Use of Rapid Screening Tests in Processing Urine Specimens by Conventional Culture and the AutoMicrobic System

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Two rapid urine screening tests, the Chemstrip LN (BioDynamics, Indianapolis, Ind.) and the Bac-T-Screen urine screening device (Marion Laboratories, Inc., Kansas City, Mo.), were evaluated as techniques to predict bacteriuria as quantitated by either conventional culture or the AutoMicrobic system (Vitek Systems, Inc., Hazelwood, Mo.). A total of 666 urine specimens were analyzed by both screening tests as well as the AutoMicrobic system and quantitative culture. The sensitivities of both Chemstrip LN and Bac-T-Screen for the detection of low levels of bacteriuria (≥10^2 CFU/ml) were comparable (73.3 and 74.4%, respectively) and were too low to recommend their use as a primary urine screen. Their excellent predictive value of a negative result at the 10^2 CFU/ml level (96 and 97.5%, respectively) makes them potentially useful in predicting urine specimens with <10^2 CFU/ml. The use of either of these tests in combination with the AutoMicrobic system markedly decreased the time required to classify urine specimens. Their low cost relative to the AutoMicrobic system urine card makes the use of either test cost effective as a screen for the AutoMicrobic system.

A great deal of effort has been spent in the last several years in attempts to develop rapid, efficient methods of screening the large numbers of urine specimens submitted to the clinical microbiology laboratory. These screening tests include microscopic (9, 17), chemical (2, 4, 17, 22), and automated methods (2, 6, 8, 10–15, 18). The purpose of rapid screening of urine specimens is threefold. First, rapid screening may provide information to the clinician in a more timely manner, resulting in appropriate antibiotic therapy or other therapeutic actions. Second, a truly rapid screening technique may encourage clinicians to screen more of the population, including asymptomatic persons (3). This may result in improved care of patients, such as the elderly, who may be at risk for asymptomatic bacteriuria (3, 7, 23). Third, rapid screening methods may assist the laboratory in developing a more efficient, cost-effective approach to the processing of urine specimens. This may include the elimination of those specimens that are negative by the screening test or processing them by an alternative, cost-effective manner.

With the recent proliferation of rapid urine screening tests there are several that may be useful in the clinical microbiology laboratory. Two of the most promising are the Bac-T-Screen (BTS; Marion Laboratories, Inc., Kansas City, Mo.), a filtration-staining device for bacterial detection (6, 14, 15), and the Chemstrip LN (BioDynamics, Indianapolis, Ind.) for the detection of leukocytes and nitrite in urine (2, 4, 22). Both of these tests have been shown to reliably detect significant bacteriuria and to have an excellent predictive value of a negative result (PVN) in studies versus quantitative culture (2, 4, 6, 14, 15, 22). Because they are both independent of bacterial growth they are very rapid, providing results in 2 to 3 min.

There are many studies describing the use of these two tests as primary urine screens (4, 6, 14, 15, 22); however, several issues remain which should be investigated further concerning their role in the clinical laboratory. One of the more important issues is the ability of these (and other) screening tests to detect low-level bacteriuria (10^2 to <10^5 CFU/ml). Although several studies have documented the ability of both the Chemstrip LN and the BTS to detect bacteriuria at ≥10^3 CFU/ml (4, 6, 14, 15, 22), relatively few have compared their ability to detect lower levels of bacteriuria (2, 6, 14). Another interesting issue is the utility of performing these rapid urine screens in tandem with a highly automated urine processing instrument such as the AutoMicrobic system (AMS; Vitek Systems, Inc., Hazelwood, Mo.). Despite the fact that previous investigators have suggested that the performance of a screening test before processing urine specimens on the AMS would result in a much more cost-effective approach to automated urine culture and identification (8, 21), there are very few published studies evaluating the role of the newer urine screening tests, such as the Chemstrip LN and the BTS, in conjunction with the AMS (2).

