Discontinuation of Contact Precautions for Methicillin-Resistant *Staphylococcus aureus*: A Randomized Controlled Trial Comparing Passive and Active Screening With Culture and Polymerase Chain Reaction

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Background. There have been no randomized controlled trials comparing active and passive screening for documenting clearance of colonization with methicillin-resistant *Staphylococcus aureus* (MRSA). We compared the efficacy of active and passive screening using both culture and commercial polymerase chain reaction (PCR) for documentation of MRSA clearance and discontinuation of MRSA contact precautions (CPs).

Methods. Inpatients with a history of MRSA infection or colonization enrolled between December 2010 and September 2011 were randomized to either passive (nonintervention arm; n = 202; observation with local standard of care) or active screening (intervention arm; n = 405; study staff screened using culture and commercial PCR). The primary outcome was discontinuation of CPs by trial arm based on 3 negative cultures. In the intervention arm, sensitivity, specificity, and positive and negative predictive values of the first PCR were compared to cultures.

Results. CPs were discontinued significantly more often (rate ratio [RR], 4.1; 95% confidence interval [CI], 2.3–7.1) in the intervention arm, including in an intent-to-screen analysis (RR, 2.6; 95% CI, 1.5–4.7). The first PCR, compared to 3 cultures, detected MRSA with a sensitivity of 93.9% (95% CI, 85.4%–97.6%), a specificity of 92.0% (95% CI, 85.9%–95.6%), a positive predictive value of 86.1% (95% CI, 75.9%–93.1%), and a negative predictive value of 96.6% (95% CI, 91.6%–99.1%).

Conclusions. Compared to passive screening using culture methods, active screening resulted in discontinuation of MRSA CPs at a significantly higher frequency. Active screening with a single PCR would significantly increase the completion of the screening process.

Clinical Trials Registration. NCT01234831.

Keywords. MRSA; infection control; contact precautions; isolation; clinical trial.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is endemic in hospitals and, increasingly, outpatient

settings [1]. Based on guidelines from the Centers for Disease Control and Prevention, inpatients with a positive culture(s) for MRSA should be managed using contact precautions (CPs) [2].

Although data suggest that the majority of individuals clear MRSA colonization spontaneously within months to years, there are currently no national or universally accepted guidelines with respect to when and under what conditions CPs should be discontinued [3–8]. To evaluate a practical algorithm for discontinuation of CPs for MRSA, we randomized eligible

inpatients to the current institutional protocol of clinician-initiated screening (primary team) for discontinuation of CPs (nonintervention arm) or to active screening using both culture- and molecular-based methods (intervention arm).

METHODS

Design Overview
We conducted a randomized controlled trial at the Massachusetts General Hospital (MGH), a 947-bed tertiary referral center in Boston, affiliated with Harvard Medical School. MGH has approximately 50 000 admissions per year, and MRSA prevalence among inpatients is approximately 8% as determined by a retrospective analysis of patients flagged as having a history of MRSA on admission. Decolonization protocols and daily skin cleansing with chlorhexidine were not routinely employed.

Settings and Participants
Eligible participants were adult inpatients identified as having a history of MRSA, but not more recently than the prior 90 days. Participants were admitted to the hospital between 6 December 2010 and 16 September 2011. Eligibility was determined by a MRSA Automated Alert System, which identified patients with a history of MRSA without documented clearance (Supplementary Appendix). Concurrent antibiotic use did not preclude enrollment, but was an exclusion criterion for discontinuation of CPs. The study protocol was reviewed and approved by the Partners Human Research Committee, with verbal consent required for participation in the intervention arm.

Randomization and Interventions
Subjects were assigned to the nonintervention arm and intervention arm in a sequential 1:2 fashion in the order of admission to account for expected attrition in the intervention arm.

