Bacterial contamination of glucose test strips: does the packaging matter?

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Infection control practitioner: so what?

**What we deal with?**

- We deal with **Infection Control**, that is prevention of **hospital acquired infection (HAIs)**, so called nosocomial infections.

**How many people are concerned by this kind of adverse event occurring during the hospital stay?**

- In France, **about 5 %** of the inpatients acquire an HAI if the study is made one given day.
  - That is one patient out of twenty.

- Each year in France, about **five hundred thousand** people suffer from HAIS and about **four thousand** people died at least in part because of them.
Putative role of fomites in the transmission of bacteria

**Reminder: how become infected?**

- First step: to become **colonized** after contact with a « reservoir » directly or indirectly (that is « through the hand of health care workers »)
- Thereafter to become **infected** if flaw in immunity

= Fomites could act as a way of cross transmission
148 strips were collected from 4 different wards from an university affiliated hospital

25.7% yield a positive culture (38/148), consisting in most cases in cutaneous flora (24.3% vs 1.4% for intestinal flora).

The bacterial load varied from 10 to 280 Colony Forming Unit per Strip (average value: 27 Colony Forming Units /CFU)

Neither a filling rate <50% nor the multi-patient use was statically associated with a bacterial contamination of the GTS

What about the packaging?
Purpose and Methodology of the study

- **Aim of the study:** to explore the bacterial contamination of GTS available in three different packaging, i.e., two multi-uses vials and one unitarian packaging

- **Method:** prospective microbiologic lab-based multicenter study (n=4)
One given day in each hospital, opened vials or boxes of GTS containing less than a half of the initial number of strips were collected in different wards, and centralized in a core laboratory.

Each strip was placed in 1 ml of 0.9% NaCl and vortexed during 30s.

100 µL of the suspension was cultured on:
- **Colombia colistin nalidixic acid** agar plate
- DrigasIki agar plate

Viable bacteria were counted after 24 h and 48 h of culture at 37°C.

One colony on the plate was equivalent to 10 Colony Forming Units per Strip.
Methodology of the study (2)

- A control sample of two unopened vials/boxes will also be sampled from one randomly selected ward per hospital.
  - 10 strips from each box will be cultured according to the same procedure.
- Each of the three types of strips will be evaluated for antibacterial activity according to the procedure previously written (activity against Escherichia coli strain ATCC25922 and Staphylococcus aureus strain ATCC29213).
- The statistical association between the packaging and the bacterial contamination was evaluated by using a χ² test, with a level of significance of 0.05.
Drigalski plate

ANC plate

Sterile Vial + isotonic NaCl + GTS

Sterile rake to streak the plate
Methodology of the study (3)

- Additional data were asked to the IC teams:
  - Whether vials for a single or multiple patients were in use, or both types
  - Whether the idea of systematically disinfecting hands with an aqueous alcohol solution before opening a vial is understood by the personnel
  - How much aqueous alcohol solution was consumed for 2011 for the ward concerned and what % of the ministry's target objective (ICSHA1) was achieved.
  - Does a protocol or technical form exist for handling glucose test strips?
Results (1)

**Global counts:**

- 606 glucose test strips tested from 4 hospitals
  - University affiliated teaching hospitals
  - Including 1 pediatric hospital
- 526 glucose test strips tested from 17 different wards
  - Medical wards: 7
  - ICU: 4
  - Surgical wards: 6
- 80 control GTS from unopened vials/boxes
## Results (2): summary

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>Vial (50 pieces)</td>
<td>Vial (50 pieces)</td>
<td>Unitarian</td>
</tr>
<tr>
<td>% positive GTS</td>
<td>11.6%</td>
<td>8.15%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Median Bacterial Load (CFU/GTS)</td>
<td>135</td>
<td>56</td>
<td>10</td>
</tr>
<tr>
<td>Range (CFU/GTS)</td>
<td>10 – 900</td>
<td>10 - 230</td>
<td>10 - 10</td>
</tr>
<tr>
<td>Antibacterial activity</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
</tr>
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</table>

The % of positive GTS is 9.7% (32/330) for vials and 2.5% (5/196) for unitarian package (Coagulase negative staphylococci) ➤ the difference is significant (p < 0.05)
Results (3):
GTS from a multi-uses vial named “A”

- Antibacterial activity of the strips:
  - absent against *E. coli*
  - exists against *S. aureus*
Results (4): Additional data from the participating centres

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<thead>
<tr>
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<th>A</th>
<th>B</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>Vial for single patient</td>
<td>0/5</td>
<td>4/8</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Availability of a technical form for GTS manipulation</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Local recommendation for a hand hygiene before opening the vial</td>
<td>Yes</td>
<td>no</td>
<td>No</td>
</tr>
<tr>
<td>% of the ministry’s target for aqueous alcohol solution consumption</td>
<td>124%</td>
<td>143%</td>
<td>136%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GTS vials</th>
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<th>vials</th>
<th>Unitarian</th>
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<tr>
<td>% positive GTS</td>
<td>11.6</td>
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<td>2.56%</td>
</tr>
</tbody>
</table>
Results (5):
Bacterial contamination of control GTS

- 80 Control glucose test strips from unopened vials collected in the 4 hospitals
  - 20 control GTS from
    - 1/20 of the unitarian strips,
    - 2/20 GTS from the multi-uses vial “B”
    - 7/40 GTS from the multi-uses vial “C”

- The mean bacterial load was 10 CFU/GTS, range [10-10 CFU/GTS]) which correspond to the limit of detection of the method (i.e one bacteria on a plate / in 100 µL)

- Coagulase negative staphylococci
Discussion:
Microbiologic contamination of GTS (1)

- The percentage of positive GTS for the multi-uses vials is lower than in the princeps study (9.7% vs 25.7%)

- But the median bacterial load among positive strip is higher (135 and 56 CFU/GTS vs 27)
  - Larger study (526 vs 148 GTS, 17 vs 4 wards)?
  - Muticenter vs monocentric study?
  - Inclusion of a pediatric hospital ("outliner"?)?
  - Differences in practices (single /multi patients)?
  - Increase in use of aqueous alcohol solution?
  - Impact of the antibacterial activity of GTS « A »?
Discussion:
Microbiologic contamination of glucose meters (2)

- Even the control GTS from unopened vials or new packaging, or the individually packaged GTS (5 out of 196) in clinical wards are sometimes positive:
  - The bacterial load of positive control GTS and all five positive unitarian GTS were only 10 CFU/GTS (1 CFU per plate), which is the limit of detection
  - A few, barely positive GTS may also be the “the background noise” of contamination since GS are not manufactured as sterile products.
  - While the exterior of the multi-use GTS vials was disinfected with alcohol-impregnated pads before removing GTS to culture, the exterior of the unitarian packaged GTS packet was not disinfected:
    - This may resulted in contamination of some of these GTS in the laboratory when removing them from the packets to culture
Conclusion: Take home messages

What we learn from this study?

- In the present study the bacterial contamination of GTS at the bedside was confirmed in a larger, multicentric study.

- The percentage of positive GTS reached 10% and the bacterial load varied broadly, including huge values as 900 CFU/GTS.

- The unitarian packaged GTS are significantly less frequently contaminated than GTS packaged in vials. The contamination of unitarian GTS corresponded the background noise. This advantage should be taken into account.