Because we utilize both quantitative culture and the AMS for processing urine specimens in our laboratory, we were interested in investigating the two issues described above. Thus, we compared the relative abilities of the Chemstrip LN and the BTS to detect bacteriuria at levels of ≥10^3, ≥10^4, and ≥10^5 CFU/ml as determined by quantitative culture; in addition, we evaluated the role of each test in predicting bacteriuria at the breakpoint of ≥10^5 CFU/ml determined by the AMS. We also examined the effect of performing each of these screening tests in tandem with the AMS on the time and cost of processing urine specimens in our laboratory.

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MATERIALS AND METHODS

Urine specimens. A total of 666 urine specimens were processed simultaneously by Chemstrip LN, BTS, AMS, and quantitative culture during the study. Specimens were obtained from both inpatients and outpatients at the University of Iowa Hospitals and Clinics. All patients were suspected by their attending physician of having a urinary tract

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infection. All specimens included in the study were clean-
catch, midstream specimens and were collected in sterile
containers without preservatives. Specimens were trans-
ported immediately to the laboratory or were stored at 4°C
until the time of transport. Upon arrival in the laboratory,
specimens were processed immediately or stored at 4°C until
processed. All specimens were completely processed within
2 h of receipt.

Quantitative culture. A 0.001-ml calibrated bacteriological
loop was used to inoculate the urine specimens onto tryptic
soy agar with 5% defibrinated sheep blood and eosin-meth-
ylene blue agar plates. Colony counts were determined after
incubation at 35°C for 24 h, and bacterial and fungal isolates
were identified by conventional procedures. Growth was
recorded as \(10^0\) to \(<10^4\), \(10^4\) to \(<10^9\), or \(\geq 10^5\) CFU of one or
two potential pathogens per ml. Levels of bacteriuria of
\(<10^5\) CFU/ml were below the limits of detection of this
technique, and such specimens were recorded as no growth.
Urine specimens containing \(10^1\) or \(<10^5\) CFU of nonpatho-
gens (lactobacilli, diphtheroids, \textit{Staphylococcus epiderm-
idis}, \textit{Streptococcus} spp. not group D) per ml or multiple
(three or more) gram-negative organisms were recorded as
such and were considered contaminated.

AMS. The procedure for processing urine specimens by
the AMS was the routine procedure used daily in our
laboratory and in accordance with the manufacturer’s in-
struction. The instrumentation, urine identification cards,
and performance characteristics have been described in
detail elsewhere (10, 11). Quantitative results for each urine
specimen were reported by the AMS as \(\geq 10^5\) CFU/ml, \(<10^5\)
CFU/ml, or no growth. In addition, the identification and
time to final report were also recorded.

Urine screening with the Chemstrip LN. The Chemstrip LN
test strips were used according to the manufacturer’s instruc-
tions. In screening urine specimens with the LN strip a
reaction of trace or greater for either the leukocyte esterase
or nitrite or both was considered positive. The tests were
read at 60 and 120 s for leukocyte esterase and at 30 s for
nitrite. As recommended by the manufacturer, all previously
refrigerated specimens were allowed to come to room tem-
perature (at least 25°C) before testing. Specimens that pro-
duced staining of the test strips due to urinary pigments were
excluded.

Urine screening with the BTS. All specimens were screened
by the BTS as described previously (6, 14, 15) and in
accordance with the manufacturer’s instructions. The filters
were read immediately after staining. A staining intensity of
1+ or greater was considered positive. Specimens that
clogged the filter or produced staining due to urinary pig-
ments were excluded from analysis.

Time and cost analysis. At the conclusion of this study the
data were evaluated to determine the potential effect of the
rapid screening tests on the time and cost of processing urine
specimens on the AMS. To accomplish this we examined the
experimental data according to three different urine-process-
ing protocols. The first protocol was simply the processing
of all urine specimens by the AMS alone. The second and
third protocols required that all urine specimens first be
screened by either the Chemstrip LN (LN-AMS protocol) or
the BTS (BTS-AMS protocol) and that only those with a
positive screening test be processed on the AMS. Specimens
with negative screening tests were considered presumptively
negative (\(<10^5\) CFU/ml) for significant bacteriuria. Using the
data available on the AMS printout, we calculated the
average time required to classify the urine specimens as
containing \(\geq 10^5\) or \(<10^5\) CFU/ml for each protocol. In the

\[\text{LN-AMS and BTS-AMS protocols a value of 2 min was} \]
\[\text{assigned to each specimen with a negative screening test.} \]
\[\text{The cost of materials required for each urine processing} \]
\[\text{protocol was determined by using the actual cost of reagent} \]
\[\text{purchase for our laboratory. The cost of instruments was not} \]
\[\text{included in this analysis.} \]