Nonintervention Arm
The nonintervention arm utilized the local standard of care for discontinuation of CPs. This protocol involved (1) the primary team identifying the patient as eligible based on MRSA history; (2) the primary team completing a series of 3 surveillance nasal cultures negative for MRSA at least 24 hours apart; and (3) cultures obtained without concurrent administration of antibiotics with activity against MRSA in the preceding 48 hours. The primary team was not informed of the subjects' enrollment; if they obtained surveillance swabs, the timing of their collection and culture results were documented by study staff. The primary team was responsible for referral of subjects to the Infection Control Unit for validation for discontinuation of CPs.

Intervention Arm
Subjects who consented to participate were swabbed by study staff immediately, with one swab processed for culture as in the nonintervention arm, and the second swab processed using a commercially available polymerase chain reaction (PCR) assay. The procedure was employed on subsequent days, at least 24 hours apart. The series continued through to completion when possible, regardless of the results or antibiotic administration. Any subject with 3 negative cultures was immediately referred to the Infection Control Unit. In those subjects not receiving antibiotics with activity against MRSA in the prior 48 hours, CPs were discontinued. Clinical and demographic data for participants were collected from medical and administrative databases.

Swab Collection
The nasal swab procedure was commonly performed under a variety of circumstances throughout the institution, and no additional training of hospital staff in the nonintervention arm was undertaken. In the intervention arm, swabs were obtained by study staff who were trained by the study investigators.

Laboratory Methods
Culture-Based Screening
Nasal swab specimens were collected for both trial arms with the BBL CultureSwab Collection and Transport System (Becton, Dickinson and Company, Franklin Lakes, New Jersey) and were inoculated onto BBL CHROMagar MRSA media plates ("CA," Becton, Dickinson and Company). Mauve-colored colonies seen by 48 hours were tested by Gram stain, and those with gram-positive cocci were confirmed by a positive tube coagulase test for reporting as MRSA.

PCR-Based Screening
In the intervention arm, specimens were also collected with the Cepheid Collection Device (Copan, Marietta, Georgia) and processed using the Xpert MRSA real-time PCR assay on the GeneXpert platform ("PCR," Cepheid, Sunnyvale, California; Supplementary Appendix).

Outcomes
The primary outcome was discontinuation of CPs, using culture-based methods. We also examined completion of the series and frequency of clearance. For the intervention arm, outcomes included the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the first PCR compared to 3 negative cultures. We conducted sensitivity analyses to examine the impact of prevalence of MRSA on the NPV. For the small fraction of subjects in whom the CA and PCR were discordant, we applied a protocol for discordancy testing (Supplementary Appendix).

Approach to Antibiotics Received

Using medication administration data, we determined timing of sampling with respect to administration of antibiotics with activity against MRSA. Separate analyses were conducted for all subjects and those with samples obtained in the absence of antibiotics (Supplementary Appendix).

Statistical Analysis

The Fisher exact test was used to compare participant demographics, admission source site and clinical service, and the proportion of subjects with prior hospitalizations; the independent samples *t* test was used to compare means related to MRSA history. Rate ratios and 95% confidence intervals (CIs) were calculated using the Armitage and Berry method in both the efficacy analysis and the intent-to-screen analysis [9]. The 95% CIs for sensitivity, specificity, PPV, and NPV were calculated based on the exact binomial model. Additional details are provided in the Supplementary Appendix.

Estimation of Contact Precautions Days Averted and Associated Costs

To compute the total estimated decrease in CP days, the frequency of observed CP discontinuation was multiplied by the total length of stay (LOS) minus the specimen-processing time. Applying a total of 5 days of processing for culture and a single day for PCR resulted in the subject-level LOS off CPs, with the sum over all subjects equal to the total number of CP days averted. Published data reporting the cost of CP per patient per day were used, multiplied by study-derived CP days averted, to estimate associated cost savings (Supplementary Appendix) [10, 11].

RESULTS

Study Population

A total of 634 eligible admissions were evaluated for inclusion, of which 202 were randomized to the nonintervention arm and 198 allocated. Of 405 randomized to the intervention arm, 259 were allocated. A total of 457 subjects were included in the efficacy analysis (Figure 1).

