Home hygiene trends and future challenges

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What is home hygiene?

The home is an environment where infections are transmitted, a proper home hygiene helps to prevent infection transmission.

Dirty public area versus safe and clean homes?

→ Public restrooms are often more hygienic than the kitchen at home

• Hand hygiene / Personal hygiene
• Food hygiene
• Safe water
• Safe disposal of faeces
• General hygiene (laundry, surfaces, toilets, bath, sink)
• Disposal of solid waste
• Control of wastewater and rainwater
• Situations where there is more risk
  • Care of infected persons
  • Care of more vulnerable persons
Risk of infection transmission

- **Respiratory infections (cold, flu):** Inhalation of infected droplets, **hand contact** with nasal mucosa or conjunctiva of the eye
- **Diarrhoeal diseases:** direct **hand** to mouth contact, contaminated food or water
- **Skin and eye infections:** **hand contact**
Today’s hygiene status and standards in the world

Hugh contrasts between hygiene problems and the everyday situations of people in different countries (EU versus India, Brasil, African countries)

WASH (Basic needs and problems)
- Clean Water
- Sanitation
- Hygiene (→ Education!)

Reduction of diarrhoeal diseases in developing countries:
→ ca. 30% if sanitation is available
→ Ca. 25% if water supply is available
→ Ca. 40% reduction if SAFE water is available (water treatment, safe storage)

Hygiene status and standards in India

Sanitation in India:
- Less than 50% of indian households have a toilet at home
- People demands mobile phones and TVs, not toilets
- Social hurdles like toilet cleaning is only done by the lowest caste
- Safety and dignity for women
Washing habits in developing countries

India:
- 85% sales of laundry detergent are soap bars
- < 10% of household own a washing machine
- Water, electricity not always available

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Brazil:
- Rural: hand wash = social event, soap bars
- Urban: own washing machine
- Mainly powder detergents

China:
- Mainly powder detergent, liquid increasing
- 75% of household own a washing machine
- Even owning washing machine, hand wash is still very common

→ Half of the world's population still washes their laundry by hand!!
Lack of sanitation: Impact on women

“I didn’t know what was happening or what to do to manage menstruation. I used cotton wool, pages from an exercise book, leaves from trees. I suffered much embarrassment at school because I leaked and stained my uniform.”

- Girls miss school during menstruation (lack of sanitation, no hygiene products) → Kenya: Adolescent girls miss 4.9 days school every month
- Infections as urinary tract infections because of lack of female hygiene products, increased maternal mortality
- Religious and cultural taboos: Impurity (most religions), dirty, contaminated

Today’s hygiene status and standards in the developed world

No ‘basic’ (= life-threatening) hygiene problems, but:
• Antibiotic resistances (Superbugs)
• New niches for microorganisms (household devices)
• Hand hygiene, surface hygiene
• Social changes (more elderly, more single households)
• Hygiene opinions / cultures
  • Hygiene hypothesis
The Hygiene Hypothesis

‘Hygiene Hypothesis’ = ‘We have become to clean for our own good’ → Relaxed hygiene standards

→ Scientific consensus today:
  • Link between reduced bacterial exposure in early life and chronic inflammatory diseases (allergies, MS, diabetes type 1…) → Regulation of the immune response is affected
  • But what sort of microbes is needed?
  • ‘Old Friends’ and ‘Diversity-’ Hypothesis (normal gut, skin, respiratory flora, helments, environmental flora → rather than pathogens)

UK as dirtiest country in the developed world!

- Investigation of the contamination of surfaces in 140 homes in seven countries

- **Hygiene hotspot surfaces:** Chopping boards (harbour more *E. coli, Campylobacter* and *Salmonella sp.* than toilet seats!), kitchen work surfaces, cleaning cloths, sponge and drying towels, toilet seats and flush handle, sink, rubbish bin lid

