Evaluation of an Intensive Care Outreach Nurse Program in 4 UAE Hospitals

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ABSTRACT

Background: Intensive care outreach nurses (ICONs) can reduce deterioration and death of patients in hospitals.

Purpose: Evaluate outcomes associated with implementation of the ICON role across 4 UAE hospitals.

Methods: Trend analyses and χ^2 tests were used to measure changes before ICON program, during ICON year 1, ICON year 2, when the service coverage extended 24/7, and until the end of 2019.

Results: From year 1 to year 2, failures to escalate decreased from a rate of 14.8 to 5.6 episodes per 1000 admissions for all sites combined ($P < .001$). The cardiac arrest rate went from 4.04 to 1.42 per 1000 admissions in year 2 and continued downward to 0.72 per 1000 ($P < .001$). Transfer from ward or readmission to intensive care unit/high dependency unit varied by site, although there was a statistically significant trend for all hospitals combined.

Conclusion: The ICON role contributed to fewer failure to escalate incidents and lower cardiac arrest rates.

Keywords: critical care outreach, intensive care, rapid response system, resuscitation, unplanned readmission

Rapid response systems (RRS) and the role of the intensive care outreach nurse (ICON) have evolved in many western hospitals and are being adapted globally as an integral factor in the fight against unnecessary deterioration and death of patients in general ward settings. Importantly, the RRS has both an afferent and an efferent arm.[1,2] The afferent arm of the RRS requires the bedside clinician to recognize and respond to the signs and symptoms of patient deterioration and to raise an alarm for help. The efferent arm is the response that comes from either an individual or a team, depending on the model adopted by the hospital.

In a meta-synthesis of 20 studies into the scope and impact of intensive care liaison and outreach services, it was found that they had an impact on intensive care unit (ICU) and hospital mortality, unplanned ICU admissions/readmissions, discharge delay, and rates of adverse events.[3] In addition, the major unmeasured benefit across all studies was improved communication pathways between critical care and ward staff. Similarly, a systematic review and meta-analysis of 29 studies showed that the RRS was associated with a reduction in hospital mortality and cardiopulmonary arrest, and a meta-regression did not identify the presence of a physician in the RRS to be significantly associated with a mortality reduction.[4]

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However, implementation of a pilot ICON model in a new setting has inherent difficulties. Jeddian et al[5] found that nursing staff shortages, the instability of physician positions, the lack of specialized essential services, the absence of a system to establish do-not-resuscitate orders, and staff resistance to different nursing priorities, routines, and extra work were all challenges identified by stakeholders that made implementation difficult.

Despite the many studies and models used to implement ICON-type roles, there is no consensus on the precise structure and format that can be applied to all settings. Hence, many terms, titles, and translations are found to describe the RRS and ICON equivalents in the literature.[6] Furthermore, most of the published models emanate from Western health systems; very few are from non-Western and developing health systems.[5,7]

For the purposes of this article, the term ICON refers to the overall roles, responsibilities, and interventions performed by the ICU outreach nurse. The term ICON Response (ICONR) refers to the ICON nurse responding to a deteriorating patient call requiring a rapid response that has been triggered by Modified Early Warning Scoring (MEWS) and/or a concerned bedside nurse.

ICON ROLE IN UAE CONTEXT

The 4 hospitals participating in this study belong to a network of public hospitals in the United Arab Emirates. In 2015, the ICU Nursing Advisory Group (NAG) was a network of nursing leaders linked to the 4 hospital ICUs in this study and was established to improve and standardize consistent practices where needed. This group immediately identified failure to recognize and respond to deteriorating patients on the general wards of the hospitals as a major priority. The MEWS system had been implemented via the electronic medical record (EMR) 2 years earlier based similarly on the UK early warning systems,[8,9] and there was a system-wide policy requiring all participating hospitals to establish RRS using MEWS as the primary (afferent arm) trigger.

The ICU NAG identified that the RRS was not meeting expectations in all hospitals, as indicated by high cardiac arrest rates, and many nurses on the wards were not confident to identify and escalate deteriorating patients in a timely manner. The nursing model in most hospitals was primarily patient allocation with a charge nurse identified for each shift in each ward and mostly expatriate workforce from India, Philippines, and other Arab states. Earlier attempts at each of the hospitals to implement an ICON-type response had failed and the default rapid response was the medical officer on call for the ward/specialty, which was considered inadequate, or a code blue that was often considered too late.