Baseline characteristics of subjects did not differ significantly between the 2 arms (Table 1). The mean number of days since last documented MRSA culture and the mean LOS in the nonintervention and intervention arms were 749 and 726 ($P = .8$) and 8 and 7 ($P = .2$), respectively. Of the 198 subjects in the nonintervention arm and 259 subjects in the intervention arm, 32 (16.2%) and 33 (12.7%), respectively, had an LOS of <48 hours, which would have precluded completion of the series of swabs (data not shown).

Outcomes and Estimation

The efficacy analysis included all allocated randomized subjects (Table 2). In the nonintervention arm, 62 of 198 (31.3%) subjects had screening initiated, compared with 259 of 259 (100%) in the intervention arm. Among the 62 subjects in the nonintervention arm, 30 (48.4%) were swabbed on admission to one of the hospital's units that conducted active surveillance for MRSA on admission (data not shown). Once initiated, completion of the series of swabs occurred in 19 of 198 (9.6%) and 191 of 259 (73.7%) in the nonintervention arm and intervention arm, respectively. Of those who completed the series of swabs, the number of subjects for whom all 3 culture swabs were negative did not differ significantly between the nonintervention (78.9%) and intervention arms (65.4%; Table 2). Of the 191 subjects completing the series in the intervention arm, 66 had at least one positive culture. Of those, 60 were positive on the first swab, 63 were positive by the second swab, and all 66 positive on the third. The cumulative sensitivity of the series was thus 90.9% (60/66) based on the first culture, 95.5% (63/66) by the second culture, and 100% (66/66) by the third culture (data not shown).

For the primary outcome of discontinuation of CPs in the absence of anti-MRSA antibiotics, based on culture results, subjects in the intervention arm had CPs discontinued 4.1 times more frequently (95% CI, 2.3–7.1) as those in the nonintervention arm. In the intent-to-screen analysis, which included all randomized subjects (n = 607), there remained significantly more subjects in the intervention than the nonintervention arm who completed screening and had discontinuation of CPs (Table 2).

Concurrent Antistaphylococcal Antibiotic Use by Trial Arm

Roughly half of subjects in the nonintervention arm who had a first swab obtained were off antistaphylococcal antibiotics within the window of screening (32/62 [51.6%]; 95% CI, 38.6%–64.5%). Similarly, almost half of subjects in the intervention arm who had a first swab obtained were off antibiotics within the window of screening (127/259 [49.0%]; 95% CI, 42.8%-55.3%; data not shown).