\textbf{RESULTS}

Of the 666 specimens processed during the study, 90
(13.5%) could not be analyzed due to interfering pigments in
70 specimens (57 BTS only, 11 BTS and Chemstrip LN, 2
Chemstrip LN only) and clogging of the filter in 20 speci-
mens (all BTS). This is similar to the rate of pigmentation
and clogging reported in previous studies with the BTS (6,
14, 15). The remaining 576 specimens were processed by the
Chemstrip LN, BTS, quantitative culture, and the AMS as
described above.

Comparison of screening tests with quantitative culture. A
total of 135 specimens (23.4%) contained \(\geq 10^5\) CFU/ml, 209
(36.3%) contained \(<10^5\) CFU/ml, and 232 (40.3%) had no
growth as determined by quantitative culture (the limit of
detection with a 0.001-ml loop is \(\geq 10^5\) CFU/ml). There were
172 specimens containing \(\geq 10^5\) CFU of one or two potential
pathogens per ml, including 36 with \(10^5\) to \(<10^4\) CFU/ml, 22
with \(10^4\) to \(10^3\) CFU/ml, and 114 with \(\geq 10^4\) CFU/ml.

The results of screening the urine specimens with the
Chemstrip LN and the BTS tests are summarized in Table 1.
The Chemstrip LN correctly detected 126 (73.3%) of 172
specimens with \(\geq 10^5\) CFU/ml, 107 (78.7%) of 136 specimens
with \(<10^5\) CFU/ml, and 101 (88.6%) of 114 specimens with
\(\geq 10^4\) CFU/ml of one or two potential pathogens, whereas
the BTS detected 128 (74.4%), 119 (87.5%), and 105 (92.1%),
respectively (\(P > 0.05\) for the comparison of Chemstrip LN
versus BTS at each breakpoint). The BTS correctly classi-
fied as negative significantly more of the specimens with
insignificant bacteriuria (specimens containing fewer CFU
per milliliter than the respective breakpoint value or contam-
inated specimens) at each of the following breakpoints: \(10^5\)
CFU/ml (316 of 404, 78.2%), \(10^4\) CFU/ml (343 of 440, 78%),
and \(10^3\) CFU/ml (351 of 462, 76%). By comparison, the

\begin{table}[h]
\centering
\caption{Screening of 576 urine specimens with Chemstrip LN and BTS}
\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{Quantitative culture results} & 
\textbf{Organisms} & \textbf{No. with LN/BTS results:} & \\
\hline
\textbf{CFU/ml} & & & \\
\hline
\(\geq 10^5\) & 1 or 2 potential pathogens & 97 & 4 & 8 & 5 \\
\(10^4\) to \(<10^5\) & 1 or 2 potential pathogens & 5 & 1 & 9 & 7 \\
\(10^3\) to \(<10^4\) & 1 or 2 potential pathogens & 9 & 10 & 17 \\
\(\geq 10^4\) & Multiple organisms or nonpathogens & 9 & 1 & 4 & 7 \\
\(<10^3\) & Multiple organisms or nonpathogens & 31 & 26 & 10 & 84 \\
\hline
\textbf{No growth} & & 18 & 44 & 16 & 154 \\
\hline
\end{tabular}
\end{table}

* LN results were considered positive when either leukocyte esterase or
nitrite or both were positive (trace or greater reactivity). BTS results were
considered positive when staining was 1+ or greater.
TABLE 2. Summary of the detection of potential pathogens by Chemstrip LN and BTS

