Retrospective chart review was conducted on 3,319 medical records of patients admitted in the year 1985. The overall nosocomial infection rate is 11 infections per 100 admissions. The great majority causative pathogens were *Pseudomonas* species and most common site of infection was urinary tract which accounted for 30.7 per cent of the total infections. Infection was most prevalent in surgical service and in intensive care units.

**INTRODUCTION**

There is an increasing awareness of the importance of the suffering and financial cost created by nosocomial infections. The contributory factors include the increasing numbers of highly susceptible patients in hospital, the increasing numbers of invasive procedures and antibiotic-resistant microorganisms.

Since it has been shown that effective surveillance and control programs can actually reduce the incidence of nosocomial infection, an infection control committee was set up at Songklanagarind Hospital in July 1986. To perform the tasks effectively in terms of cost benefit ratio, it is vital to identify the...
magnitude and priority of nosocomial infection problems, especially regarding to what organ sites, pathogens or wards that nosocomial infections prevail.

Retrospective chart review was the method used by SENIC Project for measuring the nosocomial infection rate. The method was that the medical records were reviewed by nonphysicians following a standardized procedure. By modifying some aspect, we applied this method to obtain the infection rate and present here an analysis of the magnitude and pattern of nosocomial infection in Songklanagarind Hospital which is a teaching hospital of 556 beds and has about 12,000 admissions per year.

MATERIALS AND METHODS

Sample charts of 3,320 patients admissions were drawn from total 12,489 admissions in year 1985. The sampling technic used was stratified systemic sampling. Samples were stratified by services into 8 strata which were surgery, orthopedics, obstetrics and gynecology, ophthalmology, ENT, pediatrics, and medicine. The samples were allocated into each stratum by mean of proportional allocation. The last two digits of the hospital number were selected as the system to select the samples. The selected medical records from all admissions were reviewed by fifth year and sixth year medical students trained to perform a standardized retrospective chart review. By recording on preprinted data collection forms (Appendix A) the demographic and clinical data relevant to nosocomial infections and applying algorithmic criteria (Appendix B), they rendered diagnosis of infections. All of the data collection forms that were diagnosed nosocomial infection by the medical students together with the medical records were to be examined by one of the investigators. We restricted our review to four major sites. Urinary tract infection, lower respiratory tract infection and surgical wound infection were further divided into two subcategories which were asymptomatic urinary tract infection and symptomatic urinary tract infection, pneumonia and tracheobronchitis, deep and incisional surgical wound infection. Only one chart was excluded from the study because one half of the chart had been lost. In patients who were undercared of many services, infections which could not be indicated the service that responsible for them, we allocated these infections to the service that admitted the patients into the hospital.

We presented the infection rates in terms of infections per 100 admissions and infection per patient-day. Infection per 100 admissions were derived from dividing the number of infections by the number of admissions into that service or ward, time 100. Infection per patient-day (incidence densities) were obtained by dividing the number of infection by total length of hospital stay.

RESULTS

In this study, we found 240 admissions developed nosocomial infection. The total number of nosocomial infection was 367 infections. The overall infection rate was 11.06 infections per 100 admissions. There were 9 patients admitted because of nosocomial infections resulted from the previous admissions. The infection rates varied widely between services (Table 1) and were most prevalent in surgical service especially in service of neurosurgery (40 infections per 100 admissions). The relatively low infection rates in pediatric service when compared with service of medi-

<table>
<thead>
<tr>
<th>Service</th>
<th>Number of admission</th>
<th>Number of infection</th>
<th>Infections per 100 admissions</th>
<th>Average length of stay</th>
<th>Infections per patient day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurosurgery</td>
<td>30</td>
<td>12</td>
<td>40.00</td>
<td>18.40</td>
<td>2.17</td>
</tr>
<tr>
<td>Medicine</td>
<td>661</td>
<td>126</td>
<td>19.06</td>
<td>13.04</td>
<td>1.46</td>
</tr>
<tr>
<td>Urosurgery</td>
<td>58</td>
<td>11</td>
<td>18.97</td>
<td>17.00</td>
<td>1.12</td>
</tr>
<tr>
<td>Gen. surgery</td>
<td>491</td>
<td>85</td>
<td>17.31</td>
<td>15.08</td>
<td>1.14</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>236</td>
<td>29</td>
<td>12.29</td>
<td>22.81</td>
<td>0.54</td>
</tr>
<tr>
<td>Plastic</td>
<td>94</td>
<td>11</td>
<td>11.70</td>
<td>13.54</td>
<td>0.86</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>596</td>
<td>63</td>
<td>10.57</td>
<td>9.20</td>
<td>1.15</td>
</tr>
<tr>
<td>Gynecology</td>
<td>385</td>
<td>19</td>
<td>4.94</td>
<td>10.87</td>
<td>0.45</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>333</td>
<td>5</td>
<td>1.50</td>
<td>7.91</td>
<td>0.19</td>
</tr>
<tr>
<td>Others</td>
<td>435</td>
<td>6</td>
<td>1.38</td>
<td>9.26</td>
<td>0.15</td>
</tr>
<tr>
<td>Total</td>
<td>3,319</td>
<td>367</td>
<td>11.06</td>
<td>12.22</td>
<td>0.90</td>
</tr>
</tbody>
</table>
Cine may be somewhat artifically reduced by the large number of admissions of newborn born in the hospital. Infection rates were found relatively very low in services of Obstetrics and Gynecology.

