Although studies elsewhere have already
demonstrated that open disclosure does not increase medical litigation[15], some QMH colleagues resisted practicing open disclosure in the beginning because of the innate fear to admit mistakes or face litigation. Following the adoption of open disclosure policy by QMH in 2009 and the training of a senior clinician in the techniques to deliver bad news, open disclosure is now commonly practiced in the Hospital.

(VII) Heightening staff awareness

When evaluating the outcome of the current study, we have not been able to quantify reduction in reportable clinical incidents or SE/SUE with the use of RCA. However, we believed that the other side of the coin is that implementation of the SU/SUE policy and use of RCA has inculcated a heightened awareness of frontline staff in a way which encourages them to be more willing and forthcoming in reporting adverse events. This heightened staff awareness, coupled with the change in the HA corporate incident reporting policy to include SUE in 2010, can explain why the number of reportable incidents / events in QMH has not decreased in recent years.

Structure and Process

To ensure reasonable and robust outcome, this study has identified legitimate opportunities for improvement within the present structure. Through enhancing these structure and process constructs, the effectiveness and credibility of the RCA system can be further improved:
(I) Enhancing panel expertise

RCA is time consuming. The average man-hours spent to prepare one RCA report is 17.0 hours and on average 4.4 health care workers are involved in each RCA panel. It would therefore be a substantial waste of resources if the desired outcome of RCA is not achieved. In QMH, only 11.3% of the participants in RCA panels from the hospital have received training in RCA methodology. Since a knowledgeable RCA team is integral to effective performance [16] [17], there existed a need to train up more staff on the understanding, philosophy and methodology of RCA in order to improve the quality of the system.

(II) Expanding panel membership

At present, it is uncommon for RCA panels to include lay members, as consumer participation is often regarded by many as tantamount to surrendering clinical autonomy, or exposing the hospital to media challenges and political fallout. In the QMH experience, a patient group representative had been invited to serve as a member of one RCA panel. This had initially aroused skepticism, with worries that dialogues in the panel might be restricted and its effectiveness compromised. The arrangement had eventually proven to be very successful as the lay member had given many useful comments from a patient perspective which added credibility to the findings and outcome of the report of the RCA panel. Based on this experience, QMH is considering expansion of membership to enhance the effectiveness of RCA panel.
(III) Promoting reporting of near misses

A near miss is an event that did not cause harm, but had the potential to. Near misses are warning signs which, if not detected and addressed properly, may cause tragic consequences in the future. The current HA corporate incident reporting policy or system does not mandate the reporting of or conducting RCA for near misses. Since reported incidents typically represent only the tip of the iceberg, near misses constitute the vast majority of events that have gone unnoticed. The authors believed that expanding the SU/SUE reporting structure to include near misses would help identifying vulnerability in an institution and accepting fallibility of the system[18]. This can be achieved through intensified education to change the perception of staff and remove the disincentives of reporting near misses[19]

(IV) Protecting RCA from legal discovery

RCA is meant for quality improvement and not fault finding. In an increasingly litigious society such as Hong Kong, protecting confidential and privileged information in RCA report from legal discovery is of paramount importance. It is worthwhile to note that in the Institute of Medicine’s landmark report “To Err is Human”, one chapter is dedicated to discussing the importance of protecting voluntary incident reporting system from legal discovery[3]. The lack of statutory immunity in the Hong Kong legislation is currently the “Achilles heel” of our SE/SUE policy and RCA system. Although efforts are taken to de-identify
relevant information in all RCA reports, there is still the concern and risk that information contained in such reports, which are not meant to be discoverable, may eventually come under media spotlight or subject to disclosure in the court of law [20]. Unlike the situation in some countries such as Australia and United States, there are no ordinance to protect health care workers from legal discovery by limiting the use of RCA reports [21] [22]. To address this problem, it is imperative for health policy makers in Hong Kong to seriously consider recommending amendment of the present legislation to the government.