After a period of considerable consultation with the members of the multidisciplinary teams and ICU teams of all 4 hospitals over a 6-month period, the ICU NAG recommended the pilot implementation of the ICON role during the vulnerable hours (on night shifts only, 7 p.m. to 7 a.m.) and if successful to expand the role to 24/7. The ICONs are experienced ICU nurses specifically selected for their clinical assessment and intervention, supportive and assertive communication, and bedside teaching skills; together these skills enable the ICON to fulfill the expectations of the role. The roles and responsibilities of ICONs have been described elsewhere.[10] When in the ICON role, they do not have any ICU responsibilities and are available to actively seek out and respond to nurses (and physicians) who have a potentially deteriorating patient. In addition to providing ward staff with support and guidance, the ICONs respond to any other clinical emergency throughout the hospital, such as code blue, fire, and evacuation.

The ICON role was implemented as a pilot program in spring 2016 across the 4 large public teaching hospitals and as a 24/7 service in spring 2017. The primary focus of the ICONs was on adult patients in general wards; however, if required, they were called to specialty units such as maternity or pediatrics.

OBJECTIVE

The objectives of this article are to (1) describe the implementation of the ICON role across 4 teaching hospitals in Abu Dhabi, United Arab Emirates, simultaneously; (2) measure the activity of the ICONs, including changes in program delivery between year 1 and year 2; and (3) analyze outcome measure including failure to escalate, hospital cardiac arrest, readmission to ICU, and unplanned admission to ICU.

METHODS

Study design setting

This was a retrospective study conducted with data collected prospectively by the ICONs from May 2016 to April 2018, and quality department data available from October 2014 through to December 2019. All 4 hospitals have general adult/pediatric populations and all except hospital A have obstetric/maternity and neonatology services. Hospitals A, B, and D provide tertiary/quaternary services in pediatrics, trauma/burns, and oncology/hematology, respectively. Two of the hospitals (A, D) had a high dependency unit (HDU) in addition to the ICU.

Implementation

All 4 hospitals commenced the ICON program during the night shift in May 2016. Advertising and awareness campaigns were implemented 4 months prior to commencement, and critical relations with key personnel were established to help source "customers." The notification source for the ICON services was extensive, including but not limited to ward nurses and junior physicians, nursing supervisors, ICU with patient posttransfer follow-up for the first 24 hours or longer as needed, opportunistic rounding while on the wards seeing other patients, and reviewing the report from the patients' EMR (patients exceeding the MEWS score threshold = single score of 3 or combined score of 4 and above). Urgent calls for assistance from ward staff had an expectation that the ICON would arrive within 15 minutes of receiving the call. Opportunistic rounding and EMR reviews allowed ICONs to identify potentially deteriorating patients who had been missed by the ward staff; these instances were measured as failure to escalate and used to inform education sessions throughout the program.

Measures and data collection

This article reports on 3 types of measures: (1) ICON program descriptors, (2) activity measures, and (3) measures of impact of the program. An overview of all measures used is presented in Supplemental Digital Content Table 1, available at: http://links.lww.com/JNCQ/A944.

Measures selected came from the literature and were readily available in the hospital EMR, data systems, and/or quality department records. For self-collected measures (see Supplemental Digital Content Table 1, available at: http://links.lww.com/JNCQ/A944), an audit tool (Excel spreadsheet) was created by the ICU NAG and provided to each hospital. Data were collected each shift by the ICONs in a de-identified manner and then aggregated monthly. The ICU NAG and local hospital ICON teams regularly checked and discussed data collection processes in the early months to ensure consistency and accuracy of measures taken by the ICONs. The measures collected by each team are summarized in Supplemental Digital Content Table 1, available at: http://links.lww.com/JNCQ/A944.

Data on hospital admissions for adults and arrests outside of critical care areas by hospital were available by calendar quarter for ICON for the fourth quarter 2014 to the fourth quarter 2019 from the public health system quality department that keeps and reports official performance records for the health system.

Data analysis

Data were analyzed in Excel (Microsoft, Redmond, Washington) and Python 3.7 (Van Rossum, Amsterdam, the Netherlands). In Excel, simple counts and proportions were computed for descriptors. The changes over time for 1 activity indicator and 2 impact indicators were assessed using trend analysis with linear regression in Python for each hospital with complete data and for all hospitals combined. These indicators were *indicator a (activity)* monthly ICON visits rates, *indicator b (impact)* failures to escalate, and *indicator c (impact)* unplanned transfer from ward to ICU/HDU or unplanned readmission to ICU/HDU within 72 hours (see Supplemental Digital Content Table 1, available at: http://links.lww.com/JNCQ/A944). Unplanned transfers from the ward to HDU and readmissions to HDU occurred only at one hospital. Therefore, HDU and ICU were grouped together as one area. The denominator for each rate was the monthly admissions at each site. For the period May-December 2016, total visits data for 1 hospital (hospital C) were missing. Therefore, hospital C was excluded from the activity indicator.