Infections in the intensive care units (Table 2) were extremely high both in NICU (83.67 infections per 100 admissions) and in multidisciplinary ICU (38.55 infections per 100 admissions). Infection rate in traumatic ward, occupied by traumatized patients, was slightly higher than other surgical wards.

Urinary tract was the commonest site of infections which accounted for 30.7 per cent of all nosocomial infections (Figure 1). The surgical wound infection (SWI) constituted 23.0 per cent, bacteremia (blood) 15.5 per cent, lower respiratory tract infection (LRTI) 14.1 per cent. Urinary tract infections were found most prevalent in service of Urology (15.52 infections per 100 admission) (Table 4). While bacteremia or septicemia were found prevalent in service of Medicine (3.78 infections per 100 admissions). Surgical wound infection was not found in service of Obstetrics while commonly found in service of Neurosurgery (10.0 infections per 100 admissions) and service of General surgery (8.96 infections per 100 admissions). Lower respiratory tract infections were prevalent in service of Medicine and service of Neurosurgery (Figure 2).
Table 2 Ward specific nosocomial infections

<table>
<thead>
<tr>
<th>Ward</th>
<th>Admission</th>
<th>Infection</th>
<th>Rate (/100 admissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NICU</td>
<td>49</td>
<td>41</td>
<td>83.67</td>
</tr>
<tr>
<td>ICU</td>
<td>83</td>
<td>32</td>
<td>38.55</td>
</tr>
<tr>
<td>Traumatic</td>
<td>112</td>
<td>24</td>
<td>21.43</td>
</tr>
<tr>
<td>Surgery (male)</td>
<td>275</td>
<td>49</td>
<td>17.82</td>
</tr>
<tr>
<td>Medicine (female)</td>
<td>280</td>
<td>46</td>
<td>16.43</td>
</tr>
<tr>
<td>Medicine (male)</td>
<td>327</td>
<td>49</td>
<td>14.98</td>
</tr>
<tr>
<td>Surgery (female)</td>
<td>255</td>
<td>34</td>
<td>13.33</td>
</tr>
<tr>
<td>Orthopedic (male)</td>
<td>88</td>
<td>10</td>
<td>11.36</td>
</tr>
<tr>
<td>Private</td>
<td>240</td>
<td>21</td>
<td>8.75</td>
</tr>
<tr>
<td>Pediatric</td>
<td>530</td>
<td>33</td>
<td>6.23</td>
</tr>
<tr>
<td>Gynecology</td>
<td>337</td>
<td>19</td>
<td>5.64</td>
</tr>
<tr>
<td>Orthopedic (male)</td>
<td>112</td>
<td>6</td>
<td>5.36</td>
</tr>
<tr>
<td>Obstetric</td>
<td>264</td>
<td>5</td>
<td>1.89</td>
</tr>
<tr>
<td>ENT</td>
<td>219</td>
<td>4</td>
<td>1.83</td>
</tr>
<tr>
<td>Ophthalmic</td>
<td>151</td>
<td>2</td>
<td>1.32</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>53</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Table 3 Total number of pathogens.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas</td>
<td>93</td>
<td>26.9</td>
</tr>
<tr>
<td>Escherichia</td>
<td>51</td>
<td>14.8</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>43</td>
<td>12.4</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>35</td>
<td>10.1</td>
</tr>
<tr>
<td>Proteus</td>
<td>34</td>
<td>9.8</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>28</td>
<td>8.1</td>
</tr>
<tr>
<td>Candida</td>
<td>12</td>
<td>3.5</td>
</tr>
<tr>
<td>Nonfermentative gram-ve rod</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>8</td>
<td>2.3</td>
</tr>
<tr>
<td>Citrobacter</td>
<td>8</td>
<td>2.3</td>
</tr>
<tr>
<td>Achromobacter</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>Plasmodium</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>Salmonella</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Edwardsiella</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Enterococci</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Flavobacterium</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Serratia</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Alcaligenes</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Aeromonas</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Clostridium</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>345</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

DISCUSSION

Retrospective chart review is constrained by incompleteness of medical records but the level of accuracy is sufficient to ensure a meaningful study result. The reasons why we decided to use the retrospective chart review in our study was that it was the fastest way to get accurate information and we could avoid confounding effect on infection rate from prospective surveillance study.

Reported rates of nosocomial infection have been shown to vary widely among hospital. We present the infection rates both in form of number of infections per admissions and in term of number of infections per total length of hospital stay. For services with long duration of hospitalization due to therapeutic procedures such as service of Orthopedics the first term produced high rate of infection even when few infection was occurring (Table 1).

