



Introducing Intravenous Interoperability: Expanding the Pharmacist's Role in Medication Administration

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Introduction

Health-Care Facility

- Lancaster General Health
 - Not-for-profit healthcare system
 - 604-bed Lancaster General Hospital
 - 98-bed Lancaster General Women & Babies Hospital
- Recipients of state and national awards for clinical and operational excellence

Background

- 56% of medication errors are associated with intravenously (IV) administered medications^{1,2,3}
 - 61% lead to serious or life-threatening errors^{1,2,3}
- LGH has implemented medication error reduction strategies
 - Bar-coded medication administration (BCMA) in 2003
 - Electronic medication administration record (eMAR) in 2003
 - Intelligent infusion devices (IID) in 2006
- Limitations
 - BCMA, eMAR, and IID systems operate independently
 - Pump programming, despite 'intelligent' software, is a complex, manual process prone to errors

Purpose

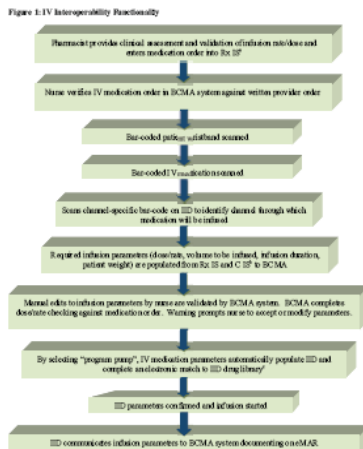
- Improve medication safety through integration of IID, BCMA, and eMAR systems
- Decrease error potential in medication administration process

Goals

- Successfully implement IV interoperability beyond a pilot phase
- Increase IID drug library adherence (ensure dose limit checking)
- Reduce pump mis-programming (edits)
- Demonstrate a reduction in IV medication error rates
 - Particularly with high risk medications, such as IV heparin

Description of the Program

Figure 1: IV Interoperability Functionality



* IIS: Pharmacy Information System
 † CDS: Clinical Information System
 ‡ Manual edits to the programming deviating from previously transmitted infusion parameters prompt a warning for nurse to re-validate IID programming

Description of the Program (continued)

IV Interoperability (aka: auto-programming) Overview

- Integrates eMAR, BCMA, and IID into bar-code driven workflow
 - Bi-directional integrated data flow
 - Automatically populates pharmacist-validated, provider-ordered infusion parameters on IID
 - Allows infusion-specific data from IID to be electronically charted in eMAR

Development and Implementation

- Multidisciplinary team charged with project development
 - Phase 1: Preparation (November 2005 – July 2008)**
 - BCMA and IID software design, evaluation, testing, trouble-shooting, and validation
 - Software workflow development
 - Channel-specific bar-codes
 - Drug library modification
 - Pharmacist oversight
 - Rapid cycle testing: one nurse / one pharmacist / one provider order
 - Phase 2: IV Interoperability Pilot**
 - Official pilot launched July 2008: cardiac-telemetry unit
 - Systematic roll-out: software tutorial and one-to-one, hands-on training
 - Pilot expansion (total 64 telemetry patient beds)
 - September 2008: cardiothoracic step-down unit
 - November 2008: neurology/surgical unit
 - Phase 3: Validation**
 - Time and Motion Study: manual pump programming versus interoperability workflow
 - Design
 - 19 nurses randomly selected (varying experience and tenure)
 - 24 scenarios performed by each nurse
 - 12 IV interoperability scenarios / 12 manual scenarios
 - 50% randomly assigned to initiate IV interoperability arm

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- Results
 - 24.8% reduction in nursing time for IV interoperability ($p < 0.0001$)
 - 58% reduction in number of programming steps (17 to 7)

Table 1: Workflow Comparison Pre / Post IV Interoperability

Manual Program	IV Interoperability
1. Scan patient	1. Select CCA
2. Scan medication and complete required fields	2. Scan patient
3. Manually document in eMAR/BCMA	3. Scan medication and complete required fields
	4. Scan pump channel
Program pump:	5. Press start
	6. Select 'Yes' to confirm
	7. Press 'OK' to document in eMAR/BCMA
10. Enter concentration (3 steps)	
13. Enter weight	
14. Enter dose	
15. Enter volume to be infused	
16. Press start	
17. Select 'Yes' to confirm	
Total steps = 17	Total steps = 7

Phase 4: Expansion

- May 2009: began expansion to all telemetry and medical/surgical units

Experience with the Program

- Implementation complete on 18 nursing units (392 licensed beds)
- Pharmacist directly impacts medication administration at bedside
 - 2 additional safety checks:
 - Pharmacist infusion rate oversight
 - Nurse independent validation of auto-programmed rate
- Pre-IV interoperability: telemetry and medical/surgical nursing units accounted for 85% monthly reported IV heparin errors
 - Post-IV interoperability: 60% reduction in reported IV heparin errors

