Background: Surgical site infections (SSIs) are a threat to patient safety; however, there were no available data on SSI rates stratified by surgical procedure (SP) in Turkey.

Methods: Between January 2005 and December 2011, a cohort prospective surveillance study on SSIs was conducted by the International Nosocomial Infection Control Consortium (INICC) in 20 hospitals in 16 cities in Turkey. SSIs were classified based on the National Nosocomial Infections Surveillance System (NNIS) definition. Susceptible patients were defined as those with an operation of 60 min or longer, and those undergoing operations with a European Ranking System (ERS) classification of 2 or more.

Results: The SSI rates were low in all SSIs with the exception of abdominal procedures for which the rate increased from 2005 to 2011. The SSI rates were highest in the surgical specialties of general surgery and thoracic surgery.

Conclusion: The SSI rates were low in all SSIs with the exception of abdominal procedures. This surgery is most likely to increase SSI rates due to the nature of the procedures, the patients undergoing them, and the infections that can be transmitted to the patient. Other surgical specialties that are potential sources of SSI should be addressed as well.
Surgical wound infection
Developing countries

131 Turkish cities. Data from hospitalized patients were registered using the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) methods and definitions for SSIs. Surgical procedures (SPs) were classified into 22 types according to International Classification of Diseases, Ninth Revision criteria.

134 **Results:** We recorded 1879 SSIs, associated with 41,563 SPs (4.3%; 95% confidence interval, 4.0-4.7%)

135 Among the results, the SSI rate per type of SP compared with rates reported by the INICC and CDC NHSN were 11.9% for ventricular shunt (vs 12.9% vs 5.6%); 5.3% for craniotomy (vs 4.4% vs 2.6%); 4.9% for coronary bypass with chest and donor incision (vs 4.5 vs 2.9); 3.5% for hip prosthesis (vs 2.6% vs 1.3%), and 3.0% for cesarean section (vs 0.7% vs 1.8%).

139 **Conclusions:** In most of the 22 types of SP analyzed, our SSI rates were higher than the CDC NHSN rates and similar to the INICC rates. This study advances the knowledge of SSI epidemiology in Turkey, allowing the implementation of targeted interventions.

143  

146 **Methods**

149 **Background on the INICC**

150 The INICC is an open, nonprofit, HAI surveillance network that applies methods based on US CDC NHSN guidelines. The INICC was established to measure and control HAIs worldwide in hospitals through the analysis of standardized data collected on a voluntary basis by its member hospitals, fostering the use of evidence-based preventive measures. Since its international inception in 2002, the INICC has steadily grown and now comprises nearly 1000 hospitals in 300 cities of 60 countries in Latin America, Asia, Africa, the Middle East, and Europe, and is currently the sole source of aggregate standardized international data on the epidemiology of HAIs.

154 **Study setting and design**

158 Between January 2005 and December 2011, we conducted a cohort prospective multicenter surveillance study of SSIs on patients undergoing SPs in 20 medium-sized hospitals of 16 cities in Turkey. Sixteen of the 20 hospitals (80%) participating in this study are academic teaching hospitals, 3 (15%) are public hospitals, and 1 (5%) is a private community hospital.

162 Each participating hospital’s Institutional Review Board approved the study protocol. Patient confidentiality was protected by codifying the recorded information, making it identifiable only to the infection control team.

166 **INICC surveillance program**

170 As part of the INICC program on SSI prevention, infection control professionals (ICPs) at each participating hospital were trained in conducting outcome surveillance of SSI rates, according to the standard CDC NHSN definitions for superficial incisional, deep incisional, and organ/space SSIs, including laboratory and clinical criteria.

174 **Data collection**

178 SSI rates were calculated using the number of SPs as the denominator and the number of SSIs as the numerator. The ICP recorded these SSI rates, as well as data by type of SP, which were collected from the SP book of the operating theater at each participating hospital. The collected data included the names of the patients who underwent SPs; these patients were followed up during the 30 postsurgical days to detect early SSIs, or for 12 months for prosthesis-related SSIs. Microbiological data were collected.
For analytical purposes, collected data were stratified into 22 SPs according to ICD-9 criteria.2,5 ICPs reviewed each SP report to identify all SPs performed and note the ICD-9 codes. The collected data were validated at the INICC’s central office in Buenos Aires before their inclusion into the INICC database as reported SSIs. The validation process included revision of age, sex, and length of stay, among other data revised for consistency.

Data on the duration of SPs, level of contamination, and infection risk index classification of the American Society of Anesthesiology12 according to the patient’s physical condition were not collected at this first step. As a result, we were not able to calculate the infection risk index of each SP, and thus we pooled the different risk categories included in the CDC NHSN reports for 2005-2010 and in the CDC NHSN reports for 2007-2009 to obtain the mean SSI rate, and compared this rate with our results.