The magnitude of nosocomial infection in Songklanagarind Hospital (11.06 infections per 100 admissions) seem to be considerable when compare to figures obtained from other hospitals (Table 7). This rate is twice as high as the nationwide nosocomial infection rate of U.S hospitals (5.7 infections per 100 admissions). The latter figure was derived from the Study on Efficacy of Nosocomial Infection Control.
Table 4 Site specific infection rate by service

<table>
<thead>
<tr>
<th>Service</th>
<th>ASB</th>
<th>Rate</th>
<th>SUTI</th>
<th>Rate</th>
<th>Total</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td>9</td>
<td>1.36</td>
<td>42</td>
<td>6.35</td>
<td>7.72</td>
<td>3.78</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>1</td>
<td>0.17</td>
<td>2</td>
<td>0.34</td>
<td>0.52</td>
<td>2.35</td>
</tr>
<tr>
<td>Gen. surgery</td>
<td>2</td>
<td>0.41</td>
<td>9</td>
<td>1.83</td>
<td>2.24</td>
<td>2.65</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>4</td>
<td>1.69</td>
<td>8</td>
<td>3.39</td>
<td>5.08</td>
<td>0.42</td>
</tr>
<tr>
<td>Uroscopy</td>
<td>3</td>
<td>5.17</td>
<td>6</td>
<td>10.34</td>
<td>15.52</td>
<td>0.00</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>0</td>
<td>0.00</td>
<td>2</td>
<td>6.67</td>
<td>6.67</td>
<td>0.00</td>
</tr>
<tr>
<td>Plastic</td>
<td>1</td>
<td>1.06</td>
<td>2</td>
<td>2.13</td>
<td>3.19</td>
<td>0.00</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>0</td>
<td>0.00</td>
<td>3</td>
<td>0.90</td>
<td>0.90</td>
<td>0.00</td>
</tr>
<tr>
<td>Gynecology</td>
<td>7</td>
<td>1.82</td>
<td>8</td>
<td>2.08</td>
<td>3.90</td>
<td>0.52</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>0.00</td>
<td>2</td>
<td>0.46</td>
<td>0.46</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>27</td>
<td>0.81</td>
<td>84</td>
<td>2.53</td>
<td>3.34</td>
<td>1.69</td>
</tr>
</tbody>
</table>

ASB = Asymptomatic bacteriuria
SUTI = Symptomatic urinary tract infection
Rate = Number of infections/Number of admissions

Table 5

<table>
<thead>
<tr>
<th>Service</th>
<th>Surgical wound infection</th>
<th>Incisional</th>
<th>Rate</th>
<th>Deep</th>
<th>Rate</th>
<th>Total</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td></td>
<td>4</td>
<td>0.61</td>
<td>4</td>
<td>0.61</td>
<td>1.21</td>
<td></td>
</tr>
<tr>
<td>Pediatrics</td>
<td></td>
<td>3</td>
<td>0.50</td>
<td>3</td>
<td>0.34</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Gen. surgery</td>
<td></td>
<td>28</td>
<td>5.70</td>
<td>16</td>
<td>3.26</td>
<td>8.96</td>
<td></td>
</tr>
<tr>
<td>Orthopedics</td>
<td></td>
<td>11</td>
<td>4.66</td>
<td>3</td>
<td>1.27</td>
<td>5.93</td>
<td></td>
</tr>
<tr>
<td>Uroscopy</td>
<td></td>
<td>2</td>
<td>3.45</td>
<td>0</td>
<td>0.00</td>
<td>3.45</td>
<td></td>
</tr>
<tr>
<td>Neurosurgery</td>
<td></td>
<td>2</td>
<td>6.67</td>
<td>1</td>
<td>3.33</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td></td>
<td>2</td>
<td>2.13</td>
<td>3</td>
<td>3.19</td>
<td>5.32</td>
<td></td>
</tr>
<tr>
<td>Obstetrics</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Gynecology</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>0.26</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>0</td>
<td>0.00</td>
<td>1</td>
<td>0.23</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>52</td>
<td>1.57</td>
<td>31</td>
<td>0.93</td>
<td>2.50</td>
<td></td>
</tr>
</tbody>
</table>

Deep = Deep surgical wound infection

(SENIC Project) which was a retrospective chart review study similar to ours. The U.S National Nosocomial Infection Study (NNIS) which is a prospective surveillance study also gave a lower figure (4.1 infections per 100 discharges) for nosocomial infection rate in large (> 500 beds) teaching hospitals in USA. A study from Ramathibodi Hospital in Bangkok which is also a teaching hospital of similar size to Songklanagarind hospital, reported nosocomial infection rate of 9.6 infections per 100 discharges in 1981. This latter study was a prospective surveillance of some high risk areas of hospital, so the actual nosocomial infection rate for the whole hospital might even lower than this. Thus from the figure cited above, it can be seen that Songklanagarind Hospital seem to have higher nosocomial infection rates when compare with certain hospitals in USA and in Bangkok. The reasons for the discrepancy were not clear, although, admittedly, these might be partly due to difference in the design of the studies, the criteria for diagnosis of nosocomial infections, the intensity of surveillance and reporting infections and most importantly, the present or absence of infection control programs. In contrast to the other hospitals mentioned above, there was no infection control program existed in Songklanagarind Hospital in the year 1985.

In term of the distribution of nosocomial infections, we found that the service of neurosurgery had the highest infection rate (40 infection per 100 admissions) This high rate might partly be due to the method used to identify service responsible for infections described elsewhere in Materials & Methods. The majority of neurosurgical patients were poly-traumatized, which predisposed the patients to infections. The high infection rate probably was not explained by the duration of hospital stay since the Orthopedic and Urological patients had lower infection rate per patient day even with comparable or longer hospital stay (Table 1). It must be pointed out that 40 per cent of the nosocomial infections in these neurosurgical patients occurred outside the four major sites namely, urinary tract, lower respiratory tract, surgical wounds and bacteremia. These "other" infections (5 infections in service of neuro surgery) were infected decubitus ulcers, peritonitis following peritoneal dialysis, bacterial conjunctivitis, skin infections and periurethral infection due to prolong...
When we extracted the babies born in the hospital (294 newborns) out, the infection rate was raised up to 20.86 infections per 100 admissions.