The dependent variable in each model was the number of ICONR visits, failures to escalate, or unplanned transfers/readmissions, respectively, divided by the number of admissions. The independent variable was month. The β coefficient for month was considered statistically significant if $P < .05$. To provide a more understandable measure of activity and impact (albeit not as robust a statistic as the time series β), program year 1 was compared with program year 2 using the Mantel-Haenszel χ^2 test and its 2-sided P value.

A third impact measure was also reported: cardiopulmonary arrests outside critical care areas. Cardiopulmonary arrest includes those patients outside critical care wards who had a cardiac arrest sheet completed by the response team with interventions described, that is, no false alarms are included. The cardiopulmonary arrest rate was calculated as the number of cardiopulmonary arrests outside of critical care areas divided by the number of hospital admissions times 1000. Rates for 4 periods were calculated: pre-ICON (Q4 2014 to Q1 2016), ICON period 1 (Q3 2016 to Q2 2017), ICON period 2 (Q3 2017 to Q2 2018), and ICON postevaluation period (Q3 2018 to Q4 2019). Q2 2016 data were not included in period-period analysis because the ICON program started in the middle of that quarter. Confidence intervals (95%) around the cardiopulmonary arrest rates were calculated using the Wilson score method. To compare the change in rates between periods within intervention hospitals, the χ^2 test was used.

Ethics

The ICON role and reporting processes were approved by the chief nursing officer of each participating hospital through the chief nursing officer forum in early 2015. Formal ethics committee approval was not sought because of the ICON role being a quality improvement initiative that was already identified and accepted in published literature.[3]

RESULTS

ICON program descriptors and activity measures

A total of 17 461 ICONR calls were made during the study periods at all hospitals. Across the 3 hospitals with complete activity data, 6350 ICONR calls were initiated from May 2016 to April 2017, and 8001 ICONR calls were initiated from May 2017 to April 2018: a 26% increase from the first ICON year (night duty cover only) to the second ICON year (24/7 cover). During the second year of ICON (24/7 cover), there were a total of 74 431 admissions to all 4 hospitals resulting in an overall ratio of 129.64 ICONR per 1000 admissions.

The number of monthly ICON visits per 100 admissions is shown in Supplemental Digital Figure 1, available at: http://links.lww.com/JNCQ/A945, for the 3 hospitals with complete data. Statistically significant increases in the rate of ICON visits by month ($P < .001$) were observed at sites B and D and for the 3 sites combined ($\beta = .40$, 0.16, and 0.17, respectively). For site A, there was a nonsignificant decrease in ICON visit rate ($\beta = -.017$, $P = .803$).

In terms of the ICONR trigger, a MEWS score was responsible for 80% of calls over the 2-year period, with a value equal to 3 on 2636 occasions (15%), 4 on 4738 occasions (27%), and greater than 4 on 6656 occasions (38%). Bedside Nurse Concern was the reason for the ICONR trigger on the remaining 3431 occasions (20%). Bedside Nurse Concern showed a 60% increase comparing the first 5 months to the next 5 months of the program and maintained a relatively constant high rate thereafter. Most other triggers remained relatively stable throughout.

The most common vital sign changes causing a MEWS/ICON trigger are reflected in Table 1, and in most instances, it was a combination causing the triggers. The ICON also occasionally responded to obstetric emergencies and pediatrics.

On average, 48% (8354) of the total patients who were responded to by the ICON over the 2-year intervention period required more than 1 visit. The clinical profiles of patients requiring ICONR calls were medical (40%), HDU (21%), surgical (15%), oncology/hematology (10%),

Table 1. Most Common Triggers for ICON Call

Trigger for ICON Call	n (%), Total 35 665
Respiratory rate	10452 (29.3)
Heart rate	9134 (25.6)
Spo_2	4075 (11.4)
Systolic BP	3736 (10.5)
Temperature	3124 (8.8)
Nurse Concern	2263 (6.3)
Consciousness: alert, verbal, pain, unresponsive	2171 (6.1)
Pain	651 (1.8)
Bleeding	59 (0.2)

Abbreviations: BP, blood pressure; ICON, intensive care outreach nurse; Spo_2, oxygen saturation.

telemetry (6%), pediatrics (3%), long-term care (3%), and other (2%). The ICONs attended a total of 4761 (27%) ICONR calls without needing to refer to other members of the multidisciplinary team. Of the total patients assessed by the ICONR, 1355 (7.8%) were transferred to ICU, 329 (1.9%) were transferred to HDU, and 57 (0.3%) were transferred to other unit/operating room; all others were stabilized and managed on the wards with follow-up review as determined by the ICON assessment of the patient. The overall ICON response rate (respond to the ward within 15 minutes of call) was 80% over the 2-year period. In the first year, it was 70%, and in the second year, it improved to 87%.