Performance Characteristics of Single PCR Versus 3 Culture Assays

In the 191 subjects in the intervention arm who completed the series, the sensitivity of the first PCR compared to the set of 3 cultures was 93.9% (95% CI, 85.4%–97.6%), and specificity was 92.0% (95% CI, 85.9%–95.6%). With a prevalence of persistent MRSA of 44.4%, the PPV of the first PCR compared to 3 cultures was 86.1% (95% CI, 75.9%–93.1%), and the NPV was 96.6% (95% CI, 91.6%–99.1%). Subgroup analyses, performed for subjects with all swabs obtained "off antibiotics" (as defined in the Supplementary Appendix), produced similar point-estimates with wider CIs (Table 3).
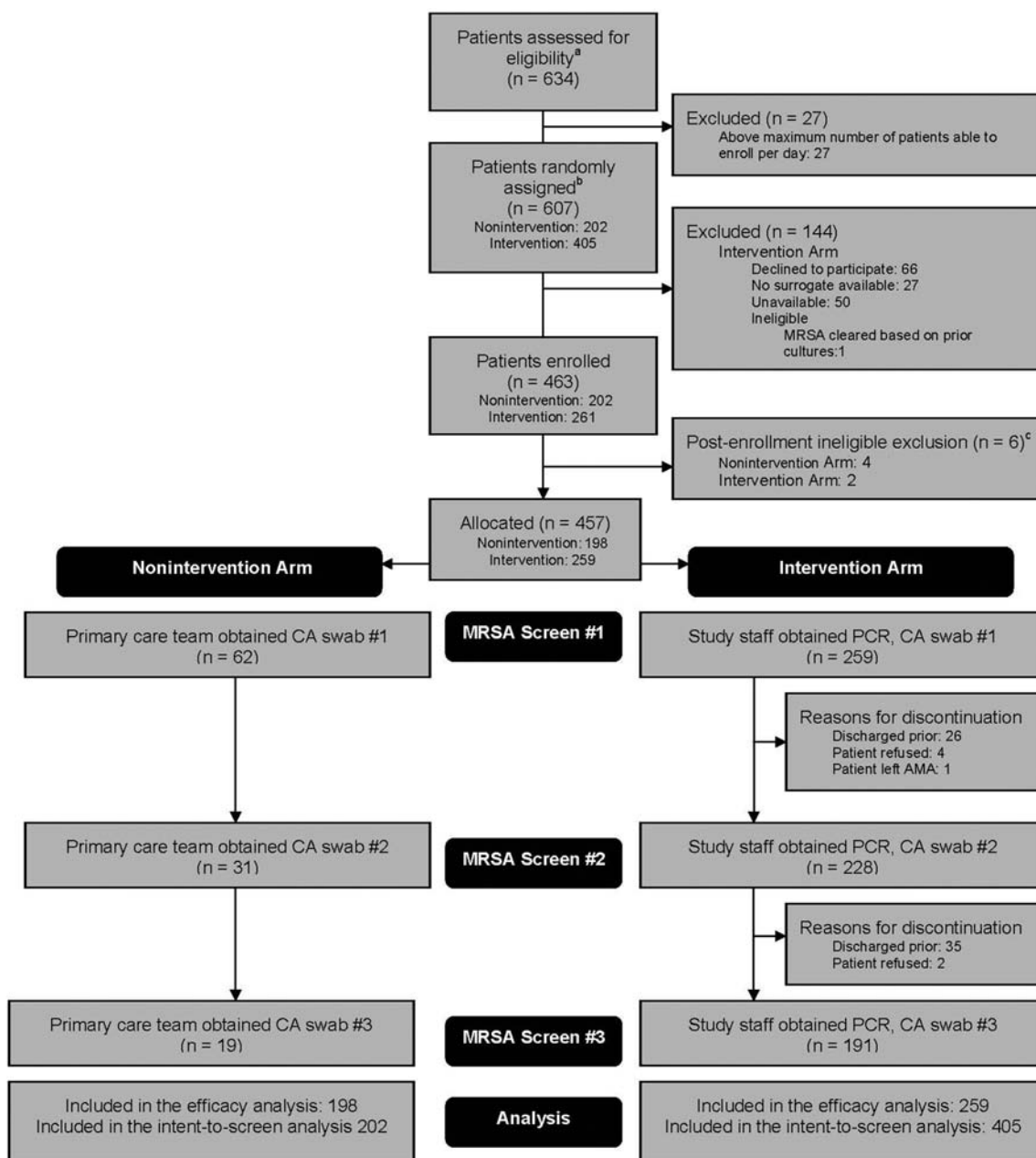
Figure 1. Patient flow diagram. [a]Only patients with a history of methicillin-resistant *Staphylococcus aureus* (MRSA) >90 days at time of admission were assessed for eligibility. [b]Subjects were assigned to the nonintervention arm and intervention arm in a sequential 1:2 fashion in the order of admission, which was assumed to be random. [c]Of 202 subjects randomized to the nonintervention arm, 4 were excluded because they were found to be ineligible after enrollment (admission cancelled [n = 2]; found to be MRSA negative based on prior cultures [n = 1]; or determined to have methicillin-susceptible *S. aureus*, not MRSA [n = 1]). Of 261 randomized to the intervention arm, 2 were excluded because they were found to be ineligible after enrollment (prior enrollment [n = 1]; or found to be MRSA negative based on prior cultures [n = 1]). Abbreviations: CA, chromogenic agar (culture); MRSA, methicillin-resistant *Staphylococcus aureus*; PCR, polymerase chain reaction.