When compared with data from Ramathibodi and NNIS (Table 8), service by service, it was obvious that Songklanagarind Hospital, actually had much higher nosocomial infection rate on all service except for Obstetrics and Gynecology service. This latter department probably deserves low priority list in the future infection control planing. This also the case with the “other service (i.e; ENT, Ophthalmology and Psychiatry). Regarding the ward distribution of nosocomial infections, it was obvious that the intensive care units had extra ordinary high rate of nosocomial infections. The 84 infections per 100 admissions for the neonatal ICU was unacceptably high for any standards. This raised the question of epidemic situation if the infection was real and this area demanded for emergency investigation and control. Our preliminary investigation revealed that the high NICU infection rates was “hyperendemic” for a long time and was due to colonization and/or infections by Pseudomonas cepacia contaminating the chlorhexidine antiseptic solutions used in that unit.

Regarding the site of infections, urinary tract was the commonest site of infection (30.7%), followed by surgical wound infections (23.0%). This finding were universal with all other studies. However the rate for bacteremia (15.5%) was disproportionately high when compared to the rate for other sites. In other study nosocomial bacteremia accounted for only 3.6-7.5 per cent of all nosocomial infections. Investigation should be done to explain this finding. We did not know yet whether this relative high rate of bacteremia result from the so called “pseudobacteremia” or not.

**Table 6**

<table>
<thead>
<tr>
<th>Service</th>
<th>Lower respiratory tract infection</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pneumonia Rate</td>
<td>TRBR Rate</td>
</tr>
<tr>
<td>Medicine</td>
<td>13 1.97</td>
<td>11 1.66</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>8 1.34</td>
<td>5 0.84</td>
</tr>
<tr>
<td>Gen. surgery</td>
<td>8 1.63</td>
<td>3 0.61</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>0 0.00</td>
<td>1 0.42</td>
</tr>
<tr>
<td>Urosurgery</td>
<td>0 0.00</td>
<td>0 0.00</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>0 0.00</td>
<td>1 3.33</td>
</tr>
<tr>
<td>Plastic</td>
<td>1 1.06</td>
<td>0 0.00</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>0 0.00</td>
<td>0 0.00</td>
</tr>
<tr>
<td>Gynecology</td>
<td>0 0.00</td>
<td>0 0.00</td>
</tr>
<tr>
<td>Others</td>
<td>0 0.00</td>
<td>0 0.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30 0.90</td>
<td>21 0.63</td>
</tr>
</tbody>
</table>

TRBR = Tracheobronchitis

**Table 7** Nosocomial infection rate in university hospital.

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Year</th>
<th>Reference</th>
<th>Infection rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Illinois</td>
<td>1964</td>
<td>(6)</td>
<td>10.9</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>(6)</td>
<td>10.4</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>(6)</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>(6)</td>
<td>8.9</td>
</tr>
<tr>
<td>University of Kentucky</td>
<td>1965</td>
<td>(7)</td>
<td>7.6</td>
</tr>
<tr>
<td>University of Virginia</td>
<td>1973</td>
<td>(8)</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>1974</td>
<td>(8)</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>1975</td>
<td>(8)</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**Table 8** Comparison of nosocomial infection rates by service: from different series.

<table>
<thead>
<tr>
<th>Service</th>
<th>Songkla</th>
<th>NNIS*</th>
<th>Ramathibodi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td>19.06</td>
<td>4.69</td>
<td>16.1</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>10.57</td>
<td>2.03</td>
<td>–</td>
</tr>
<tr>
<td>Gen. surgery</td>
<td>17.31</td>
<td>5.93</td>
<td>7.7</td>
</tr>
<tr>
<td>Obstetrics</td>
<td>1.50</td>
<td>2.03</td>
<td>–</td>
</tr>
<tr>
<td>Gynecology</td>
<td>4.94</td>
<td>1.66</td>
<td>7.2</td>
</tr>
</tbody>
</table>

*Data of University hospital from Nosocomial Infection Study.*

catheterization. Only one-fourth of nosocomial infections in this group were surgical wound infection. The relatively low infection rates in Pediatric service when compared to the medical service might be somewhat artifactually diluted by the large number of admissions of heathy neonates born in the hospital.
Our bacteriologic pattern was different from other studies. We found *Pseudomonas aeruginosa* the most common pathogen while NNIS found it the second most common (11.4%). Ramathibodi, in three year, found only 3 cases of *Pseudomonas cepacia* septicemia while we found it the most common pathogen associated with nosocomial bacteremia (45.5%). *Pseudomonas* spp. especially *Pseudomonas cepacia* is far beyond doubt the serious nosocomial infection problem. *E. coli*, the same as NNIS, was the most common nosocomial urinary tract infection pathogen but was different from Ramathibodi that the most common pathogen was *Klebsiella* spp. *Klebsiella pneumoniae* was the second most nosocomial urinary tract infection pathogen result from this study.