### RESULTS

Table 1 presents SSI rates, stratified by SP, including number of SPs, number of SSIs, and SSI rate with 95% confidence intervals. The SPs with the highest SSI rates were VSHN (11.9%) and COLO (11.4%). Compared with the CDC NHSN rates, our SSI rates were significantly higher in 19 of the 22 analyzed SP types (86%) (AMP, CBGB, CRAN, COL, CRAN, CSEC, FUSN, FX, GAST, HPRO, HYST, KPRO, NECK, NEPH, SPLE, THOR, VHYST, and VSHN), but similar in 3 SPs (14%) (CARD, PROST, and XLAP). Compared with the CDC NHSN rates, our SSI rates were significantly higher in 4 of the 22 analyzed SPs (18%) (AMP, CSEC, KPRO, and NECK), similar in 17 (77%) (CBGB, CHOL, COLO, CRAN, FUSN, FX, GAST, HPRO, HYST, LAM, NEPH, PROST, SPLE, THOR, VHYST, and VSHN), and lower in 1 (5%) (CARD).

### DISCUSSION

The present study was designed to determine the incidence of SSIs in 20 hospitals in 16 cities in Turkey, a limited-resource economy. In this study, we found higher SSI rates for AMP, COLO, CBGB, CRAN, HPRO, and NECK compared with those reported by the INICC and CDC NHSN. Our SSI rates for CBGB, FX, GAST, HYST, LAM, and VSHN were higher than those of the CDC NHSN, but similar to those of the INICC. Our SSI rates for COL and FX were lower than those of the INICC, but higher than those of the CDC NHSN. Our SSI rate for CSEC was higher than that of the INICC, but similar to that of the CDC NHSN. Finally, our SSI rates for FUSN, NEPH, PROST, SPLE, THOR, and VHYST were not statistically significantly different from the INICC and CDC-NHSN rates.9,16

### Table 1

SSIs in participating Turkish hospitals by type of procedure

<table>
<thead>
<tr>
<th>Code</th>
<th>Procedure</th>
<th>Procedures, n</th>
<th>SSIs, n</th>
<th>Turkey SSI rate, % (95% CI)</th>
<th>Hospitals, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AMP</td>
<td>Limb amputation</td>
<td>404</td>
<td>47</td>
<td>9.5 (7.1-12.5)</td>
<td>5</td>
</tr>
<tr>
<td>2. CBGB</td>
<td>Coronary bypass with chest and donor incision</td>
<td>4040</td>
<td>198</td>
<td>4.9 (4.3-5.6)</td>
<td>13</td>
</tr>
<tr>
<td>3. CARD</td>
<td>Cardiac surgery</td>
<td>1228</td>
<td>33</td>
<td>2.7 (1.9-3.8)</td>
<td>8</td>
</tr>
<tr>
<td>4. CHOL</td>
<td>Gallbladder surgery</td>
<td>3353</td>
<td>44</td>
<td>1.3 (1.0-1.8)</td>
<td>7</td>
</tr>
<tr>
<td>5. COL</td>
<td>Colon surgery</td>
<td>2373</td>
<td>6</td>
<td>11.4 (10.1-12.7)</td>
<td>3</td>
</tr>
<tr>
<td>6. CRAN</td>
<td>Craniotomy</td>
<td>3122</td>
<td>166</td>
<td>5.3 (4.6-6.2)</td>
<td>10</td>
</tr>
<tr>
<td>7. CSEC</td>
<td>Cesarean section</td>
<td>197</td>
<td>6</td>
<td>3.0 (1.1-6.5)</td>
<td>2</td>
</tr>
<tr>
<td>8. FUSN</td>
<td>Spinal fusion</td>
<td>371</td>
<td>8</td>
<td>2.2 (0.9-4.2)</td>
<td>4</td>
</tr>
<tr>
<td>9. Fx</td>
<td>Open reduction of fracture</td>
<td>2592</td>
<td>130</td>
<td>5.0 (4.2-5.9)</td>
<td>7</td>
</tr>
<tr>
<td>10. GAST</td>
<td>Gastric surgery</td>
<td>466</td>
<td>20</td>
<td>4.3 (2.6-6.5)</td>
<td>2</td>
</tr>
<tr>
<td>11. HPRO</td>
<td>Hip prosthesis</td>
<td>2706</td>
<td>96</td>
<td>3.5 (2.8-4.2)</td>
<td>16</td>
</tr>
<tr>
<td>12. HYST</td>
<td>Abdominal hysterectomy</td>
<td>2025</td>
<td>62</td>
<td>3.1 (2.4-3.9)</td>
<td>8</td>
</tr>
<tr>
<td>13. KPRO</td>
<td>Knee prosthesis</td>
<td>1876</td>
<td>64</td>
<td>3.4 (2.6-4.3)</td>
<td>13</td>
</tr>
<tr>
<td>14. LAM</td>
<td>Laminectomy</td>
<td>4211</td>
<td>56</td>
<td>1.3 (1.0-1.7)</td>
<td>8</td>
</tr>
<tr>
<td>15. NECK</td>
<td>Neck surgery</td>
<td>175</td>
<td>13</td>
<td>7.4 (4.0-12.4)</td>
<td>4</td>
</tr>
<tr>
<td>16. NEPH</td>
<td>Kidney surgery</td>
<td>4040</td>
<td>198</td>
<td>4.9 (4.3-5.6)</td>
<td>13</td>
</tr>
<tr>
<td>17. PROST</td>
<td>Prostate surgery</td>
<td>1470</td>
<td>27</td>
<td>1.8 (1.2-2.7)</td>
<td>6</td>
</tr>
<tr>
<td>18. SPLE</td>
<td>Spine leptomeningastomy</td>
<td>139</td>
<td>7</td>
<td>5.0 (2.0-10.1)</td>
<td>5</td>
</tr>
<tr>
<td>19. THOR</td>
<td>Thoracic surgery</td>
<td>6137</td>
<td>408</td>
<td>6.6 (6.0-7.3)</td>
<td>7</td>
</tr>
<tr>
<td>20. VHYST</td>
<td>Vaginal hysterectomy</td>
<td>239</td>
<td>4</td>
<td>1.7 (0.5-4.2)</td>
<td>4</td>
</tr>
<tr>
<td>21. VSHN</td>
<td>Ventricular shunt</td>
<td>1213</td>
<td>138</td>
<td>11.4 (9.6-13.3)</td>
<td>12</td>
</tr>
<tr>
<td>22. XLAP</td>
<td>Exploratory abdominal surgery</td>
<td>2718</td>
<td>71</td>
<td>2.6 (2.0-3.3)</td>
<td>10</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>41,563</td>
<td>1879</td>
<td>4.3 (4.3-4.7)</td>
<td>20</td>
</tr>
</tbody>
</table>
Within this context, INICC reports can serve as an invaluable tool in understanding the infection rates in hospitals worldwide. Nonetheless, there has been much recent progress in hospital accreditation and regulations for infection control bundles, education, outcome surveillance, process surveillance, feedback on HAI rates, and performance feedback on infection control practices. The incidence of HAI in INICC hospitals has been reduced by as much as 30%-70% through the implementation of multidimensional strategies for HAI prevention that include infection control bundles, education, outcome surveillance, process surveillance, feedback on HAI rates, and performance feedback on infection control practices for central line-associated bloodstream infections, mechanical ventilator-associated pneumonia, and urinary catheter-associated urinary tract infections.

