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Health care workers' perceptions of respiratory and gastrointestinal algorithms for patient management in emergency care settings

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Background: Patients with respiratory or gastrointestinal illness in emergency care settings are often not yet diagnosed but are at risk of transmitting disease. Infection control algorithms delineating a standard approach to patient management decrease risk of secondary exposure, but few articles document health care workers' (HCWs) perceptions as to their effectiveness and ease of implementation.
Methods: A cross-sectional survey approach was used to explore HCWs perceptions in 2 emergency departments of the current algorithms for management of potentially infectious respiratory and gastrointestinal illnesses.
Results: Surveys from 96 HCWs revealed that algorithms were perceived as invaluable in protecting staff, patients, and colleagues. Differences in self-reported compliance, clarity, and ease of implementation of the respiratory algorithm were noted between facilities, likely reflecting variation in the physical plant. Physicians scored significantly lower for compliance with the respiratory algorithm.
Conclusion: Algorithms were perceived to offer a clear and consistent approach to patient management and protect HCWs in spite of environmental and resource limitations.
Key Words: Surveillance; infection control; algorithms; patient management.

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Patients presenting with respiratory or gastrointestinal illness in emergency care settings are often not yet diagnosed but are potentially capable of transmitting disease. The potential for transmission increases when infection control measures for the early recognition and management of potentially infectious illnesses are not consistently used at the first point of contact. Infection control algorithms delineating a standard approach to managing patients with suspected communicable infections have been developed to decrease this risk of secondary exposure.[1-3]

Written policies were revised and implemented by a multidisciplinary team (infection control, occupational health, emergency, and intensive care unit staff) for the immediate management of patients with respiratory illness not yet diagnosed in 2003 at Vancouver General Hospital (VGH) and 2006 at Lions Gate Hospital (LGH). A separate algorithm for gastrointestinal (GI) illness was introduced in 2005 at VGH and 2006 at LGH. These administrative controls outline symptoms of potentially communicable respiratory or GI illness, the procedure to request engineering controls (eg, negative pressure room, dedicated commode), elements for communication with infection control, isolation precautions for patients, restrictions for staff and visitors, and requirements for environmental cleaning.

Previous efforts had assessed compliance to specific personal protective equipment elements included in the respiratory and GI algorithms.[4,5] This study evaluated health care workers' (HCWs) perceptions and self-reported compliance to the algorithms. HCWs were asked their opinions as to the extent to which the algorithms were being used. Compliance, clarity, ease of implementation, and value of the algorithms were also assessed.

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METHODS

Study design and data collection

A cross-sectional survey approach was used to explore perceptions of HCWs in emergency departments of 2 acute care facilities in the province of British

Table 1. Algorithm usage

	Respiratory algorithm				GI algorithm			
	Eligible patients		Algorithm applied		Eligible patients		Algorithm applied	
Frequency	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0 times	7	7.9	10	11.1	5	5.7	8	9.1
1-5 times	65	73.0	68	75.6	60	68.2	64	72.7
6-10 times	13	14.6	10	11.1	17	19.3	12	13.6
11-15 times	4	4.5	2	2.2	4	4.5	2	2.3
16-20 times					2	2.3	2	2.3
Unknown	7		6		8		8	
Total	96		96		96		96	

NOTE. Values represent algorithm usage during a shift.

Columbia, Canada. VGH is a 955-bed, adult, tertiary care teaching hospital, offering 24-hour emergency services to residents from across British Columbia. As of July 2007, renovations to the VGH emergency department increased the number of patient beds from 22 to 28 and improved isolation capabilities with sliding doors between most beds. LGH, a 335-bed community hospital, also providing 24-hour emergency services, was renovating the emergency department during the survey and temporarily was without negative pressure ventilation (NPV) or isolation rooms.