The results of this study revealed that the problem of nosocomial infection in Songklanagarind Hospital was really existing and so serious that it requires the emergence of infection surveillance and control programs. We have learned from the history of nosocomial infection control that the clinicians who are oriented almost entirely toward the treatment of their patients, often fail to appreciate the severity of the problem. This study vividly demonstrated us the problem of nosocomial infection. The pattern of infections are also helpful in future planning for infection surveillance and control programs.

REFERENCES


ใน Appendix A และ B
Appendix A

NIS form ประกอบขั้นตอนการเก็บข้อมูล 3 แผน (sheet) โดยแผน 1 (sheet 1) จะเป็นแผนที่รวบรวมข้อมูลเพื่อนำข้อมูลมา
แผน 2 (sheet 2) และแผน 3 (sheet 3) เป็นแผนที่รวบรวมข้อมูล
เพื่อช่วย chart reviewer ในกรณีการผลิตข้อมูล ข้อมูลใน 2 แผน
นี้ไม่สามารถใช้ในการวิเคราะห์ในการศึกษาค้น

Sheet 1 ประกอบด้วย 4 card คือ card 01-04 card 01 จะเป็นข้อมูลเกี่ยวกับลักษณะ
ชื่อ อายุ เพศ วัน และระยะเวลาที่อยู่รักษาในโรงพยาบาล แผนที่
ให้การรักษา (service) ข้อมูลเหล่านี้จะได้จาก general summary
sheet คือ ใบสรุปข้อมูลในหน้าแรกของกระดาษ ข้อมูลที่เกี่ยวกับ
ที่อยู่และเงื่อนไข การตัดสินใจเมื่อ 1 รอบ สามารถตัดสินใจ
วันที่ 1 อยู่ที่ 1 รอบ ได้ผลผลิต 0 ในปียIDGE ระยะเวลาที่อยู่รักษา
การพักผ่อนในโรงพยาบาล (Length of hospital stay) ได้ในกรณี
สำหรับ service ในกรณีของผู้ป่วยกลุ่ม และ general summary
sheet จะตั้งข้อ 0 ศูนย์ โดยไม่แยก subspecialty ได้
ตั้งชื่อ chart reviewer ต้องแยกแผนกโดยจุดการวิจัย การ
ผ่าน หรือไม่ผ่าน ข้อมูลที่เกี่ยวกับ 0 ศูนย์ รายชื่อ
การรักษา และแพทย์ผู้รักษาจะต้องจัดเก็บข้อมูลที่เกี่ยวกับ
ระยะเวลาและข้อมูลต่างๆของกระดาษ ข้อมูลนี้จะถูก approval บาย
ข้อมูลจาก service คือ อาจารย์ น.พ.พิชัย - urology,
อาจารย์ น.พ.ศักดิ์ - neurosurgery, อาจารย์ น.พ.จรัส - plastic
surgery ตั้งอย่าง เลือก service เป็น neurosurgery กรณีที่
จะต้องใช้เวลาที่ครบจะยื่น เช่น Head injury และการตัด
การเป็นกระดาษต่อกระดาษ (Internal classification
code 501-503) ในกรณีที่ผู้ป่วยรายเดียว แล้วได้รับการรักษาจาก
หลาย service ให้ใช้ service ที่รับผู้ป่วยเข้ารักษาในโรงพยาบาล
ต่อมา เช่น ผู้ป่วยมี multiple injury มี head injury, maxillo-
facial injury, fractured extremities จะมี service ที่เกี่ยวกับ
โรค neurosurgery, plastic surgery และ orthopedic surgery
และ neurosurgeon เป็นผู้รับผู้ป่วยเข้ารักษาในโรงพยาบาล
ให้โดย neurosurgery เป็น service ที่ทำบางกลุ่ม เช่น
การผ่าตัด

สำหรับ ward ให้ลง code เฉลี่ยของ ward ที่มี code อวัย
แพทย์ นอกเหนือให้ชื่อ ward ไว้ข้อความ เหมือน ward transfer
ไว้เลยถึง

Card 02 ในกรณีการศึกษาจะต้องระบุของ Additional diag-
nosis และ Discharge diagnosis ที่มี สำหรับ operation
procedure ให้ลงเฉพาะ Operation ซึ่งมี code ตั้งแต่ 5010 ถึง 5899
เท่านั้น วัน (date) และระยะเวลา (duration) ของการผ่าตัด
ให้ถูกต้องตาม (Anesthesia record) Card 03 เป็นประวัติและ
อาการบาดเจ็บของผู้ป่วยในช่วงการรักษา เก็บข้อมูลจะอยู่ใน
data base ในกระดาษ Card 04 เป็นการสรุปข้อมูล
ว่ามีการติดเชื้อหรือไม่ ซึ่งจะถูกทำการสกัดหลังจากทำการข้อมูลใน
sheet 3 และ 3 หมดแล้ว และให้การวินิจฉัยการติดเชื้อได้