(V) Communicating results
Learning and sharing is undoubtedly a main theme of RCA because mishaps tend to fall into a recurrent rather than random pattern. On a corporate scale, HA Head Office has been issuing regular risk alerts to all staff and public on lessons learnt from clinical incidents[23]. Over the hospital level, the importance to promote and direct learning and sharing towards relevant audience cannot be overemphasized. In an era of information explosion however, even the most pertinent messages could be ignored should recipients fail to realize their importance. Accordingly, the Q&SD of QMH has taken up the responsibility to filter, cascade and highlight relevant information in the RCA report for communication with targeted stakeholders. New communication strategies are also being considered by QMH, including face to face feedbacks with department heads and interactive RCA sharing forum with staff.
In the process of learning and sharing, some will raise the concern that it may renew anguish of those involved, though the authors believed, through interactions with staff, that such concerns are usually unfounded. Nevertheless, transparency in the RCA process should be balanced against the need of protecting privacy of staff and patients as well as addressing untoward sentiments of individuals.

(VI) Enforcing recommendations

The quintessence of RCA lies in its recommendations. The whole RCA system could be rendered futile if we fail to translate RCA recommendations into practice. In one study, it was reported that only 18.6% of recommendations were implemented[24]. The Q&SD in QMH made an effort to revisit recommendations six months after they were made. In one follow up review, it was found that one measure to prevent patient suicide through assessing all new admissions for suicidal intent with three screening questions was not followed. Some nurses refused to comply with this measure because they felt asking such screening questions awkward and uncomfortable, particularly when facing clients like post delivery mothers or celebrity patients. Acknowledging such difficulties, the QMH Patient Safety Committee had invited a specialist nurse from Department of Psychiatry to help equip staff with necessary skills in approaching such questions.

To ensure successful implementation of RCA recommendations for the purpose of continuous quality improvement, reasonability is the most important consideration.
Recommendations should be pragmatic and achievable, as extreme measures that could not be complied with would be worthless. On the other hand however, RCA panels should not refrain from making recommendations that are considered too expensive or sensitive to the extent that they might embarrass the institution [25]. To attain such fine balance, perhaps the only infallible yardstick RCA panels can rely on is to recommend measures in moderation.

(VII) Engaging Staff

No RCA program will be successful without staff support. If staff do not believe in what they are doing, RCA would only regarded as an administrative evil. No local surveys have ever been conducted to see how frontline staff perceived RCA. At inception, many feared RCA because of the misconception that it would be used as a blaming exercise. Over the years, QMH has observed health care workers are in general more open to RCA process. The paradigm shift from a “punitive” organization culture to that of a “just” culture may also have been affected by introduction of hospital accreditation which altered the orthodoxy to some degree[26]. However, it is envisaged that more work will still be needed to take the fear out of RCA[27]. One way of doing so is to consider introducing the concept to our next generation of clinicians and nurses early in their career development[28] [29].

Limitations of the study

There are a number of limitations in this study. The major limitation is the
outcomes described are based on empirical standards only, and there is a lack of critical quantitative measurements employed to appraise the RCA framework. Formal system level cost-benefit analysis should be considered in the future. Furthermore, two of the researchers (AC and SK) were involved in the quality improvement programme of the hospital and their observations may therefore be biased. To balance their views, the authors have invited two senior clinicians to take part in the research. Finally, because of its retrospective nature, limitation existed in the depth and breadth of the scope, of which a prospectively designed study may be of more benefit.
Conclusion

To achieve safer healthcare, RCA is a proven tool and powerful lever. In the investigation of significant incidents, we found that the use of RCA had unfolded various latent errors confined within our intricate healthcare processes that were previously overlooked. The practice has also brought along heightened awareness of QMH staff in reporting adverse events and public disclosure. The outcome of RCA is incumbent upon the participant’s allegiance and commitment, and support from clinical leaders and senior administration of the hospital. The programme has been an invaluable learning process for the staff, the institute and the HA corporate. With the continued use of the RCA programme, we are confident that QMH is embarking on the right trajectory in its continuing journey to provide safer care for its patients, staff and community.