Clearance by 3 negative cultures or by first negative PCR increased with time since the most recent culture. Comparing subjects by time since most recent MRSA culture (<1 year, 1 to <2 years, and ≤2 years) in the nonintervention arm, there were

8, 3, and 8 subjects in each time frame, of whom 5 of 8 (62.5%), 2 of 3 (66.7%), and 8 of 8 (100%) cleared by sequential cultures at the respective time intervals. Among subjects in the intervention arm, there were 84, 51, and 56 subjects in each time frame,

Table 1. Baseline Demographics and Clinical Characteristics of Subjects

Characteristic	Nonintervention Arm (n = 198)	Intervention Arm (n = 259)
Age, y[a]	63.1 ± 18.3	63.8 ± 16.8
Female sex	84 (42.4)	91 (35.1)
Race[b]		
White	174 (87.9)	229 (88.4)
Black	13 (6.6)	14 (5.4)
Hispanic/Latino	8 (4.0)	9 (3.5)
Asian	. . .	4 (1.5)
Other	. . .	2 (0.8)
Not identified	3 (1.5)	1 (0.4)
Admission source		
Walk-in	51 (25.8)	65 (25.1)
Physician/self-referral	50 (25.3)	84 (32.4)
Emergency Medical Services transport decision	64 (32.3)	76 (29.3)
Transfer from acute care hospital	24 (12.1)	21 (8.1)
Transfer from rehabilitation hospital	5 (2.5)	6 (2.3)
Transfer from skilled nursing facility	3 (1.5)	4 (1.5)
Transfer from intermediate care facility	. . .	1 (0.4)
Clinic/health center referral	1 (0.5)	2 (0.8)
Admitting site		
Emergency department	135 (68.2)	167 (64.5)
Scheduled admission	61 (30.8)	85 (32.8)
Surgical day care unit	2 (1.0)	7 (2.7)
Admitting service		
Medicine	135 (68.2)	169 (65.3)
Surgery	57 (28.8)	85 (32.8)
Emergency department[c]	6 (3.0)	5 (1.9)
Length of hospital stay, d		
Mean length of stay (25th, 50th, 75th percentiles)	8 ± 10 (2, 5, 9)	7 ± 7 (3, 5, 8)
No. hospitalizations at MGH in prior mo[d]		
Inpatient, median (0; ≥1)	0 (183; 15)	0 (238; 21)
Emergency department, median (0; ≥1)	0 (176; 22)	0 (240; 19)
No. hospitalizations at MGH in prior y[d]		
Inpatient, median (0; ≥1)	1 (91; 107)	1 (121; 138)
Emergency department, median (0; ≥1)	0 (137; 61)	0 (187; 72)
MRSA history		
Mean time since last positive MRSA culture, d[a]	749 ± 737	726 ± 772
Mean time since original MRSA documentation, d[a]	1078 ± 737	1085 ± 772

Data are No. (%) unless otherwise specified.

Abbreviations: MGH, Massachusetts General Hospital; MRSA, methicillin-resistant *Staphylococcus aureus*.

[a] Values are means ± SD.

[b] Race was self-reported.

[c] These subjects were initially admitted to the emergency department observation unit but subsequently admitted to the inpatient service.

[d] Median and counts for specified ranges of hospitalizations provided. *P* values calculated using Fisher exact test for proportions.

of whom clearance by culture was 46 of 84 (54.8%), 36 of 51 (70.6%), and 43 of 56 (76.8%), and 44 of 84 (52.4%), 34 of 51 (66.7%), and 41 of 56 (73.2%) by single PCR, respectively (data not shown).

Sensitivity Analysis of PCR NPV Examined at Alternative Rates of MRSA Persistence

The NPV was ≥90% at persistent MRSA prevalences of <70% in both the overall analysis and in the subgroup analyses in the absence of antistaphylococcal antibiotics (Figure 2).