Surveys were distributed by hand to a total of 150 HCWs based on the relative size of the 2 departments (100 at VGH, 50 at LGH) during the month of July 2008. The algorithms (available by e-mailing request to Elizabeth.Bryce@vch.ca) were deliberately not attached to assess unprompted knowledge. Respondents were asked to report the extent of agreement with statements about use, compliance, clarity, ease of implementation, and value of the respiratory and GI algorithms on 5-point Likert scales. The survey instrument was anonymous to ensure confidentiality and took approximately 5 to 10 minutes to complete. Prospective respondents were provided with a coffee card as an incentive.

Statistical analyses

Standard descriptive statistics (eg, frequency, percentage) were employed to characterize the study population (data not shown). Occupations of respondents were grouped to facilitate analyses: ''Other Clinical'' includes resident care aide (RCA), registered respiratory therapist (RRT), licensed practical nurse (LPN), emergency response professional (ERP), and ward aide; ''Other Non-Clinical'' includes clerk, nursing unit assistant, patient care coordinator (PCC), and student. Statements marked ''not applicable'' by respondents were considered as missing values.

Frequencies and percentage distribution of algorithm use per shift were tabulated for each algorithm (Table 1). Global mean scores were calculated for compliance, clarity, ease of implementation, and ability to protect (Table 2). These were compared between facilities using independent samples t test, occupation groups using nonparametric Kruskal Wallis test, and groups of experience using ANOVA. For significant dependent variables, post hoc multiple comparisons were computed with the Mann-Whitney U test for occupation groups and Bonferroni test for groups of experience. Descriptive statistics for individual items relating to compliance, clarity, ease of implementation, and ability to protect were computed for each algorithm (Tables 3 and 4). Selected post hoc comparisons were computed for independent variables deemed significant in the global mean score analysis (results not shown). Qualitative comments provided were categorized into themes. All tests were carried out using Statistical Package for the Social Sciences SPSS 14.0 (SPSS, Inc, Chicago, IL) with 2-sided significance levels of $P \leq .05$.

RESULTS

Descriptive statistics

A total of 96 of 150 surveys (64%) was returned, of which 53 (53%) were from VGH and 43 (86%) from LGH. Occupation groups were representative of the population studied: registered nurses (RNs) (70.5%), medical physicians/residents (MDs) (9.5%), other clinical staff (11.6%), and other non-clinical staff (8.4%). In terms of experience, respondents reported means of 11.3 years in health care, 7.4 years at their facility, and 5.1 years in the emergency department. Most (80%) respondents worked both day and night shifts; the remaining 20% worked day shifts only. The minimum number of shifts per week was 2, with 75% working more than 3.5 shifts per week (full-time equivalency).

Algorithm usage

Table 1 shows distributions between expected and actual use of the respiratory and GI algorithms. During a

Table 2. Comparison of global scores between facilities, occupation groups, and groups of experience