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<table>
<thead>
<tr>
<th>Rank order</th>
<th>Country</th>
<th>% Unsatisfactory heavily contaminated / poor areas of home</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Malaysia</td>
<td>90%</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>78%</td>
</tr>
<tr>
<td>3</td>
<td>UK</td>
<td>33%</td>
</tr>
<tr>
<td>4</td>
<td>Saudi Arabia</td>
<td>27%</td>
</tr>
<tr>
<td>5</td>
<td>USA</td>
<td>22%</td>
</tr>
<tr>
<td>6</td>
<td>Germany</td>
<td>21%</td>
</tr>
<tr>
<td>7</td>
<td>South Africa</td>
<td>15%</td>
</tr>
</tbody>
</table>

Source: Global study conducted by Global Hygiene Council, since 2008

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WARNING! YOUR OFFICE KITCHEN HAS MICROORGANISM

(Header of the blog: http://www.ics-onlinecleaning.co.uk/)
Hygiene practices and perceptions

- **Consumer habits:** Mexico (cleaning the home twice a week) versus Sweden (cleaning the home less than once a week)

- **Consumers greatest concerns about hygiene:**
  - Using a public restroom (France, Mexico)
  - Preparing food (Mexico)
  - Contact with other people (China, Sweden, Germany)
  - Public transportation (US, China)

- **Consumer perception of need of Hygiene:**
  1) Kitchen, (US prioritize bathroom)
  2) Bath
  3) Toilet (Chinese prioritize bedroom)

Source: SCA Hygiene Report 2008: Survey in nine countries (Sweden, UK, France, Germany, Russia, China, Australia, US, Mexico, ca. 4500 respondents)
Regardless of the standard, infection prevention through improved hygiene practice and education is always possible:

- **Waterless hand sanitizer:** Alcohol-based hand sanitizers (same / better efficacy than water and soap, easy application in schools, hand cleaning behaviour is increased compared to washing with soap)
- **Water treatment** by heat, sunlight etc.

Recommendations for proper home hygiene

- Setting priorities (developing countries)
- Psychosocial impacts / eduction (information, motivation, skills) → disgust, habitual practices

**Recommendation:**

1) Hand washing
2) Surface cleaning
3) Food hygiene
4) Laundry hygiene
5) Get immunized
6) Use antibiotics appropriate

→ Targeted hygiene measures

Source: [www.cdc.gov](http://www.cdc.gov) (center for disease control and prevention)
Future Hygiene challenges

- Antibiotic resistances (AMR) as a world wide issue
- New pathogens, new superbugs, pandemic risk
- Growing world population (between 9.4 and 10 billion people)
- Climate change
- Countries with highest population in 2050:
  1) India
  2) China
  3) Nigeria
  4) USA
  5) Indonesia
  6) Pakistan
  7) Brasil
  8) Bangladesh
- Demographic changes (2015: 901 mio > 60Y; 2050: 2.1 bio > 60Y)
- Limited ressources (water, energy, rawmaterials)

Antimicrobial resistances in the future

Deaths attributable to antimicrobial resistance every year by 2050

→ Black szenario: It is expected that more people will die because of antimicrobial resistances than of cancer (Today, only around 5% of death due to infections in the developed world)
Antimicrobial resistances (AMR)

Tackling the AMR with HYGIENE MEASURES:
- Sanitation, hygiene and infection prevention
- Decrease the burden of infectious diseases
- Control the spread of infection
- Control the spread of antibiotic resistances

Increased use of antibiotics in low- and middle income countries

Antimicrobial resistance risk associated with biocidal product usage

• No significant difference in microbial numbers on kitchen and bathroom surfaces
• No impact of antibacterial cleaning products on the proportion of AMR-microorganisms

Systematic lab study (Wesgate, Grasha & Maillard, 2016):
• Triclosan (0,0004%) → AMR in Staphylococcus aureus / Escherichia coli
• Hydrogen peroxide (0,001%) and Chlorhexidine (0,00005%) → no AMR promoted
• Cationic biocides, oxidizing agents → unstable clinical AMR to different antibiotics
Future challenges: Demographic changes

Increase in elderly people (from 0.9 billion (2015) to 2.1 billion (2050))
• Reduced immunity to infection
• Increased risk of death from gastrointestinal disease
• More special care at home

➔ New markets for special cleaning, disinfecting and hygiene products

Source: UN Department of Economic and Social Affairs Data
Future consumer needs related to hygiene