For valid comparisons of a hospital's SSI rates with the rates from INICC hospitals, the hospital needs to start collecting data by applying the CDC NHSN definitions to identify SSIs, the ICD-9 definitions, and the methodology for calculating SSI rates described by CDC NHSN. Study limitations

Owing to a lack of budget, this study has 3 main limitations. First, we were unable to calculate the risk category of the SPs, because we did not collect the duration of each SP, the level of contamination, and the ASA score. Furthermore, we applied a 30-day follow-up, although a 90-day follow-up is the standard of care for many procedures. Second, we were not able to collect data to differentiate superficial, deep, and organ/space SSIs; collect data on microorganism profiles and bacterial resistance; or implement any other kind of postdischarge surveillance, such as phone calls, visits, or letters to patients. However, since 2012, these data have been collected by INICC member hospitals, thereby enabling future assessment of SSI risk index associated with SPs. Third, given the small sample size of cases in some SPs, these results should be interpreted with caution. Our review of the literature found no systematic data on SSI global rates or SSI rates stratified by surgical procedure. For this reason, it is worth mentioning that despite the aforementioned limitations, this study provides substantial and useful data, which is a first step in advancing our understanding of the SSI rate in Turkey.
CONCLUSION

Compared with data reported by the INICC for 2005-2010, our present findings show similar SSI rates in 77% of the analyzed SPs. In contrast, our SSI rates were significantly higher than those reported by the CDC NHSN for 2006-2008 in 86% of the analyzed SPs. This study provides important advancements in the knowledge of SSI epidemiology in Turkey and will enable the introduction of targeted interventions. Furthermore, it demonstrates that the INICC is a valuable international benchmarking tool, whose participating hospitals have unrivaled infection control experience and resources.

Acknowledgment

We thank the many health care professionals at each member hospital who assisted with the conduct of surveillance in their hospital, including the surveillance nurses, clinical microbiology laboratory personnel, and physicians and nurses providing care for the patients during the study. We also thank the following individuals for their cooperation and generous assistance, without which the INICC would not be possible: Mariano Vilar and Déborah López Burgardt, who work at INICC headquarters in Buenos Aires, for their hard work and commitment to achieving INICC goals; the INICC Country Coordinators and Secretaries (Altaf Ahmed, Carlos A. Álvarez-Moreno, Anucha Apisarnthanarak, Luis E. Cuéllar, Bijie Hu, Namita Jaggi, Hakan Leblebicioglu, Montri Luxsuswong, Eduardo A. Medeiros, Yatin Mehta, Ziad Memish, and Lul Raka,); and the INICC Advisory Board (Carla J. Alvarado, Nicholas Graves, William R. Jarvis, Patricia Lynch, Dennis Maki, Gerald McDonnell, Toshhiro Mitsuda, Cat Murphy, Russell N. Olmsted, Didier Pittet, William Rutala, Syed Sattar, and Wing Hong Seto), who have so generously supported this unique international infection control network.

References