The hidden dangers of getting inked
Microbial risks associated with tattooing

Sascha Al Dahouk
Tattoo process

- surgical procedure **breaking the skin barrier**
- **180,000 puncture wounds** for one-hour-tattoo
- **health risks** including **infections**
Infected tattoos – clinical signs and symptoms

Cardinal signs of inflammation

- Dolor (pain)
- Calor (heat)
- Rubor (redness)
- Tumor (swelling)
- Functio laesa (loss of function)

Systemic effects

- Lymphadenitis
- Fever
Incidence of tattoo-related infections

• no reliable data available

• ICD-10-GM code: U69.10
  - diseases related to aesthetic surgery, tattoos and piercing

• Internet survey in German-speaking countries (n = 3,411)
  - 67.5% skin problems and 6.6% systemic reactions directly after tattooing
  - 6% persistent skin problems in tattooed area
  - 1% medical consultation

• rough estimate of infection rate: 1-5%
  - about 120 Mio people in Europe and USA are tattooed
  - 1-6 Mio people may be affected

Klügl et al. (2010); Dermatology 221: 43-50
Local and systemic tattoo infections

Local skin infections

- superficial (folliculitis, impetigo, furonculosis, ecthyma)
- severe pyogenic (erysipelas, gangrene)
- polybacterial (cellulitis, necrotizing fasciitis)
- fungal (rare cases of zygomycosis, sporotrichosis)

Systemic complications

- bloodborne infections
  - hepatitis B/C and HIV (only single case reports)
  - tetanus, tuberculosis, leprosy, syphilis (mainly historic cases)
- infective endocarditis (rare, predisposing valvular heart disease)
- deep skin infection leading to bacteremia and sepsis (very rare)
Origin and types of pathogens

**endogenous microbial skin flora**
*Staphylococcus aureus* (CA-MRSA) & group A-Streptococci

**environmental/opportunistic bacterial pathogens**
non-tuberculosis *Mycobacteria* (MOTT), *Corynebacteria*,
*Pseudomonas*, *Klebsiella*

**bloodborne pathogens**
viruses
Mycobacterium chelonae

red hyperkeratotic papules restricted to grey tattoo areas

Potential source of infection: **Tap water**

- for diluting black ink into grey
- for rinsing tattoo devices

Rodriguez-Blanco et al. (2011); *Acta Derm Venereol* 91: 61-106
Methicillin-resistant *Staphylococcus aureus*

Potential source of infection:
- suboptimal infection-control practices
- non-sterile equipment

Centers for Disease Control (2006); *MMWR* 55: 677-9
Main routes of transmission

- non-sterile devices and lack of sterile conditions
  - from one client to another (contamination with infected blood)
  - from tattoo artists (personal hygiene)
  - from surfaces and equipment (environmental contamination)
- infection during the healing process
- tattoo products (pigments, inks, dilution solvents)
## Skin infection outbreaks via tattooing and permanent make-up

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>No. of cases</th>
<th>Pathogens</th>
<th>Origin of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio, Vermont, Kentucky</td>
<td>2004/2005</td>
<td>44 (6 clusters)</td>
<td>MRSA</td>
<td>nonsterile equipment, suboptimal infection-control practices</td>
</tr>
<tr>
<td>France</td>
<td>2005</td>
<td>8</td>
<td>MOTT</td>
<td>tap water</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2007-2008</td>
<td>6</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2009</td>
<td>12</td>
<td><em>M. haemophilum</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Spain</td>
<td>2008/2009</td>
<td>5</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water, non-sterile devices</td>
</tr>
<tr>
<td>Germany</td>
<td>2011</td>
<td>7</td>
<td><em>M. chelonae</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Rochester, New York</td>
<td>2011/2012</td>
<td>19</td>
<td><em>M. chelonae et abcessus</em></td>
<td>unopened ink bottles, manufacturing chain</td>
</tr>
<tr>
<td>Scotland</td>
<td>2012</td>
<td>4</td>
<td><em>M. chelonae</em></td>
<td>undiluted ink</td>
</tr>
</tbody>
</table>
## Skin infection outbreaks via tattooing and permanent make-up

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>No. of cases</th>
<th>Pathogens</th>
<th>Origin of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio, Vermont, Kentucky</td>
<td>2004/2005</td>
<td>44 (6 clusters)</td>
<td>MRSA</td>
<td>nonsterile equipment, suboptimal infection-control practices</td>
</tr>
<tr>
<td>France</td>
<td>2005</td>
<td>8</td>
<td>MOTT</td>
<td>tap water</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2007-2008</td>
<td>6</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2009</td>
<td>12</td>
<td><em>M. haemophilum</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Spain</td>
<td>2008/2009</td>
<td>5</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water, non-sterile devices</td>
</tr>
<tr>
<td>Germany</td>
<td>2011</td>
<td>7</td>
<td><em>M. chelonae</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Rochester, New York</td>
<td>2011/2012</td>
<td>19</td>
<td><em>M. chelonae et abcessus</em></td>
<td>unopened ink bottles, manufacturing chain</td>
</tr>
<tr>
<td>Scotland</td>
<td>2012</td>
<td>4</td>
<td><em>M. chelonae</em></td>
<td>undiluted ink</td>
</tr>
</tbody>
</table>
## Skin infection outbreaks via tattooing and permanent make-up