		Respiratory algorithm				GI algorithm			
		R - compliance (global)	R - clarity (global)	R - ease of implementation (global)	R - ability to protect (global)	GI - compliance (global)	GI - clarity (global)	GI - ease of implementation (global)	GI - ability to protect (global)
Facility	*P* value	0.001	0.032	0.001	0.940	0.197	0.499	0.840	0.627
VGH	Mean	3.5657	3.7440	3.8133	4.6100	3.6061	3.7670	3.8670	4.6863
	SD	0.54079	0.78131	0.82931	0.57697	0.62915	0.89862	0.83395	0.47801
LGH	Mean	3.0078	3.3366	3.2024	4.6190	3.3613	3.6413	3.8286	4.6310
	SD	0.87003	0.95829	0.92139	0.57769	1.13659	0.87261	0.96507	0.59416
Occupation group	*P* value	0.050	0.198	0.354	0.019	0.135	0.393	0.304	0.033
RNs	Mean	3.4201	3.5843	3.6404	4.6795	3.6249	3.6785	3.8492	4.7273
	SD	0.63969	0.87372	0.89501	0.50630	0.65633	0.91481	0.89917	0.45913
MDs	Mean	2.8889	3.0952	3.0476	4.1458	3.0179	3.4286	3.6857	4.3542
	SD	0.49690	0.67944	0.80343	0.56651	0.75839	0.61567	0.77337	0.39277
Other clinical	Mean	3.5657	3.8939	3.5606	4.5606	3.8250	4.0545	4.1818	4.5152
(RCA, RRT, LPN, ERP, ward aide)	SD	0.66042	0.90146	0.95240	0.73512	0.88231	0.77507	0.96106	0.77623
Other non-clinical	Mean	2.3148	3.4611	3.2278	4.8571	2.5000	3.8429	3.6857	4.8571
(clerk, nursing unit asst., PCC, student)	SD	1.44259	1.00894	1.01880	0.37796	1.87083	0.99307	0.76470	0.37796
Experience in health care, yr	*P* value	0.000	0.028	0.259	0.896	0.099	0.136	0.159	0.929
<5	Mean	2.9867	3.3773	3.3182	4.5652	3.2228	3.4217	3.5304	4.6522
	SD	0.52117	0.57702	0.87122	0.48393	0.82396	0.77808	0.89363	0.50230
5-9	Mean	3.0380	3.2472	3.4194	4.6267	3.3862	3.6438	3.9604	4.6267
	SD	0.93079	0.97826	0.91956	0.50065	1.10162	0.80990	0.74992	0.49131
10+	Mean	3.6304	3.7902	3.6795	4.6326	3.6971	3.8667	3.9295	4.6780
	SD	0.62136	0.88783	0.91827	0.66042	0.78318	0.93984	0.93450	0.58003
Experience at facility, yr	*P* value	0.022	0.016	0.595	0.093	0.244	0.266	0.707	0.489
<2	Mean	3.0538	3.3417	3.4167	4.4931	3.3594	3.5833	3.8583	4.5972
	SD	0.82076	0.69555	0.79248	0.53721	0.91805	0.66963	0.78348	0.52686
2-9	Mean	3.2779	3.4602	3.5626	4.7636	3.4552	3.6496	3.7964	4.7442
	SD deviation	0.76259	0.94305	1.01344	0.39379	0.96143	0.98365	1.03065	0.45038
10+	Mean	3.6394	3.9907	3.6827	4.5347	3.7656	3.9600	3.9840	4.6467
	SD	0.58825	0.80499	0.83495	0.74532	0.67999	0.87939	0.71396	0.57397
Experience in ED, yr	*P* value	0.043	0.133	0.123	0.008	0.023	0.035	0.211	0.012
<2	Mean	2.9915	3.2594	3.2101	4.4097	3.0729	3.3125	3.6000	4.5625
	SD	0.85728	0.84291	0.72860	0.67384	0.98212	0.78647	0.70279	0.57064
2-9	Mean	3.3781	3.6096	3.6904	4.7971	3.6748	3.8307	3.9967	4.8188
	SD	0.75291	0.85949	0.96205	0.33686	0.80324	0.86560	0.95931	0.32170
10+	Mean	3.5205	3.7652	3.5681	4.4545	3.5909	3.8870	3.8217	4.4493
	SD	0.55342	0.93157	0.95645	0.73496	0.87047	0.92407	0.90351	0.72026
Total	Mean	3.3171	3.5604	3.5381	4.6141	3.4958	3.7096	3.8495	4.6613
	SD	0.75576	0.88433	0.91933	0.57413	0.89702	0.88422	0.89133	0.53130

NOTE. Significant post hoc comparisons (between groups of occupations and experience).
MDs scored significantly lower for respiratory algorithm compliance ($P = .033$ compared with RNs, $P = .023$ compared with other clinical staff), respiratory algorithm ability to protect ($P = .005$ compared with RNs, $P = .012$ compared with non-clinical staff), and GI algorithm ability to protect ($P = .007$ compared with RNs, $P = .020$ compared with non-clinical staff).
For respiratory algorithm compliance, those with 10+ years in health care scored higher than those with <5 ($P = .002$) or 5-9 years ($P = .003$).
For respiratory algorithm clarity, those with 10+ years in health care scored higher than those with 5-9 years ($P = .041$).
Ten+ years at facility scored higher than <2 years for respiratory algorithm compliance ($P = .020$) and clarity ($P = .026$).
Less than 2 years in the emergency department scored lower than those with 2-9 years for GI compliance ($P = .022$) and respiratory algorithm ability to protect ($P = .019$).
Those with 10+ years in the emergency department scored lower than those with 2-9 years for GI ability to protect ($P = 0.17$).

