Introduction
An efficient cleaning and disinfection practice plays a crucial role in preventing cross-contamination in nosocomial environment. The binding of quaternary ammonium compounds (QACs) on cellulosic material which may fail the disinfection process hinder the broad use of pre-impregnated disinfecting wipes (ready-to-use disinfectant wipes) in hospitals. Nothing is known about the adsorption and antimicrobial performance of plasma treated wipes. Moreover, ageing of disinfectant-impregnated wipes may affect the products’ disinfection performance later in practice but very little research was performed regarding this issue.

Objectives
The purpose of this study is to evaluate the change in terms of adsorption and antimicrobial activity due to the ageing of the disinfecting wipe over storage time with and without atmospheric Double Barrier Dielectric (DBD) plasma pre-treatment. The main questions to be answered are:

i) How does the adsorption of active ingredients onto textile substrate change with storage time;

ii) How does the antimicrobial efficacy vary by time.

The study of the adsorption of QACs in storage is important to ensure hospitals daily workflow and to complement the products’ user manual of disinfectant and wipes in the market.

Materials and methods
Plasma-treated and untreated commercial wiping materials of polyester (PET), 55% cellulose/45%PET and 100% cotton were immerged into QACs solution with a certain liquor ratio for 30 min, 3, 7, 15 and 30 days. The absorption and adsorption of QACs onto wiping material were measured by UV spectrophotometer. Standards ASTM E 2149-13a was carried out to assess the antimicrobial efficacy.

The quaternary ammonium salt and wipes used are listed in the Table 1.

Table 1. Test material and variables

<table>
<thead>
<tr>
<th>Surface Disinfectant: Alkylidimethylbenzlammonium chloride (CnH2nCH2N(CH3)2RCl (where R=CnH2n to C13H27))</th>
<th>Textile Substrate</th>
<th>Composition</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wipe 1</td>
<td>100% polyester</td>
<td>Nonwoven hydroentangled</td>
</tr>
<tr>
<td></td>
<td>Wipe 2</td>
<td>55%cellulose/45%polyester</td>
<td>Nonwoven hydroentangled</td>
</tr>
<tr>
<td></td>
<td>Wipe 3</td>
<td>100%cotton</td>
<td>1/1 plain weave</td>
</tr>
</tbody>
</table>

Result and discussion
Fourier transform infrared spectroscopy (FTIR)

Conclusion
The antimicrobial efficacy result based on standard ASTM E 2149-13a shows 100% cellulose wipe sample failed the antimicrobial test completely (log reduction under 2) due to the adsorption of quats on cellulose. The plasma treatment improves the wiping material’s ability against E.coli when integrated with quats.

Taking the E.coli result from wipe 1 and wipe 2, a slight antimicrobial efficacy decline with the storage time can be observed. Overall, the antimicrobial efficacy did not have a significant change for S. aureus over storage time.

Test results shows the adsorption of quats on cellulose completely block the biocidal effect of active ingredients, which is a high risk for infection control. Overall, the quats-impregnated wipes maintain a relative effective antimicrobial performance over storage time.

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Storage time effects on the bactericidal activity of plasma treated quats disinfectant-impregnated wipes

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Fig. 2. ADBAC concentration reduction change over storage time.

Fig. 3. Antimicrobial efficacy test result (log reduction) against S. aureus and E. coli based on test standard ASTM E 2149-13a.