Estimated Effect on Unnecessary CP Days Avoided

The 457 subjects accounted for 3339 patient-days in the course of the study. Passive culture screening, active culture screening, and active PCR screening (with respective discontinuation rates of 6.6%, 26.6%, and 63.8%) would have resulted in 104, 418, and 1841 fewer CP patient-days, respectively. The latter strategy represents a 55% reduction in patient-days on CPs. These reductions in CP days resulted in estimated annualized savings of $86 950, $349 472, and $1 539 180 for each respective strategy (Supplementary Appendix).

DISCUSSION

We found, through a randomized trial design, that active screening is superior to passive screening for discontinuation of MRSA CPs. Under the current local standard of care, in the absence of active, targeted screening, few eligible individuals who have cleared MRSA will ever be identified.

That subjects in the nonintervention arm were substantially less likely to have initial screening specimens obtained (31% vs 100%) is likely due to several factors. First, determination of eligibility requires review of historical microbiological data, a process that may deter providers from screening. Increasingly shorter lengths of stay likely serve as a barrier to either initiating or completing the series of 3 swabs, which from start to finalization of cultures is at least a 5-day process. Whereas antibiotic administration did not appear to influence the initiation of the series, the possibility of potential wasted efforts—due either to expedient discharges or antibiotic initiation—may discourage providers from completing the process.

Table 2. Implementation of Screening Protocol and Discontinuation of Contact Precautions

	Efficacy Analysis			Intent-to-Screen Analysis		
Protocol Implementation	Nonintervention, No. (%)	Intervention, No. (%)	Rate Ratio (95% CI)	Nonintervention, No. (%)	Intervention, No. (%)	Rate Ratio (95% CI)
Screen initiated	62/198 (31.3%)	259/259 (100%)	3.2 (2.6–3.9)	62/202 (30.1%)	259/405 (64.0%)	2.1 (1.7–2.6)
Three swabs obtained	19/198 (9.6%)	191/259 (73.7%)	7.7 (5.0–11.9)	19/202 (9.4%)	191/405 (47.2%)	5.0 (3.2–7.8)
All negative, given 3 swabs obtained	15/19 (78.9%)	125/191 (65.4%)	0.8 (.6–1.1)	15/19 (78.9%)	125/191 (65.4%)	0.8 (.6–1.1)
Removed from CPs, given negative screen completed[a]	13/15 (86.7%)	69/125 (55.2%)	0.6 (.5–.8)	13/15 (86.7%)	69/125 (55.2%)	0.6 (.5–.8)
Removed from CPs, given allocation/randomization.[a]	13/198 (6.6%)	69/259 (26.6%)	4.1 (2.3–7.1)	13/202 (6.4%)	69/405 (17.0%)	2.6 (1.5–4.7)

Abbreviations: CI, confidence interval; CPs, contact precautions.

[a] Only subjects in whom all 3 cultures were negative were referred to Infection Control Unit for review of record and discontinuation of CPs if criteria were met. The only disqualifying criterion at this level of review for subjects in the intervention arm was whether the samples had been obtained within 48 hours of concurrent exposure to antibiotics with activity against methicillin-resistant *Staphylococcus aureus*. Because intervention arm subjects were screened regardless of concurrent antibiotic exposure, a smaller proportion of those who screened negative were able to be removed from CPs, compared to the nonintervention arm. See Supplementary Appendix for detailed discussion of restricted antimicrobials.

The trend toward a higher proportion of negative swabs in the nonintervention arm could reflect differences in specimen collection practices or the policy guidance to providers to discontinue the series if either the first or second swab returned positive results or if antibiotics had been administered. The reported rate of discontinuation of CPs in the nonintervention arm may underestimate the impact of active screening. For 6 subjects in the nonintervention arm who were not referred to the Infection Control Unit, study staff alerted Infection Control. These subjects were included among those who had CPs discontinued.