Sheet 2 เป็นการรวบรวมข้อมูลที่เกี่ยวกับการติดเชื้อในแต่
ละวัน เช่น ใช้ antibiotic, ยาหรือ immuno suppressive drug
หรือ steroid ผล urine culture และ hemoculture เพื่อ speci-
culture รายและผู้ป่วยจะได้รับ antibiotic อยู่ไว้ตลอด 1 ข้อมูล
แรก และเครื่องหมาย + หรือ - ของค่าผล ในการที่ผลลัพธ์เป็น positive
หรือ negative ตามค่าดี สำหรับ culture ข้อมูลอยู่ในผล
เฉพาะ Urinary cath ได้ลง code ตามระยะเวลาที่ retain cath
continuous ventilatory support หมายถึงการใช้ endotracheal tube
และใช้ respirator หรือ O2 therapy อัน drainage หรือ
การใส่ drainage เช่น ผู้ป่วย หรือ chest drain เป็นต้น I.V cath
เช่น venesection หรือ subelavian venous catheter

Sheet 3 เป็นรายละเอียดของ lab ที่ positive Card 07

17
Table 1 Site-specific clinical infection data bits and codes for diagnosing nosocomial infection.

<table>
<thead>
<tr>
<th>Type of data bit</th>
<th>Physician’s diagnosis</th>
<th>Specimen analysis or examination</th>
<th>Clinical sign and Symptom</th>
<th>Confounding or negative diagnosis</th>
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<tbody>
<tr>
<td><strong>1 Symptomatic</strong></td>
<td>Definite Dx of UTI</td>
<td>Bacteriuria 1.2</td>
<td>Dysuria 1.4</td>
<td>No UTI 1.9</td>
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<tr>
<td></td>
<td>Prb. or poss. Dx</td>
<td>Pyuria 1.3</td>
<td>Frequency 1.5</td>
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<tr>
<td><strong>2 Asymptomatic</strong></td>
<td>Definite Dx of asymptomatic bacteriuria</td>
<td></td>
<td>Flank tenderness or pain 1.6</td>
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<tr>
<td><strong>3 Bacteremia</strong></td>
<td>Definite Dx of bacteremia</td>
<td></td>
<td>Suprapubic tenderness or pain 1.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prb. or poss. Dx</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4 Pneumonia</strong></td>
<td>Definite Dx of pneumonia</td>
<td>Purulent drainage from wound</td>
<td>Redness of wound 6.4</td>
<td>Stitch abscess 6.8</td>
</tr>
<tr>
<td></td>
<td>Prb. or poss. Dx</td>
<td>Wound drainage purulent not specified</td>
<td>Separation of wound edges 6.5</td>
<td>Healed 72 hours after removal of sutures 6.6</td>
</tr>
<tr>
<td><strong>5 Tracheobronchitis</strong></td>
<td>Definite Dx of tracheobronchitis</td>
<td>Purulent drainage from wound</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prb. or poss. dx</td>
<td>Wound drainage purulent not specified</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6 Incisional surgical wound Infection</strong></td>
<td>Definite Dx of ISWI</td>
<td>Purulent drainage from wound</td>
<td>Redness of wound 6.4</td>
<td>Stitch abscess 6.8</td>
</tr>
<tr>
<td></td>
<td>Prb. or poss. Dx</td>
<td>Wound drainage purulent not specified</td>
<td>Separation of wound edges 6.5</td>
<td>Healed 72 hours after removal of sutures 6.6</td>
</tr>
<tr>
<td><strong>7 Deep surgical wound infection</strong></td>
<td>Definite Dx (see list)</td>
<td>Purulent drainage from drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prb. or poss Dx</td>
<td>or fistula 7.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List of physicians’ diagnosis of deep surgical wound infection:
- Abdominal or retroperitoneal abscess (infection) after abdominal surgery
- Vaginal cuff abscess or pelvic cellulitis after hysterectomy
- Endocarditis after heart surgery
- Endometritis or parametritis after C-section or other gyn. Surgery
- Meningitis after neuro - or ENT surgery: pelvic abscess after abdominal or pelvic surgery
- Pleural empyema after thoracic surgery, pelvic abcess after abdominal or pelvic surgery
- Pericarditis after thoracic surgery, septic arthritis or osteomyelitis after bone and joint surgery.

*ให้ดูที่หน้า Card 08
Appendix B

Algorithms for Diagnosing Infection

Section I. Rules for Diagnosing Urinary Tract Infection

Pertinent Definitions

Urinary tract infection (UTI) includes symptomatic urinary tract infection (SUTI) and asymptomatic bacteriuria (ASB).

Signs
1. Fever $>$ 37.5°C
2. Pyuria (Urine wbc $>$ 20 wbc/HPF).
3. Dysuria
4. Frequency
5. Flank pain.
6. Suprapubic pain or tenderness.

Positive urine culture
1. From a catheterized urine specimen, a colony count $>$ 10⁴ bacteria/ml of urine and isolation of any number of pathogens.
2. From a non-catheterized urine specimen, a colony count $10^5$ bacteria/ml of urine and isolation of only one pathogen.

Bacteriuria
Physician's note indicating a finding of $>$ 20 bacteria/HPF in the microscopic examination of the urine; synonyms include "many bacteria" and "numerous bacteria"

Criteria for Diagnosing Infection

Symptomatic urinary tract infection (SUTI)
SUTI may be diagnosed in any of the following ways:
1. Physician's definite diagnosis of UTI and at least one sign (see above).
2. Positive urine culture and at least one sign.
3. No culture was done and at least one sign and a physician confirmed microscopic bacteriuria.
4. A negative urine culture and patient on antibiotic at the time the urine specimen was obtained for culture and at least two signs and no previous diagnosis of UTI during this stay.