Acknowledgement

The authors would like to thank all QMH colleagues who have participated in the RCA programme. Without their sterling support and contribution, the programme would not have been successful nor sustainable.
References:

Figure 1: Process of RCA

By RCA Manager

Study incident

Chart Review
Staff Interview
Site Visit
Literature review

By RCA Panel

Identify contributing factors

Identify system weakness

Confirm root cause

Explore improvement strategies

Formulate recommendations

By Quality and Safety Department

Monitor & evaluate outcome
Figure 2: Number of Case Review (CR), Serious Untoward events (SUE) and Sentinel Events (SE) conducted in Queen Mary Hospital from 2007 to 2011 first Quarter
Figure 3: Outcome of RCA, with Structure and Process factors affecting it.

OUTCOME
1. Heightened awareness of staff
2. Promotion of open disclosure
3. Identification of root causes and contributory factors leading to incidents
4. Enhancement of Patient Safety

STRUCTURE
1. Enhancement of panel expertise
2. Expansion of panel membership
3. Inclusion of reporting of near misses
4. Protection from legal discovery

PROCESS
1. Communication of results
2. Enforcement of recommendations
3. Staff engagement
Table 1: Sentinel events and Serious Untoward events stipulated for RCA [1]

<table>
<thead>
<tr>
<th>Sentinel Events</th>
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<tbody>
<tr>
<td>1. Surgery / interventional procedure involving the wrong patient or body part</td>
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<tr>
<td>2. Retained instruments or other material after surgery / interventional procedure</td>
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<tr>
<td>3. ABO incompatibility blood transfusion</td>
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<tr>
<td>4. Medication error resulting in major permanent loss of function or death</td>
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<tr>
<td>5. Intravascular gas embolism resulting in death or neurological damage</td>
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<tr>
<td>6. Death of an in-patient from suicide (including home leave)</td>
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<tr>
<td>7. Maternal death or serious morbidity associated with labour or delivery</td>
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<tr>
<td>8. Infant discharged to wrong family or infant abduction</td>
<td></td>
</tr>
<tr>
<td>9. Other adverse events resulting in permanent loss of function or death</td>
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<tr>
<td>(excluding complications)</td>
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<table>
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<tr>
<th>Serious Untoward Events</th>
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<tbody>
<tr>
<td>1. Medication error which could have led to death or permanent harm</td>
<td></td>
</tr>
<tr>
<td>2. Patient misidentification which could have led to death or permanent harm</td>
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</table>
Table 2: Root causes, Contributory Factors and Recommendations of RCA conducted in QMH 2007 to 2011 first quarter

<table>
<thead>
<tr>
<th>Nature</th>
<th>No of cases</th>
<th>Root causes</th>
<th>Contributory Factors</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| **Medication error**    | 18          | Communicative error:  
Error in checking allergy status, drug label, administration route or time  
Illegibility of writing  
Cognitive Error:  
Knowledge deficit in cross sensitivity of drugs  
Equipment failure:  
Mechanical failure of medication administration device (infusion pump) | System factor:  
Allowing process of pharmacy confirmation to be bypassed  
Allowing medication prescribed for one patient to be used by another  
Long turn around time required for medication delivery predisposing staff to circumvent normal dispensing procedures  
Process design factor:  
No standardized labeling  
Look Alike Sound Alike medication stored within same site | Reinforce staff compliance in sending prescription to pharmacy for dispensing instead of using ward stock  
Reinforce the importance of checking drug allergy status of patient during prescription and administration  
Reinforce verification of drug name, dose and route before administration  
Posting information of common known drug cross sensitivity in ward area  
Increase number of portering staff to deliver medication from pharmacy to ward |
| **Retained instrument/** | 6           | Violation of protocol:  
Inadequate checking and | Equipment factor:  
Fragility of delicate instruments | Enforce checking to be performed by 2 qualified staff |