Impact measures

A total of 7087 transfers from ICU or HDU to the ward were documented across the 4 sites; 173 (2.4%) of these transfers returned to ICU or HDU within the next 72 hours. All hospitals were assessed for changes in the combined indicator of unplanned admissions to ICU/HDU and readmissions to ICU/HDU within 72 hours of transferring. From year 1 to year 2, the all-hospital rate per 1000 admissions was 9.38, increasing to 10.30 in year 2 (P = .053). Site A experienced a statistically significant decrease in ICU/HDU indicator (2.48-1.35 per 1000, P = .013), while site C significantly increased its rates for this indicator from 12.0 to 15.3 per 1000 (P = .013). None of the trend statistics were statistically significant (data not shown).

There was a decreasing monthly trend in instances of failure to escalate per 1000 hospital admissions for all sites combined ($\beta = -.718$, $P < .001$) and for sites A and B ($\beta = -1.3$ and -1.5, respectively, $P < .001$ each) and C ($\beta = -.16$, $P < .01$) individually (see Supplemental Digital Content Figure 2, available at: http://links.lww.com/JNCQ/A946). Failures to escalate cases to the ICON totaled 1501 during the study period: 1077 occurred in the first year (14.8 per 1000 admissions) and decreasing to 424 (5.6 per 1000 admissions) in the second year. This year-to-year change was statistically significant for each site individually (A to D χ^2 statistic = 101.6, 222.8, 8.99, and 10.05, with $P < .01$ or $P < .001$ depending on the site) and for all sites combined (χ^2 statistic = 311.8, $P < .001$).

The trend in cardiopulmonary arrest rates per 1000 admissions outside of critical care areas is shown in the Figure in context of the program initiation. Decreases are seen following the commencement of the program and then sustained for 2018-2019 (Figure).

The aggregated cardiopulmonary arrest rate across all 4 hospitals decreased from 4.04 per 1000 admissions pre-ICON implementation to 1.42 per 1000 admissions in the second year of the study when ICONs provided 24/7 coverage (ICON period 2) and continued downward to a rate of 0.72 per 1000 during the ICON

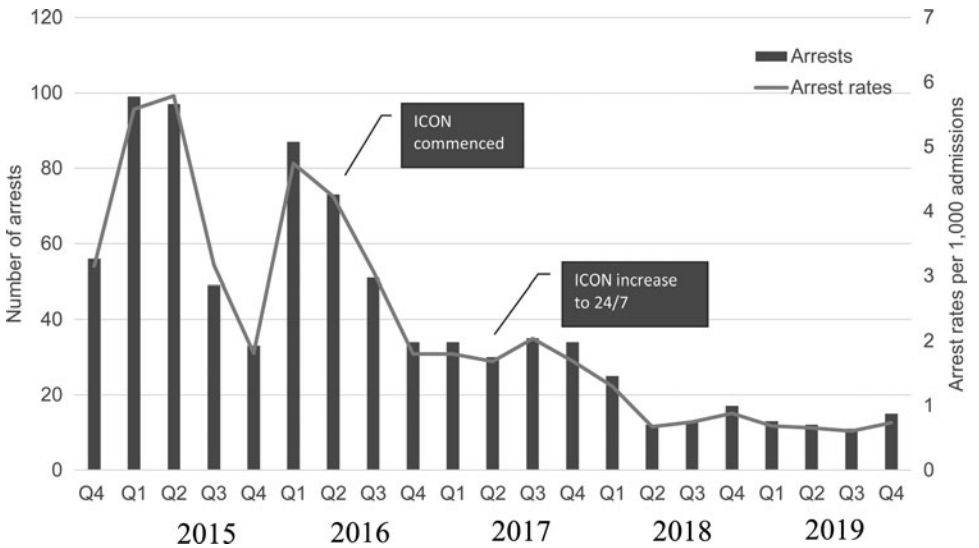

Figure. Number of cardiopulmonary arrests outside of critical care areas (all sites) and arrest rate per 1000 admissions at ICON study sites. ICON indicates intensive care outreach nurse program.