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. of isolates</th>
<th>No. detected by:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10^4</td>
<td>10^5</td>
<td></td>
<td></td>
<td>10^4</td>
<td>10^5</td>
</tr>
<tr>
<td>Gram negative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>62</td>
<td>54</td>
<td>49</td>
<td>48</td>
<td>56</td>
<td>52</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>14</td>
<td>12</td>
<td>13</td>
<td>12</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Proteus spp.</td>
<td>11</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Gram positive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Enterococci</td>
<td>18</td>
<td>15</td>
<td>11</td>
<td>10</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Candida spp.</td>
<td>10</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>

* A total of 148 cultures (≥10^4 CFU/ml) were isolated in 136 urine specimens.
* A total of 126 cultures (≥10^5 CFU/ml) were isolated in 114 urine specimens.

Chemstrip LN correctly classified 275 of 404 (68.5%), 292 of 440 (66.4%), and 308 of 462 (66.7%) specimens as negative at the respective breakpoints (P < 0.005 for the comparison of Chemstrip LN versus BTS at each breakpoint).

A tabulation of the gram-negative and gram-positive pathogens present at ≥10^4 and ≥10^5 CFU/ml is presented in Table 2. Both screening procedures were slightly, but not significantly, more sensitive in detecting gram-negative versus gram-positive pathogens. Of the 112 gram-negative pathogens present at ≥10^4 CFU/ml, 84.8% were detected by the Chemstrip LN and 91.1% were detected by the BTS (P > 0.05). In contrast, 69.4% of the 36 gram-positive organisms were detected by the Chemstrip LN, and 83.3% were detected by the BTS (P > 0.05). Both systems failed to detect several gram-negative pathogens including Escherichia coli, Proteus spp., and Pseudomonas aeruginosa. The Chemstrip LN, in particular, had difficulty in detecting those specimens with ≥10^5 CFU of enterococci per ml. It is worth noting that the nitrate test is expected to be negative for enterococci and to some extent may explain the decreased sensitivity with specimens containing these organisms.

Table 3 is a comparative analysis of the Chemstrip LN and BTS test results obtained in this study for all urine specimens using breakpoints of ≥10^3, ≥10^4, and ≥10^5 CFU of one or two potential pathogens per ml. The predictive value of a positive result (PVP) was quite low for both BTS and Chemstrip LN at all three breakpoints. The PVP for BTS was significantly greater than that of the Chemstrip at ≥10^3 CFU/ml (59.3 and 49.4%, respectively; P > 0.05) and slightly, but not significantly, greater at ≥10^4 CFU/ml (55.1 and 42%, respectively; P > 0.1) and ≥10^5 CFU/ml (48.6 and 39.6%, respectively; P > 0.05). The PVP was excellent for both Chemstrip LN and BTS at ≥10^3 CFU/ml (96 and 97.5%, respectively; P > 0.1). The BTS also had a slightly higher PVP than did the Chemstrip LN at both the 10^4 CFU/ml (95.3 and 91%, respectively; P < 0.05) and the 10^5 CFU/ml (87.8 and 85.7%, respectively; P > 0.1) breakpoints.

Comparison of screening tests with the AMS. The 576 urine specimens processed by all methods were categorized by the AMS as follows: 128 specimens (22.2%) contained ≥10^5 CFU/ml, including 108 with ≥10^5 CFU of one or two potential pathogens per ml, and 448 specimens (77.8%) contained <10^5 CFU/ml or no growth. The overall agreement between the AMS and quantitative culture in this study was 95% (data not shown), consistent with previously published values (10, 11).

The comparison of screening test results with the AMS quantitation is summarized in Table 4. The Chemstrip LN detected 105 (82%) of 128 specimens classified as containing ≥10^5 CFU of any organism per ml and 95 (88%) of 108 specimens with ≥10^5 CFU of one or two potential pathogens per ml, whereas the BTS detected 112 (87.5%, P > 0.1) and 99 (91.7%, P > 0.1), respectively. The results of the Chemstrip LN test were negative for 296 (66.1%) of 448 specimens containing <10^5 CFU/ml and for 306 (65.4%) of 468 specimens containing either ≥10^5 CFU of contaminants (multiple organisms or nonpathogens) per ml or <10^5 CFU of any organism per ml. By comparison the BTS test results were negative for 356 (79.5%, P < 0.005) and 362 (77.4%, P < 0.005) of the specimens in each group, respectively.