Asymptomatic Bacteriuria (ASB)
ASB may be diagnosed in either of the following ways:
1. Physician's definite diagnosis of ASB and either of the following:
   a. no previous diagnosis of UTI during this stay or
   b. If there was a previous diagnosis of UTI, culture must have been done during both episodes and the culture from the lastest episode must be positive and must show a change in pathogen from the previous UTI.
2. Positive urine culture and no sign.

Rules to Determine Type
(Nosocomial VS. Community-Acquired)

A UTI is nosocomial if it meets any of the following criteria:
1. The date onset is after day 3 of hospitalization.
2. The infection is a second UTI during this stay.
3. The date of onset is in the first three days and either of the following:
   a. A urine culture with negative results was performed before the date of onset of infection.
   b. No urine culture was done before the onset date of infection, but a urinalysis with negative results was performed before the date of onset of infection.

Section II Rules for Diagnosing Bacteremia

Pertinent Definition

Signs of septic shock
1. Hypotension
2. Oliguria or anuria

Positive blood culture
Isolation of any pathogen from only one blood culture except for the following pathogens which must be isolated in at least two blood cultures taken on the same day, unless a physician states that their isolation in only one culture represents a true infection.
1. Bacillus sp.
2. Candida sp.
3. Corynebacterium sp.
4. Micrococcus
5. Staphylococcus epidermidis

Criteria for Diagnosing Infection

**Bacteremia**

Bacteremia may be diagnosed in any of the following ways:
1. Positive blood culture.
2. Physician’s definite diagnosis of bacteremia or septicemia and fever and at least one sign of septic shock.

**Rules to Determine Type**
(Nosocomial VS. Community-Acquired)

A bacteremia is hospital-acquired if it meets either of the following two criteria:
1. The date of onset is after day 3 of hospitalization.
2. The infection is a second bacteremia during this stay.

**Section III Rules for Diagnosing Lower Respiratory Infection**

**Pertinent Definitions**

**Signs of pneumonia**
1. Fever > 37.5°C.
2. Pleuritic chest pain.
3. Purulent sputum.
4. Increased or decreased breath sounds.
5. Crepitation.

**Signs of tracheobronchitis**
1. Purulent sputum
2. Dyspnea
3. Acute bronchitis

**Positive sputum culture**
Isolation from sputum of any pathogen except the following:
1. Bacillus sp.
2. Candida sp.
3. Corynebacterium sp.
4. Micrococcus
5. Neisseria sp.
6. Staphylococcus epidermidis
7. Streptococcus viridans.

**Positive chest X-ray**
A chest X-ray is considered positive (i.e., compatible with pneumonia) if it meets any one of the following three criteria:
1. Definite, probable or possible diagnosis of infiltration, consolidation or pneumonia with no diagnosis of atelectasis, pulmonary embolism or infarction or congestive heart failure.
2. Any diagnosis of infiltration, consolidation or pneumonia 3-10 days post-operatively.

**Criteria for Diagnosing Infection**

**Pneumonia**
Pneumonia may be diagnosed in the following ways:
1. Physician’s definite diagnosis of pneumonia
2. Chest X-ray compatible with pneumonia.
3. If pneumonia has already been diagnosed, pneumonia may be diagnosed again if chest X-ray compatible with pneumonia showing extension of infiltration.
4. Chest X-ray performed between 3-10 days after surgery interpreted as compatible with pneumonia and fever.

**Tracheobronchitis**
Tracheobronchitis may be diagnosed in either of the following ways, if the patient had no previous diagnosis of tracheobronchitis:
1. Physician’s definite diagnosis of tracheobronchitis.
2. Production of purulent sputum for at least three days either consecutively or every other day after the second hospital day.

**Rules to Determine Type**
(Nosocomial VS. Community-Acquired)

A pneumonia is hospital-acquired if it meets any of the following criteria:
1. The date of onset is after day 3 of hospitalization.
2. The date of onset is in the first three days and either of the following:
   a. there is a negative chest X-ray before the date of onset or
   b. if there is no chest X-ray before the date of onset but there is a physician’s negative physical examination of chest on admission.
3. Tracheobronchitis is hospital — acquired if the date of onset is after hospital day 3.

**Section IV Rules for Diagnosing Surgical Wound Infection**

**Pertinent Definitions**

Surgical wound infection includes incisional surgical wound infection (ISWI) and deep surgical wound infection (DSWI)

**Signs**
1. Purulent drainage from wound or from drain or fistula.
2. Nonpurulent drainage (e.g., serous, sangu...
3. Redness (erythema) of wound edges.
4. Separation of wound edges.
5. Stitch abscess.
6. Delayed wound healing
7. Pus encountered at re-operation

Positive wound culture
Culture of surgical wound drainage with isolation of any pathogen except the following:
1. Bacillus sp.
2. Candida sp.
3. Coryne bacterium sp.
4. Staphylococcus epidermidis.
5. Unidentified gram-negative rod
6. Micrococcus
7. Any unidentified organism

Criteria for Diagnosing Infection

Incisional surgical wound infection (ISWI)
Incisional surgical wound infection (ISWI) may be diagnosed in any of the following ways:
1. Physician’s definite diagnosis of ISWI and no previous diagnosis of ISWI at the same anatomic site.
2. Purulent drainage from operative wound site and no previous diagnosis of ISWI at the same site.
3. Physician diagnosis of stitch abscess and incision not healed within three days after sutures removed.