Table 2. Cardiopulmonary Arrests and Arrest Rates by Study Period at Study Sites 2014–2019

	Quarters in Period	Arrests During Period	Average Quarterly Arrests	Presentations During Period	Arrest Rate per 1000[a]
Period					
Pre-ICON	6	421	70.2	104 324	4.04
ICON period 1	4	149	37.3	72 292	2.06
ICON period 2	4	106	26.5	74 431	1.42
Post-ICON evaluation	6	81	13.5	112 948	0.72
Percent change from pre-ICON to post-ICON			−420%		−461%

Abbreviation: ICON, intensive care outreach nurse program.
[a] χ^2 *for trend = 259.1;* $P < .001$.

evaluation period (see Supplemental Digital Content Figure 3, available at: http://links.lww.com/JNCQ/A947).

The change in cardiopulmonary arrest rates experienced at ICON hospitals from the pre-ICON period to the ICON evaluation period was statistically significant ($\chi^2 = 259.1$, $P < .001$) and is summarized in Table 2.

DISCUSSION

The study showed that in the second year when 24/7 ICON coverage was in place, there was an ICONR rate of 129.64 per 1000 admissions compared with 8.7 per 1000 admissions in the MERIT study.[11] This finding suggests a significantly lower threshold for calling for help in the ICON study compared with the MERIT study; however, the 2-study methodologies are different in that one is medically led and was evaluated over a 6-month time frame while the ICON study was nurse led and studied over a 24-month time frame.

Reduction in the cardiopulmonary arrest rates outside of critical care areas was the most substantial finding in this evaluation and has been sustained. Benson et al[12] and Mitchell et al[13] showed that nurse-led critical care outreach services achieved a reduction in arrest calls by 58.7% and 29.6%, respectively. The arrest call rate in this study showed substantial and sustainable improvement, with a rate of 1.42 arrest calls per 1000 hospital admissions during the second year (ICON period 2) and 0.72 in the postevaluation period (2018-2019, Table 2). These findings compare favorably with the MERIT study rate of 1.31, Australian and New Zealand rate in hospitals with RRS of 1.32,[14] and National Health Service adult in-hospital cardiac arrest of 1.6 per 1000 hospital admissions.[15]

Overall ICU readmission rate within 72 hours of transfer out was 3%; unfortunately, we did not have pre-ICON measures; however, this result compares favorably with Ball et al,[16] who were able to reduce ICU readmission to 6% and Williams et al,[17] who reported a nonstatistical improvement in ICU readmissions of 5.4%. Of note, hospital C had a significant increase in unplanned admissions to ICU. The only anecdotal suggestion for this finding is that improved bed capacity in ICU may have resulted in precautionary admissions of moderately deteriorating patients. Do-not-resuscitate and end-of-life care were relatively restricted practices compared with western health systems and did not change in nature during the study period.

From the nursing perspective, it was encouraging to see that the Nurse Concern flagged the need for ICON in 20% of cases over the 2-year period, highlighting preemptive judgments on the part of the bedside nurses. In addition, bedside nurses failed to escalate 1077 occasions of deterioration detected by the ICONs in the first year and 424 in the second year, suggesting greater confidence and vigilance in detecting and escalating deterioration in patients' condition and in using the ICON appropriately.

Limitations

The key limitation of this study is that there were multiple variable changes in practice, leadership, and the community occurring throughout all 4 hospitals and cities concurrently and for this reason, the ICON is but one of many initiatives to influence or improve care over time. Also, some of the measures initiated by the ICONs were not available preimplementation limiting the ability to show before and after comparisons, for example, ICU readmission. Furthermore, because the data were collected by the staff in the ICON roles, there may have been some bias introduced, as they may have wanted to show a positive effect of their work. Cardiopulmonary arrests in ICU and other critical care areas are not measured as part of the hospital cardiopulmonary arrest rate, which could have hidden some potential ward arrests if the ICON initiated afforded ICU capacity to accept deteriorating patients faster and before they arrested.

Reliance on routine audit data from multiple sources rather than specific data collected for research purposes can lead to error as also reported by Ball et al[16] and could apply to arrest data and inpatient admissions in this study; however, the reporting department undertakes regular self-audit for accuracy and reliability.

CONCLUSION

The ICON role was able to be implemented into 4 teaching hospitals in Abu Dhabi and effect a substantial reduction in hospital cardiopulmonary arrest, failure to escalate, and readmissions to ICU. The initiative showed progressive improvement with increasing awareness and acceptance of this role over time. While ICON-type roles are relatively new to non-Western health care systems, we have shown that they are equally implementable and effective and necessary to improve patient outcomes.

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