<table>
<thead>
<tr>
<th>Event</th>
<th>Root Cause</th>
<th>Corrective Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Object</strong></td>
<td>verification of integrity of delicate instrument and consumables after use</td>
<td>Training to educate staff on risk associated with delicate instruments and consumables</td>
</tr>
<tr>
<td></td>
<td><strong>Cognitive error:</strong> Inadequate knowledge of risk associated with medical consumables</td>
<td>Implement compulsory training for all new doctors at orientation</td>
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<tr>
<td></td>
<td><strong>Operator inexperience in the procedure involved</strong></td>
<td>Sharing of incident among staff</td>
</tr>
<tr>
<td><strong>Patient misidentification</strong></td>
<td>Violation of protocol: Not checking patient’s identification according to protocol Not following protocol when wearing identity bracelet on patients</td>
<td>Reintroduce verification of identifiers before latch on, intervention and transfer by qualified staff</td>
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<tr>
<td></td>
<td><strong>System deficit</strong> Lack of framework to check and verify minor patient’s identity</td>
<td>Enforce the use of checklist for identification of babies and infants</td>
</tr>
<tr>
<td><strong>Patient suicide</strong></td>
<td>No root cause identified</td>
<td>Enforce wearing of identity bracelets for infants over both ankles</td>
</tr>
<tr>
<td></td>
<td><strong>Resource factor:</strong> Inadequate support during home leave</td>
<td>Establish Recovery Express Team for home leave psychiatric patients</td>
</tr>
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**Fragility of medical consumables**

**Team Factor:**
Failure to supervise adequately a junior member of staff

**Training to educate staff on risk associated with delicate instruments and consumables**

**Implement compulsory training for all new doctors at orientation**

**Sharing of incident among staff**

**Equipment factor:**
Design of identity bracelet that is prone to detachment from wearer

**Enforce wearing of identity bracelets for infants over both ankles**

**System factor:**
Workload and staffing level mismatch predispose to pressure and error of commission

**Enforce the use of checklist for identification of babies and infants**
<table>
<thead>
<tr>
<th>Event</th>
<th>Reason</th>
<th>Countermeasure</th>
</tr>
</thead>
</table>
| Loss of specimen or equipment | System factor: no compulsory screening tool  
Knowledge factor: insufficient knowledge on suicidal risk assessment  
Environment factor: access to open window by patients | Enforce new suicidal risk assessment in hospital  
Organization wide training and education on suicidal precaution  
Limit access to openable window |
| Wrong surgery | System insufficiency: Lack of formal policy to conduct verification of site and side of surgery  
Violation: Noncompliance to the formal system that verify site and side of surgery | Patient factor: Abnormal anatomy leading to incorrect surgical site marking  
Human factor: Familiarity with process predispose staff to bypass normal checking procedures to commit error of commission | Formation of workgroup to implement WHO surgical safety checklist in hospital  
Enforce new practice of site confirmation by radiological imaging before reversal of anaesthesia  
Apply anatomical marker(s) for surgical site identification |
<table>
<thead>
<tr>
<th><strong>Unexpected Complications</strong></th>
<th><strong>Process design factor:</strong> Indistinct role assignment</th>
<th><strong>Establish learning and sharing of incidents with staff</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Idiosyncratic patient reaction to medication</td>
<td>Installation of panic buttons in all Operation theatres</td>
</tr>
<tr>
<td></td>
<td>Insufficiency in the alerting and consultation system for deteriorating patients</td>
<td>Procurement and ensure availability of emergency airway equipments</td>
</tr>
<tr>
<td></td>
<td>Not familiar with system in alerting others of deteriorating patients</td>
<td>Training for staff to use equipments for providing emergency airway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reinforce system for consultation and reporting of deteriorating patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Install monitoring system in single room</td>
</tr>
</tbody>
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Table 3: Training of QMH staff attending RCA

<table>
<thead>
<tr>
<th></th>
<th>Received Training</th>
<th>Not Received Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality and Safety</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Medical</td>
<td>1</td>
<td>33</td>
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