Table 5 is a comparative analysis of the ability of the two screening tests to predict the results of the AMS quantitation. As in the comparison with quantitative culture, both tests had excellent PVP and poor PVP values when compared with the AMS final reading of <10^3 or ≥10^5 CFU/ml.

The times required to classify urine specimens with the screening tests and the AMS final report are shown in Table 6. With the protocols described above, the average time to detection, quantitation, and identification for all 576 urine specimens was 11.1 h for the AMS alone, 4.5 h for the LN-AMS protocol, and 4.2 h for the BTS-AMS protocol.

Because the major expense in processing urine specimens on the AMS is the cost of materials (urine cards specifically), we estimated the impact of using these screening tests in conjunction with the AMS on the cost of supplies necessary to process the 576 urine specimens in this study. We calculated the savings in supplies that would be achieved if...
all urine specimens were processed according to either the LN-AMS or BTS-AMS protocols. Specimens in either protocol with a negative screening test would be processed by routine culture. If all 576 specimens included in this study were processed by the AMS the total cost for supplies (including a single back-up plate for susceptibility testing) would be $1,560.96, whereas if the specimens were processed by the LN-AMS protocol only 257 (45%) would be run on the AMS and the total cost for processing all 576 would be $878.57, a savings of $682.39 ($1.18 per specimen) (Table 7). Although the BTS-AMS protocol would result in even fewer specimens processed on the AMS, the overall savings in materials would be considerably less than that seen with the LN-AMS protocol ($332.04 versus $682.39) because of the greater cost of the BTS ($0.98 per test) versus the Chemstrip LN ($0.15 per test).

**DISCUSSION**

The number of CFU of bacteria per milliliter of urine that is considered clinically significant is controversial (1, 16, 19, 20). Currently accepted breakpoints for significant bacteriuria range from $10^5$ to $10^6$ CFU/ml depending upon the patient population studied (1, 16, 19, 20). Because colony counts of $<10^5$ CFU/ml may be significant in catheterized patients (16) and symptomatic women (19, 20), it is important to assess the ability of the newer urine screening tests, such as the Chemstrip LN and BTS, to detect levels of bacteriuria of $<10^5$ CFU/ml as well as $10^5$ CFU/ml. The purpose of the present investigation was not to evaluate which breakpoint was most predictive of infection in the population studied, but rather to compare the abilities of two urine screening tests to predict the results of two accepted methods of quantitating bacteriuria, conventional culture and the AMS.

The results of this study are consistent with previous work performed in our laboratories (15) and in others (2, 4, 6, 14, 22) comparing the Chemstrip LN and the BTS with quantitative culture. Both tests were rapid and simple to perform and interpret. The sensitivities of both the Chemstrip LN and the BTS for the detection of significant bacteriuria at breakpoints of $10^5$, $10^6$, and $10^5$ CFU/ml were comparable (73.3 versus 74.4%, 78.7 versus 87.5%, and 88.6 versus 92.1%, respectively; $P > 0.05$). The use of these tests in the clinical laboratory is limited by the fact that neither test has a sufficiently high sensitivity or PVN at low levels of bacteriuria ($10^5$ CFU/ml, Table 3) to be used as a urine screen in populations where low colony counts may be important (16, 19, 20). Because either of these screens would miss approximately 25% of specimens with $10^5$ CFU/ml (26.7% with Chemstrip LN and 25.6% with BTS) and from 7.9% (BTS) to 11.4% (Chemstrip LN) of those with $10^5$ CFU/ml we do not feel that they should be used as the only means of deciding whether a specimen should be cultured.

Nevertheless, we do feel that there may be a role for these screening tests in the clinical microbiology laboratory. Because of the excellent PVN of both tests at the traditional breakpoint of $10^5$ CFU/ml (96 and 97.5% for Chemstrip LN and BTS, respectively), we suggest that either test may be used to provide a reasonably accurate, rapid (within minutes), presumptive report that a specimen contains $<10^5$ CFU/ml. This type of information may be useful for clinical decision making, pending final culture results, in the ward or clinic situation (1, 2).