Table 2: Drug Library Compliance

Clinical Care Area	Baseline (%)	Post Full Implementation (%)	% Increase	p-value
	June 2008	July 2009		
Telemetry	53.7	70.3	30.9	< 0.0001
Medical/Surgical	33.1	60.7	83.4	< 0.0001

Graph 1: Drug Library Compliance: Non-IV Interoperability versus Post Full IV Interoperability Implementation

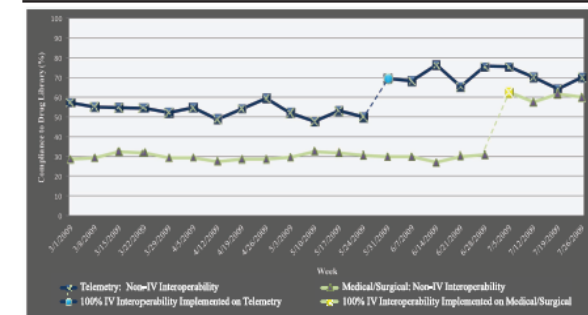


Table 3: Intravenous (IV) Interoperability Success Rates

Nursing Unit	Go Live IV Interoperability Month/Year	Total Opportunities For IV Interoperability (n)	Successful IV Interoperability (n)	Attempted, but Failed IV Interoperability (n)	Success Rate Without IV Interoperability Load (%)	IV Interoperability Rate (Attempted/ Opportunities For Improvement (n))	Total IV Interoperability Compliance (%)						
		June 2009	July 2009	June 2009	July 2009	June 2009	July 2009						
A	5/2009	722	652	622	652	51	39	92	93	49	61	86	86
B	6/2009	396	359	285	1108	52	160	85	87	59	241	72	73
C/D	6/2009	215	289	174	721	16	54	91	92	23	102	81	82
E	7/2009		41		35		4		86		71		75
F	5/2009	583	542	452	421	42	43	91	91	89	78	78	79
G	5/2009	868	759	690	625	52	52	93	92	126	82	79	82
H	5/2009	505	478	416	384	41	59	91	87	48	35	82	80
I	7/2009	460	599	335	460	36	53	90	89	89	96	73	75
J	5/2009	582	856	381	486	47	101	89	90	154	149	65	62
K	6/2009	313	1397	254	1078	20	143	93	88	29	176	81	77
L	11/2008	863	883	577	740	85	77	97	91	206	66	66	84
M	6/2009	53	1124	39	880	5	93	89	90	9	61	74	78
N	7/2009		634		348		56		85		210		55
O	7/2009		1156		847		66		93		243		73
P	6/2009	89	1369	65	1160	3	99	95	92	15	134	78	89
Q	5/2009	512	565	395	411	28	30	92	92	90	104	77	76
R	6/2009	346	389	273	325	20	10	93	94	59	45	79	84
Total		6506	14018	4958	10831	500	1189	91	90	1048	2068	76.5	76.6

* Represents two nursing units sharing the same nursing staff
 † Shaded areas were prior to IV interoperability implementation

Table 4: Edited Dose Limit Violations

Clinical Care Area	Pre Implementation	Post Full Implementation	% Reduction	p-value
	June 2008	July 2009		
Telemetry	67/6,508 (1.0%)	4/7,036 (0.06%)	94	<0.0001
Medical/Surgical	85/14,773 (0.58%)	2/8,635 (0.02%)	97	<0.0001

Discussion

- Able to successfully deploy IV interoperability beyond a pilot phase
- IV interoperability advantages
 - Guarantees correct medication is selected
 - Ensures IID dose limit checking each time IV medication is administered
 - Capable of IID interoperability even when IV medication is not included in drug library
 - Rate and volume verified by pharmacist and automatically populated on pump
 - Simplifies nursing workflow
 - Focuses on one IV administration task at a time
 - Further enhances pharmacy-nursing collaboration
- Variation and inconsistency in everyday IV medication administration does exist
 - Cultural drifts were identified
- Multi-disciplinary task force formed to champion evolution of IV interoperability

Conclusion

- IV interoperability has strengthened the health system's established medication safety foundation
- Pioneering this technology brought recognition that safe IV medication administration does not rest solely with the nurse at the bedside
 - Introduction of pharmacist oversight of IID programming
 - Interoperability extends the pharmacy-nursing collaborative partnership
- Further deployment of this novel integration is planned as a result of this positive experience

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Authors have nothing to disclose.