In both the nonintervention and intervention arms, a substantial proportion of subjects received at least one antibiotic with activity against MRSA during their entire admission (67.2% and 64.9%, respectively). This observation is in keeping with reports in the literature documenting widespread use of antibiotics among hospitalized patients [12]. Sensitivity, specificity, and NPVs of single PCR were statistically similar in the subset of subjects in whom no documented antibiotics were used in the 48 hours prior to sampling.

Intravenous vancomycin was the most commonly used antimicrobial with activity against MRSA and was administered to 44.4% of subjects in the nonintervention arm and 37.5% of subjects in the intervention arm. Although there is evidence in the literature to support no effect of intravenous vancomycin on MRSA nasal carriage [7, 13], many Infection Control policies consider specimens obtained in the presence of such antibiotics invalid for the purposes of discontinuation of CPs. The data

Table 3. First Polymerase Chain Reaction Test Performance Compared to 3 Sequential Chromogenic Agar Cultures in Intervention Arm Population

Study Population	Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)
All subjects, series of 3 swabs completed (n = 191)	93.9 (85.4–97.6)	92.0 (85.9–95.6)	86.1 (75.9–93.1)	96.6 (91.6–99.1)
All subjects, series of 3 swabs completed, no antibiotics prior 48 h (n = 128)—antibiotic list A[a]	96.9 (89.3–99.1)	92.2 (83.0–96.6)	92.5 (83.4–97.5	96.7 (88.7–99.6)
All subjects, series of 3 swabs completed, no antibiotics prior 48 h (n = 111)—antibiotic list B[b]	96.9 (89.3–99.1)	89.4 (77.4–95.4)	92.5 (83.4–97.5)	95.5 (84.5–99.4)

Among the 191 subjects who completed all 3 swabs in the intervention arm, 3 received mupirocin at some point during their encounter. The first subject received mupirocin within the 48 hours prior to the second swab. The second and third subjects did not receive mupirocin during the swabbing window (see Supplementary Appendix for details).

Abbreviations: CI, confidence interval; NPV, negative predictive value; PPV, positive predictive value.

[a] List A: Includes subjects without concurrent exposure to any of the following: trimethoprim/sulfamethoxazole, intravenous, suspension; mupirocin topical; clindamycin oral, intravenous, suspension; daptomycin; doxycycline oral and intravenous; linezolid oral and intravenous; nitrofurantoin oral and suspension; rifampin oral and intravenous; quinupristin/dalfopristin; tetracycline oral; tigecycline; vancomycin intravenous.

[b] List B: Includes subjects without exposure to ciprofloxacin or levofloxacin in addition to any of the antibiotics from List A.
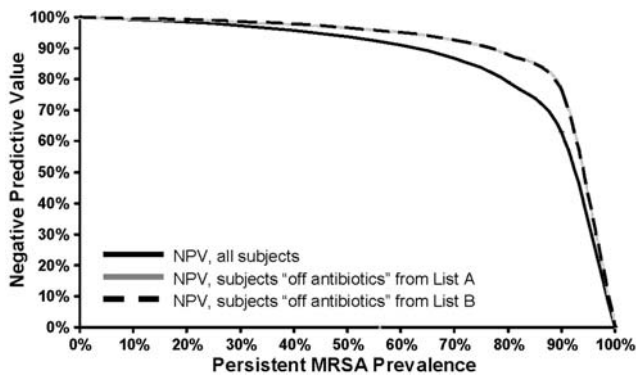
Figure 2. Negative predictive value of a first polymerase chain reaction result across a range of methicillin-resistant *Staphylococcus aureus* prevalence. Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; NPV, negative predictive value.

presented here suggest that in programs using PCR for detection of persistent colonization, such restrictions may not be necessary.