Table 3. Respiratory algorithm: means of individual items for compliance, clarity, ease of implementation, and ability to protect

Category	Survey item									
Compliance	Assess at triage	Admit to NPV Room	Admit to single room	Admit to bed and curtains closed	Patient given surgical mask	Patient flagged in electronic system	N95 used	Surgical mask used	Protective eyewear worn	Hand hygiene after care
Mean	3.25	2.33	2.98	3.46	3.63	3.25	3.73	2.74	2.35	4.79
SD	1.150	1.069	1.151	1.034	1.162	1.222	1.250	1.473	1.171	0.764
Clarity of instructions	Triage Criteria	Request for NPV or single room	If NPV or single room unavailable, curtains to remain closed		Providing surgical mask	Flagging in electronic system	N95 Use			
Mean	3.41	3.31	3.67		3.73	3.39	3.87			
SD	1.126	1.282	1.081		1.116	1.164	1.114			
Ease of implementation	Triage criteria	Admit to NPV room	Admit to single room		Surgical mask for patient	Flagging system	N95 Use			
Mean	3.65	2.88	3.29		4.00	3.48	3.97			
SD	1.073	1.373	1.276		1.100	1.201	1.011			
Ability to protect	Oneself	Other patients	Other HCWs	Facility commitment to staff safety	Facility commitment to patient safety	Ability to assess and treat patients consistently				
Mean	4.73	4.64	4.73	4.57	4.62	4.40				
SD	0.648	0.673	0.648	0.746	0.677	0.785				

typical shift, 73% of respondents reported that between 1 and 5 patients fit criteria for use of the respiratory algorithm; 75.6% reported 1 to 5 actual applications of the respiratory algorithm. For the GI algorithm, 68.2% reported 1 to 5 eligible patients; 72.7% reported that the GI algorithm was applied 1 to 5 times.

Comparison of global mean scores

Table 2 displays comparison of global mean scores for compliance, clarity, ease of implementation, and ability to protect for both respiratory and GI algorithms across independent variables (facilities, occupation groups, and groups of experience). For both respiratory and GI algorithms, global mean scores for compliance (3.3 and 3.5, respectively), clarity (3.5 and 3.7, respectively), and ease of implementation (3.5 and 3.8, respectively) were achieved. Respondents' global mean scores for ''ability to protect'' were 4.6 and 4.7, respectively, for the respiratory and GI algorithms. Differences for compliance ($P = .001$), clarity ($P = .03$), and ease of implementation ($P = .001$) of the respiratory algorithm were observed between facilities, with VGH showing significantly higher scores. Generally, those with more than 10 years experience in health care and at their facility scored significantly higher for respiratory algorithm compliance and clarity compared with those with less experience. Physicians scored significantly lower for respiratory algorithm compliance ($P = .03$ compared with RNs, $P = .02$ compared with other clinical staff), respiratory algorithm ability to protect ($P = .005$ compared with RNs), and GI algorithm ability to protect ($P = .007$ compared with RNs, $P = .020$ for non-clinical staff).