Likewise, certain urine processing decisions within the laboratory may be facilitated by using these screening tests (1, 2, 6, 15). Because these tests are so rapid and simple to perform they can potentially be used to great advantage in conjunction with an automated urine processing system such as the AMS.

The AMS has been shown to be an accurate, relatively rapid, cost-effective system for specimens with $10^5$ CFU/ml and provides detection, quantitation, and identification in 4 to 9 h in a high percentage of these specimens (8, 10, 11, 21). However, it is not cost effective for processing specimens with $<10^5$ CFU/ml (8, 21). Previous investigators have suggested that by screening urine specimens with a rapid screening test such as Gram stain (8) or the Autobac system (21) and processing positive specimens on the AMS and negative specimens by conventional culture one can take advantage of the rapid automation of the AMS and make it more cost effective to use on urine specimens. Recently, Bartlett and co-workers have reported a similar approach with the Chemstrip LN coupled with the AMS (2).

In the present study we have demonstrated that both the Chemstrip LN and BTS have a high PVN with the breakpoint of $10^5$ CFU/ml determined by the AMS (Table 5). In addition, we have shown that the use of either the Chemstrip LN or the BTS as a screening test could reduce the total number of specimens to be processed by the AMS by 55% (Chemstrip LN) to 65% (BTS). These findings are quite similar to the 65% decrease reported by Bartlett et al. with Chemstrip LN as a screen (2). As suggested above, those specimens with negative screening tests could then be reported as presumptively negative (or containing $<10^5$ CFU/ml) or processed by an alternative low-cost method (conventional culture) to ensure that nothing is missed (16,

**TABLE 6. Time required to classify urine specimens with screening techniques and the AMS final report**

<table>
<thead>
<tr>
<th>Method</th>
<th>No. of specimens</th>
<th>Time (h) to detection, quantitation, and identification</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMS only</td>
<td>576</td>
<td>2–13</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>LN-AMS</td>
<td>576</td>
<td>0.03–13</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>BTS-AMS</td>
<td>576</td>
<td>0.03–13</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 7. Cost analysis of urine screening techniques**

<table>
<thead>
<tr>
<th>Method</th>
<th>Total no. of specimens</th>
<th>No. (% processed on AMS</th>
<th>Cost of supplies*</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMS</td>
<td>576</td>
<td>576 (100)</td>
<td>$1,560.96</td>
<td></td>
</tr>
<tr>
<td>LN-AMS</td>
<td>576</td>
<td>257 (45)</td>
<td>$878.57</td>
<td>$682.39</td>
</tr>
<tr>
<td>BTS-AMS</td>
<td>576</td>
<td>204 (35)</td>
<td>$1,228.92</td>
<td>$332.04</td>
</tr>
</tbody>
</table>

* Cost per test: AMS, $2.41; LN, $0.51; BTS, $0.98; culture, $0.30.
19). By enriching the population of urine specimens processed on the AMS with those containing \( \geq 10^5 \) CFU/ml, we were able to decrease the time and cost of processing urine specimens in our laboratory (Tables 6 and 7). Our calculated savings in materials with the LN-AMS protocol \($1.18 per specimen\) was similar to that reported by Bartlett et al. \($1.73 per specimen\) (2).

In conclusion, we have shown that the Chemstrip LN and BTS have comparable sensitivities and predictive values at low levels of bacteriuria \( \geq 10^5 \) CFU/ml as well as at the traditional breakpoint of \( \geq 10^4 \) CFU/ml. Although we feel that the rather low sensitivity of both tests somewhat limits their usefulness in the clinical laboratory, we have demonstrated their potential application in combination with the AMS. The low cost of the Chemstrip LN \($0.15 per test\) and its simplicity make it most attractive for use in our urine-processing system. However, we feel that either screening procedure could be utilized in decreasing the overall time and cost of processing urine specimens on the AMS.

LITERATURE CITED