- Hygiene will get more important for consumers:
  - Antimicrobial resistances
  - Aging population with special needs
  - Rising middle class in India, China, Brasil...
    - Rising ownership of toilets, household devices
    - Hygiene becomes a status symbol and a well-being factor (hygiene – beauty, attractiveness)
  - Targeted hygiene for special situations
  - Very short future → (India should be in 2019 ‘open-defaecation-free’)
  - ‘Green’ Cleaning and Hygiene products
  - But ‘untargeted’ biocides or antimicrobials are hopefully banned in the future
Coordinated actions needed in the future

- Research on the hygiene hypothesis
- Research on the impact of biocides on the development of antimicrobial resistances
- Research on ABR (link between antibiotic use and resistance genes is still poorly understood)
- Global action (AB-use for humans, animals and in the environment, global surveillance)
- Keeping our hygiene level / rise the hygiene level in low- and middle income countries with limited resources
Excursion: Efficiency tests of laundry disinfectants / machine cleaners

2 product groups related to detergent / washing / dishwashing

Laundry disinfectants to reduce the microbial load within the laundry

Machine cleaners to reduce the microbial load / Malodour of the washing / dishwashing machine
Excursion: Efficiency tests of laundry disinfectants / machine cleaners

Laundry disinfectants to reduce the microbial load within the laundry
- Detergent with biocidal action
- Fabric softener with biocidal action
- Special additive (hygiene cleaner)

Targeted pretreatment or whole-wash use

Test methods:
- **Quantitative suspension tests** (Phase 2, Step 1) e.g. EN 1276 (bactericial action) and EN 1650 (action against yeasts)

**Requirements:** bacteria 5-log-, yeast 4-log-reduction
- **Quantitative carrier test** (phase 2, step 2) e.g. EN 16616

**Requirements:** bacteria 7 log-, yeast 6 log-reduction
Excursion: Efficiency tests of laundry disinfectants / machine cleaners

Machine cleaners to reduce the microbial load in washing /dishwashing machine

- Biofilm prevention
- Biofilm disinfection

Test methods:

1) **Quantitative suspension tests** (Phase 2, Step 1) e.g. EN 1276 (bactericial action) and EN 1650 (action against yeasts)

2) **Simulated use efficacy test** (e.g. microplate test)

3) **A field trial** (simulated use conditions)

For biofilm disinfection 1) and either 2) or 3) must be performed
For biofilm prevention 2) and/or 3)
Simulated use efficiency test: Biofilm Screening Test

1) Growth of a young biofilm
   - 24 h incubation at 30°C in growth medium
   - Microbial growth in the solution OD$_{595}$

2) Simulated washing test(s)
   - 4 h Incubation at 30°C in medium
   - Rinsing to remove planctonic cells
   - Microbial growth in the solution OD$_{595}$
   - Quantification of growth in the suspension

3) Biofilm quantification
   - Crystal violet assay
   - Quantification of biofilm amount

Microbial growth in the solution OD$_{595}$

Pseudomonas aeruginosa
E. coli
Staphylococcus aureus

Simulated washing machine cleaning test
A field trial: Biofilm disinfection in a washing machine

24 h incubation at 30°C in growth medium

Microbial counts of mixed biofilms before washing cycle

Suspension is analysed further

Microbial counts of mixed biofilms on carrier after washing cycle

Biofilm is dissolved from supports (Ultraschall, Vortex)

Koch-/Buntwäsche 60°C, short
No detergent, liquid detergent, IEC-A*, different washing machine cleaners

Pseudomonas aeruginosa

E. coli

Staphylococcus aureus

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Efficiency testing of laundry disinfectants or machine cleaners

ECHA ‘Transitional guidance on efficacy assessment for PT 1 to 5’

• Laundry disinfectants / Machine cleaners belong to Product type 2 (Disinfectants and algaeicides not intended for direct application to humans or animals)

• Step-wise testing of laundry disinfectants and machine cleaners
  • Suspension test (Phase 2, step 2)
  • Simulated use test (Phase 2, step 2)
  • Field trial test (Phase 3)

• Swissatest is happy to provide support for an appropriate test design and to carry out the tests!
Swissatest Testmaterialien AG, Mövenstrasse 12, CH-9015 St. Gallen, swissatest.ch

Thank you for your attention

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