Respiratory algorithm

Table 3 displays means of individual items evaluating the respiratory algorithm. Less than neutral scores for individual items of compliance were as follows: ''patient admitted to NPV room,'' ''HCW wears surgical mask,'' and ''HCW wears protective eyewear.'' All other items received neutral or above neutral scores, with the exception of ''HCW cleans hands after caring for patient'' (4.8/5), which was strongly positive. It should be noted that the item ''HCW wears surgical mask'' was included as a negative control; low scores were expected because HCWs are taught to use a N95 respirator at first patient contact, indicating that respondents were reading each statement and responding appropriately. Compared with LGH, VGH scored significantly higher for ''patient admitted to NPV room'' ($P < .001$) and ''HCW wears N95 respirator'' ($P < .001$) (data not shown); the former was expected, given the status of renovations at LGH. Means for all individual items evaluating ''ability to protect'' and ''facility commitment to

Table 4. GI algorithm: means of individual items for compliance, clarity, ease of implementation, and ability to protect

Evaluation category	Survey item							
Compliance	Assessed at triage	Admitted to single room	Placed on Contact Precautions	Admitted to bed and curtains closed	Flagged in electronic system	Dedicated commode and/or bathroom	Gown and Gloves worn	Hand hygiene after patient care
Mean	3.29	2.81	3.60	3.51	3.18	2.92	4.19	4.64
SD	1.180	1.253	1.178	1.164	1.264	1.309	1.064	0.944
Clarity of instructions	Triage criteria	Instructions for requesting single room			Instructions for flagging the chart	Instructions for dedicated commode and/or bathroom	Instructions for glove and gown use	
Mean	3.67	3.47			3.58	3.65	4.25	
SD	1.009	1.144			1.122	1.158	0.921	
Ease of implementation	Use of triage criteria	Use of single room	Use of Contact Precautions		Use of flagging system		Use of glove and gowns	
Mean	3.64	3.22	4.22		3.77		4.44	
SD	1.126	1.261	1.041		1.071		0.872	
Ability to protect	Oneself	Other patients	Other HCWs	Facility commitment to staff safety	Facility commitment to patient safety	Ability to assess and treat patients consistently		
Mean	4.75	4.71	4.75	4.63	4.63	4.48		
SD	0.602	0.618	0.602	0.639	0.622	0.761		

safety'' ranged between 4.40 and 4.73. All items assessing ease of implementation received at least a neutral score, except ''use of a NPV room'' (2.88) as discussed.

GI algorithm

Table 4 displays means of individual items evaluating the GI algorithm. In terms of compliance, mean scores of 2 items scored below neutral: ''patient admitted to a single room'' (2.81) and ''dedicated commode/bathroom provided'' (2.92). The lowest mean score for ease of implementation was 3.22—''use of single room/dedicated commode.'' Respondents rated the GI algorithm's ''ability to protect'' and ''facility commitment to safety'' positively, with scores ranging between 4.48 and 4.75. Both algorithms rated strongly positive for ability to assess and treat patients consistently.

General comments

Of the 96 respondents, 53 (55.2%) provided unprompted comments. Themes were extracted from the responses and coded into the following categories: lack of engineering controls/equipment (n = 14); increasing awareness/visibility of the algorithms (n = 12); safety culture/compliance (n = 11); working with physicians (n = 7); and about the survey itself (n = 3).

DISCUSSION

Literature suggests that HCWs are more likely to adhere to infection control protocols when the diagnosis is known, yet a definitive answer on admission to emergency is uncommon.[6] Recent experiences with severe acute respiratory syndrome emphasized the need to consistently apply preventive measures based on clinical presentation at the time of admission. Factors influencing utilization of recommended practices include (1) organizational norms and safety climate and (2) individual practices, perceptions, and beliefs, which often vary among occupational groups.[7,8] This study assessed HCWs perceptions of the utility and ability to comply with respiratory and GI infection control management algorithms at the time of initial patient presentation to emergency.

An overall response rate of 64% in our survey suggests that results were likely representative of HCWs in the emergency departments surveyed. RNs were most represented (70.5%) as expected, but, importantly, physicians were almost 10% of respondents, which reflected the occupational distribution in the departments. Most respondents had considerable experience, worked both day and night shifts, and worked full-time equivalents.