Deep surgical wound infection (DSWI)
DSWI may be diagnosed in any of the following three ways:
1. Physician’s definite diagnosis of any of the following conditions:
   a. Meningitis following neurosurgery or ENT surgery
   b. Pleural empyema following thoracic surgery
   c. Abdominal abscess following abdominal surgery
   d. Endocarditis following cardiac surgery
   e. Septic arthritis or osteomyelitis after bone or joint surgery
   f. Vaginal cuff abscess following hysterectomy
   g. Endometritis following cesarean section or other gynecologic surgery
   h. Pelvic abscess after abdominal or pelvic surgery
2. Purulent drainage from drain, fistula or a natural body opening
3. Pus encountered at reoperation.

Rules to Determine Type
(Nosocomial VS. community-Acquired)
A SWI is hospital-acquired if surgery was performed during admission.
### Patient Characteristics

<table>
<thead>
<tr>
<th>Card</th>
<th>Patient name</th>
<th>Age</th>
<th>Day</th>
<th>Mo.</th>
<th>Yr.</th>
<th>Sex</th>
<th>M=Male</th>
<th>F=Female</th>
</tr>
</thead>
</table>

- **Ward codes:**
  - BA1: Gastroenteritis
  - OR2: Orthopedics
  - PD5: Pneumonia
  - OB4: Other
  - ICU: Intensive Care Unit
  - MI1: Medical Intensive Care Unit
  - M4: Medical
  - EN5: Emergency

- **Site codes:**
  - S=SUTI
  - A=ASB
  - P=Pneumonia
  - T=TRBR
  - P=Physiology
  - D=DWI
  - U=Urology
  - G=Gastroenteritis
  - O=Other (specify)
  - B=Bacteremia

### Admission History & Physical Finding

- **Infection Present on Admission**
  - Site: CA, HA, Hospital
  - Diagnosis of COPD, CRF, CHF, DM

### Clinical Diagnosis of HA Infection

- **Site codes:**
  - S=SUTI
  - A=ASB
  - P=Pneumonia
  - T=TRBR
  - P=Physiology
  - D=DWI
  - U=Urology
  - G=Gastroenteritis
  - O=Other (specify)
  - B=Bacteremia

- **Date onset**

- **Pathogen**

### Operative Note

- **Procedure**
  - Day, Mo. Yr.
  - Hr. Min.

- **Additional Dx.**

- **Additional Dx.**

- **Service codes:**
  - M=Medicine
  - P=Pediatrics
  - G=General Surgery
  - O=Orthopedics
  - U=Urology
  - N=Neurology
  - P=Plastic
  - OB=OB
  - Y=Gynecology
  - T=Other

### Diagnosis

- **Admission Dx.**
- **Discharge Dx.**
- **Additional Dx.**
# DAILY CLUES TO INFECTION

<table>
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<th>Card 06</th>
<th>Month</th>
<th>Day</th>
</tr>
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</table>

**Peak temperature ≥ 37.5 °C**

- Anti #1
- Anti #2
- Anti #3
- Anti #4
- Anti #5
- Anti #6
- Anti #7
- Anti #8

**Steroid or Immunosuppressive**

**Hemoculture**

- Wound culture
- Other culture
- Sputum culture
- Urine culture
- Urine analysis
- Chest X-ray
- Surgical operation
- Urinary cath.
- Continuous ventilatory support
- I.V. Cath. (Specify)

### CLINICAL INFECTION DATA

**Urinary cath. codes:**

- 1= In place
- 2= In before admission
- 3= In < 1 day
- 4= In & Out
- C= Condom
- 0= Discontinue
### LABORATORY RESULT

**Specimen codes:**
- 1 = Urine
- 2 = Blood
- 3 = Wound
- 4 = Sputum
- 5 = Tracheal aspirate or endotracheal tube aspirate
- 6 = Tracheal aspirate
- 7 = CSF
- 8 = Other

**Urine colony count codes:**
- 1 = $10^6 - 10^5$
- 2 = $10^6 - 10^5$
- 3 = Sensitive
- 4 = Intermediate
- 5 = Resistant

**Sensitivity codes:**
- 1 = Amikacin
- 2 = Ampicillin
- 3 = Carbenicillin
- 4 = Chloramphenicol
- 5 = Colistimethate sodium
- 6 = Cotrimoxazole
- 7 = Cefuroxime
- 8 = Cefoxitin
- 9 = Cefotaxime
- 10 = Ceftriaxone

**CHEST X-RAY REPORT**

<table>
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<th>Day</th>
<th>Mo.</th>
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<tbody>
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---

**Specimen codes:**
- 07

**Pathogen**

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<tr>
<th>Code</th>
<th>Cath urine</th>
<th>Colistimethate sodium</th>
<th>Cotrimoxazole</th>
<th>Cefuroxime</th>
<th>Cefoxitin</th>
<th>Cefotaxime</th>
<th>Ceftriaxone</th>
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**Additional culture**

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**Specimen codes:**
- 07

**Pathogen**

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**Additional culture**

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**Specimen codes:**
- 07

**Pathogen**

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**Specimen codes:**
- 09

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**WBC**

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**Patient name**

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**Day, Mo.**

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**Day, Mo.**

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