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>No. of cases</th>
<th>Pathogens</th>
<th>Origin of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio, Vermont, Kentucky</td>
<td>2004/2005</td>
<td>44 (6 clusters)</td>
<td>MRSA</td>
<td>nonsterile equipment, suboptimal infection-control practices</td>
</tr>
<tr>
<td>France</td>
<td>2005</td>
<td>8</td>
<td>MOTT</td>
<td>tap water</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2007-2008</td>
<td>6</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2009</td>
<td>12</td>
<td><em>M. haemophilum</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Spain</td>
<td>2008/2009</td>
<td>5</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water, non-sterile devices</td>
</tr>
<tr>
<td>Germany</td>
<td>2011</td>
<td>7</td>
<td><em>M. chelonae</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Rochester, New York</td>
<td>2011/2012</td>
<td>19</td>
<td><em>M. chelonae et abcessus</em></td>
<td>unopened ink bottles, manufacturing chain</td>
</tr>
<tr>
<td>Scotland</td>
<td>2012</td>
<td>4</td>
<td><em>M. chelonae</em></td>
<td>undiluted ink</td>
</tr>
</tbody>
</table>
## Skin infection outbreaks via tattooing and permanent make-up

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>No. of cases</th>
<th>Pathogens</th>
<th>Origin of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio, Vermont, Kentucky</td>
<td>2004/2005</td>
<td>44 (6 clusters)</td>
<td>MRSA</td>
<td>non-sterile equipment, suboptimal infection-control practices</td>
</tr>
<tr>
<td>France</td>
<td>2005</td>
<td>8</td>
<td>MOTT</td>
<td>tap water</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2007-2008</td>
<td>6</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2009</td>
<td>12</td>
<td><em>M. haemophilum</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Spain</td>
<td>2008/2009</td>
<td>5</td>
<td><em>M. chelonae</em></td>
<td>non-sterile water, non-sterile devices</td>
</tr>
<tr>
<td>Germany</td>
<td>2011</td>
<td>7</td>
<td><em>M. chelonae</em></td>
<td>PMU ink</td>
</tr>
<tr>
<td>Rochester, New York</td>
<td>2011/2012</td>
<td>19</td>
<td><em>M. chelonae et abcessus</em></td>
<td>unopened ink bottles, manufacturing chain</td>
</tr>
<tr>
<td>Scotland</td>
<td>2012</td>
<td>4</td>
<td><em>M. chelonae</em></td>
<td>undiluted ink</td>
</tr>
</tbody>
</table>
Tattoo ink-related infections

Tattoo Ink
- pigments/dyes (metallic salts or organic molecules)
- liquid carrier (water, glycerine or alcohol)

Inks and pigments can be contaminated through
- contaminated ingredients
- manufacturing process
- unhygienic tattoo practice
- non-sterile water
- tattoo inks after the expiry date
## Microbiological status of tattoo inks

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of samples</th>
<th>Contaminated samples</th>
<th>Bacterial counts (cfu/ml)</th>
<th>Bacterial species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droß &amp; Mildau (Germany, 2007)</td>
<td>216</td>
<td>14 % [mainly opened bottles]</td>
<td>$10^3$-$10^6$</td>
<td>Pseudomonades Enterobacteria</td>
</tr>
<tr>
<td>Baumgartner &amp; Gautsch (Switzerland, 2011)</td>
<td>145</td>
<td>20 % [7 of 39 unopened bottles, 22 of 106 opened bottles]</td>
<td>$10^1$-$10^2$ up to $10^3$-$10^8$</td>
<td>gram-neg rods (Bacilli), gram-pos cocci (Staphylococci)</td>
</tr>
<tr>
<td>Hoegsberg et al. (Denmark, 2013)</td>
<td>64</td>
<td>11 % [6 of 58 unopened bottles, 1 of 6 opened bottles]</td>
<td>$10^2$-$10^3$</td>
<td>Streptococci Staphylococci Pseudomonades Enterococci Acinetobacter</td>
</tr>
</tbody>
</table>

→ Microbiologically contaminated tattoo inks have to be considered as a source of skin infection!
Regulations for tattoo and PMU products

Germany

• regulations of the Lebensmittel- und Futtermittelgesetzbuch (LFGB) and the Tätowiermittel-Verordnung (1st May 2009)
  - products must not endanger the health or safety of people

• no authorisation requirements for tattoo/PMU products
  - manufacturer or distributor have to comply with relevant legislations

Europe

• only instituted guidelines and no laws relating to tattoo inks

• in some member states national regulations based on Resolutions of the Council of Europe (ResAP(2003)2 & ResAP(2008)1)

- tattoo and PMU products must be **sterile** and supplied in preferably **single-use** containers
- **packaging information** should contain a **guarantee of sterility**
- **preservatives** should only be used to ensure the **preservation of the product** after opening (no correction of purity grade!)
- tattooing and application of PMU must be carried out in conformity with **hygiene regulations** laid down by national public health services
Are tattoos a biohazard?
Who do want to entrust your skin?
Summary and needs

• growing trend (25% of young adults in Germany are tattooed)

• only little knowledge about infectious health risks of tattoo products
  - tattoos are open wounds
  - microbial contaminations are not rare

• lack of international standards for the microbiological analysis of inks

• tattoo compounds in contrast to cosmetics are not officially controlled
Thank you for your attention

Sascha Al Dahouk

Federal Institute for Risk Assessment
Diedersdorfer Weg 1 • 12277 Berlin, GERMANY
Tel. +49 30 - 184 12 - 1244 • Fax +49 30 - 184 12 - 2000
bfr@bfr.bund.de • www.bfr.bund.de