HCWs reported an agreement between expected and actual use of the respiratory and GI algorithms. That is, the algorithms were applied to 1 to 5 patients per shift, which was also the number of eligible patients. Considering that 75% of respondents worked a minimum of 3.5 shifts per week, it seems plausible that each algorithm might be used up to 70 times per week (2 shifts per day, 7 days per week). The observations are also supported by a previous study at VGH, in which 86.5% of emergency department HCWs reported wearing a respirator from 1 to 10 times/shift.[4]

Strongly positive global mean scores indicate that HCWs perceive the algorithms as clear and invaluable tools for consistently managing patients with potentially transmissible illnesses. This is supported by the qualitative data: ''*The algorithms are [an] excellent resource/guide for triage—treatment of patients presenting symptoms of GI and respiratory infections.*'' Several respondents provided comments helpful for improving visibility of the algorithms. These suggestions include laminated fact sheets for triage clipboards, posting laminated hard copies of the algorithms, and increasing visibility on the regional infection control intranet site.

Most items evaluating compliance and ease of implementation scored positively. This differs with results from an international review of 37 studies, which describes compliance to infection control precautions as suboptimal.[9] Previous experience with severe acute respiratory syndrome and local background rates of tuberculosis are likely 2 driving factors for the increased awareness and compliance by HCWs in our 2 facilities.

Low and neutral scores reflected constraints in the physical plant design, perceived restricted access to personal protective equipment, and limited availability of commodes similar to that found in a United Kingdom study of emergency department resources.[10] This was supported by HCW comments, eg,''*not enough resources to treat patients consistently, ie, rooms, commodes, isolation.*'' Low scores for compliance and ease of implementation of using NPV rooms and N95 respirators were particularly evident at LGH. The former reflected the state of renovations at the time of the survey. Reported differences between VGH and LGH regarding N95 respirator use likely reflect a difference in organizational culture rather than resource availability; the algorithms had been in place for approximately 1 year at LGH compared with 5 years at VGH, and a previous audit documented that respirators were accessible at all sites.[5]

The challenge of adhering to guidelines regarding commode use as it pertains to the GI algorithm was illustrated in the following statement and reflected inadequate resources. ''*Sometimes it is difficult to have a designated commode at the bedside due to not having enough commodes at the bedside. Often times we have to wipe down commodes aggressively so the next patient can have a disinfected commode.*''

Compared with other HCWs, physicians reported lower compliance with the respiratory algorithm and scored lower on their perception that the algorithms protected either staff or patients. This contrasts with results from a survey conducted by Virginia Commonwealth University, in which physicians reported significantly better compliance with hand hygiene, contact precautions, and airborne precautions compared with other occupations.[6] Results were explained by different motives for compliance: RNs were motivated by patient safety more than personal safety, whereas physicians reported personal safety as more of a motivating factor.[6] Our findings showed that personal and patient safety were both strong motivating factors for all occupations.

Working effectively with physicians was conveyed qualitatively: ''*[Algorithms are] too often ignored by physicians, which seems to often set the stage for all others caring for patients. [Algorithms] need consistent implementation by everyone.*'' Physicians act as role models to other professionals in the delivery of patient care, and their compliance with institutional policy is critical in ensuring success of implementation.[11] Importantly, all agreed that the algorithms provided staff with the tools to consistently manage patients while protecting others.

There were limitations to the study. First, the difference in response rates between facilities and occupation groups might have led to disproportionate representation in the results presented. Second, the cross-sectional survey method only evaluates perceptions at 1 point in time, and results are entirely self-reported. Despite these limitations, quantitative and qualitative data presented from the perspective of the algorithms' end-users help identify specific recommendations for improvements to patient safety and occupational health. Further studies may consider incorporating objective outcome measures to accurately estimate use and compliance.

CONCLUSION

The current study advances knowledge surrounding HCWs perceptions of organizational-specific guidelines for managing patients with suspected communicable respiratory and GI illnesses in emergency departments. Our findings suggest that workers believe that algorithms offer a clear and consistent approach to patient management. Importantly, HCWs feel that algorithms are invaluable in protecting patients and colleagues in spite of environmental and resource limitations.

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