We found that a single PCR assay has high sensitivity (93.9%) and specificity (92.0%) compared to 3 cultures. We found a higher PPV (86.1%) than others have documented, although it should be noted that these other studies were conducted in lower-prevalence settings [14, 15]. We also demonstrated a very high NPV (96.6%). Our sensitivity analyses demonstrate excellent NPVs (>90%) over a wide range of MRSA prevalences. Thus, discontinuation of CPs based on a single negative PCR may offer a reasonable and streamlined strategy to address the growing pool of those designated as MRSA-colonized, although acceptance of such an approach is likely to depend upon institutional and patient-mix characteristics.

A single PCR test performed at (or before) hospital admission could result in an increase in CP discontinuation not only because of a reduction in the number of samples needed, but also given the lower likelihood of concurrent antibiotics in this population. Our findings with regard to averted CP days and their associated costs illustrates that the most substantial impact is appreciated when active screening using single PCR is implemented.

Although more expensive than culture assays on a per-test basis, PCR screening offers the advantage of high sensitivity and rapid turn-around time [16, 17]. There are substantial costs to patients and the healthcare system attributable to the lack of an efficient means to document clearance of MRSA colonization and discontinuation of CPs. Given the widespread practice of cohorting patients who have known past histories of infection or colonization [18], or active infection with MRSA, cohorted patients with discordant colonization are at risk of

reacquisition of MRSA and the associated costs [19–22]. Decreased satisfaction with care, fewer provider-patient interactions, increased reported symptoms of depression, and delays in care have been documented for patients on CPs [23–25]. Patients with a history of MRSA may also experience delays in time-to-bed-assignment [26] and may block neighboring beds in institutions with semi-private accommodations, limiting capacity. In the absence of a consensus as to when and under what testing circumstances CP can be safely discontinued, the pool of patients identified as MRSA colonized will continue to grow, with attendant adverse effects on patients and resource utilization.

The costs to patients and providers must be considered in the context of the costs of proposed screening strategies. Any active screening approach would incur costs of various types: personnel to implement screening, process assays, and manage patient results; capital investment in commercial PCR technology if active surveillance with PCR is acceptable; and laboratory costs of reagent expenses. The Manufacturers' Suggested Retail Price (MSRP) of the culture plates is $6, of which 3 would be needed for the series, for a total of $18. The MSRP for the GeneXpert MRSA kit is $42, a >2-fold difference. The use of electronic alerts to identify eligible patients rapidly at the point of care and decision support to assist providers in implementation of such programs might increase the yield, as well as programmatic costs. These costs would need to be weighed against the potential benefits including a reduction in CP days, expanded hospital capacity, decreases in MRSA transmission, and improvements in patient satisfaction. The net result of this analysis is likely to depend on institutional characteristics including MRSA prevalence and capacity constraints.

This trial was conducted at a single academic center and in the absence of any national guidelines on protocols for discontinuation of CP, we implemented the local standard of care, the components of which are found in varying combinations nationally [18]. Nevertheless the demonstrated test performance characteristics, and specifically the high NPV over a wide range of persistent MRSA prevalences, illustrate the generalizability of the findings. We sampled the bilateral nares of subjects in the study. Many patients with nasal colonization with MRSA are also colonized at extranasal body site(s) [27], and extranasal colonization in the absence of nasal colonization has been observed. Single PCR on nasal specimens has been shown to provide similar NPV as when the assay is performed on specimens from additional body sites [28, 29], and, from an operational perspective, a simplified protocol requiring a single nasal swab compared to multiple sites is more efficiently implemented. Finally, we assessed the performance of PCR to an imperfect gold standard—serial culture specimens—which, although commonly used in infection control programs, is not 100% sensitive in detecting MRSA. Thus, our results must be weighed in this context.

In conclusion, active, targeted screening of individuals with a history of MRSA resulted in a significantly higher rate of discontinuation of CPs than the current local standard of clinician-initiated screening. The single PCR offers substantial clinical and operational advantages. These benefits include rapid determination of precaution status, which has the potential to inform clinical care decisions and alleviate capacity constraints.

Supplementary Data

Supplementary materials are available at *Clinical Infectious Diseases* online (http://cid.oxfordjournals.org). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

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