Literature review on the epidemiology of tattooing and its complications

V0.7

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1 List of Abbreviations

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<th>Abbreviation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ACDP</td>
<td>Advisory Committee on Dangerous Pathogens</td>
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<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
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<tr>
<td>BBV</td>
<td>Blood Borne Virus</td>
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<tr>
<td>CASP</td>
<td>Critical Appraisal Skills Programme</td>
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<tr>
<td>CIEH</td>
<td>Chartered Institute of Environmental Health</td>
</tr>
<tr>
<td>CINAHL</td>
<td>Cumulative Index to Nursing and Allied Health Literature</td>
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<tr>
<td>HBV</td>
<td>Hepatitis B Virus</td>
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<tr>
<td>HCV</td>
<td>Hepatitis C Virus</td>
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<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<tr>
<td>HMIC</td>
<td>Health Management Information Consortium</td>
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<tr>
<td>HPA</td>
<td>Health Protection Agency</td>
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<tr>
<td>HSL</td>
<td>Health and Safety Laboratory</td>
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<tr>
<td>IDU</td>
<td>Injecting Drug User</td>
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<tr>
<td>IVDU</td>
<td>Intravenous Drug User</td>
</tr>
<tr>
<td>LA</td>
<td>Local Authority</td>
</tr>
<tr>
<td>LAC</td>
<td>Local Authority Circular</td>
</tr>
<tr>
<td>MHRA</td>
<td>Medicines and Healthcare products Regulatory Agency</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service</td>
</tr>
<tr>
<td>SIGN</td>
<td>Scottish Intercollegiate Grading Network</td>
</tr>
<tr>
<td>SSCI</td>
<td>Social Sciences Citation Index</td>
</tr>
<tr>
<td>TB</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>TPI</td>
<td>Tattoo and Piercing Industry Union</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
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</table>
2 Background

There are suggestions of an increasing number of body art practices in the United Kingdom (UK), commercial and domestic, as a result of growing interest by the public (Armstrong, et al., 2007; Alan Beswick and Calderdale Council, 2008; Clay, 2009; Cuyper and Perez-Cotapos, 2010). This growing interest in body art, especially tattooing and body piercing, has caused concern not only amongst health professionals (who recognise the potential for the spread of infection during these practice) and environmental health professionals (who are responsible for ensuring those carrying out these practices and their premises are properly regulated) but also amongst politicians who have more recently debated issues arising from effects of these practices. More worrying is the finding that some practitioners and their clients are not aware of the risk of complications associated with these practices (Oberdorfer, et al., 2003; Benjamins, et al., 2006; Cuyper and Perez-Cotapos, 2010).

In response to these concerns the Health Protection Agency (HPA), local authorities in England, the Health and Safety Laboratory (HSL) and the Chartered Institute of Environmental Health (CIEH) in collaboration with the Tattoo and Piercing Industry Union (TPI) agreed to review the evidence on tattooing and body piercing and develop national (infection control) guidelines for both practitioners and regulators. It is hoped that these guidelines will enable a consistent and a minimum standard for safe practise of body art in the United Kingdom.

The guidelines proposed would cover both body piercing and tattooing practice; see Appendix 1 for specific areas of body art practice that will be covered in the guidelines.

The guidelines will be in two parts, the first part is a review of published and unpublished (gray) literature on key issues that relate to the practise of tattooing and body piercing and the second part is an operational guide for both practitioners and regulators. The first part will cover literature review on body piercing and tattoo, and the review of decontamination and infection control advice.

The operational guide will be derived from the evidence gathered in the first part and from consultation with experts and stakeholders.

3 Scope of the Literature review

A comprehensive literature review has already been conducted by the Health Protection Agency on body piercing (Bone and Neube, 2004). This report details the findings of the literature review on tattooing.

The main aim of this literature review is to provide an insight on the practice of tattooing, a critical appraisal of existing evidence on the prevalence of tattoo, the complications and the factors associated with these complications. This report will also encompass a review of the literature on other guidelines relevant to tattooing and body piercing.
4 Introduction

4.1 Definition

Tattooing is defined as ‘the practice of producing an indelible mark or figure on the human body by inserting pigment under the skin using needles or other sharp instruments’ (Cuyper and Perez-Cotapos, 2010, p1). Cuyper and Perez-Cotapos (2010) and the America Academy of Dermatology (2012) asserts that there are five types of tattooing, these are a) Traumatic (natural) b) Amateur c) Professional d) Cosmetic, mainly those used for permanent makeup e.g. eye liners and e) Medical tattoos (also called dermatography, used in nipple reconstruction, camouflage for scars, alopecia, vitiligo and birthmarks).

5 Literature Review Method

5.1 Objectives

1. To review published and gray literature on the epidemiology of tattooing.
2. To review published and gray literature on the complications associated with tattooing.

5.2 Search Strategy

The following electronic databases were searched for published literature: the HMIC, Medline, Embase, CINAHL, SSCI, Google Scholar and NHS Evidence. The search covered articles published between the period January 1980 and March 2012. The search terms used are provided in Appendix 2. Gray literatures were collated from members of the working group, stakeholders and experts on the subject. Reference list of some identified articles from search conducted were used to identify other relevant articles as well.

5.3 Inclusion and exclusion criteria

Articles included in this review were limited to only those with exposure to tattooing as defined in section on 3.1(Definition) above. Articles that did not have abstracts, that could not be retrieved and those not written in English were excluded. See figure 1 below:
5.4 Appraisal

A critical appraisal using the Critical Appraisal Skills Programme (CASP) assessment tool was conducted. The evidence reviewed were graded for their level of evidence using the Scottish Intercollegiate Grading Network (SIGN), see Table 1.

### Table 1: SIGN Grading System

<table>
<thead>
<tr>
<th>SIGN GRADE FOR LEVELS OF EVIDENCE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1++</td>
<td>High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias</td>
</tr>
<tr>
<td>1+</td>
<td>Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias</td>
</tr>
<tr>
<td>1-</td>
<td>Meta-analyses, systematic reviews, or RCTs with a high risk of bias</td>
</tr>
<tr>
<td>2++</td>
<td>High quality systematic reviews of case control or cohort or studies</td>
</tr>
<tr>
<td></td>
<td>High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal</td>
</tr>
<tr>
<td>2+</td>
<td>Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal</td>
</tr>
<tr>
<td>2-</td>
<td>Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal</td>
</tr>
<tr>
<td>3</td>
<td>Non-analytic studies, e.g. case reports, case series</td>
</tr>
<tr>
<td>4</td>
<td>Expert opinion</td>
</tr>
</tbody>
</table>

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**Figure 1: Exclusion and Inclusion criteria**

- Intervention described meets the definition of Tattooing
- All types of report including experimental and observational studies, case series and case reports, descriptive reviews and guidelines.
- Articles identified by experts or stakeholders as relevant, published and unpublished.
- Relevant articles on reference list of published and unpublished reports

**Exclusion criteria**

- Other forms of body art e.g. branding, scarification and implants
- Other procedures where the skin is breached e.g. acupuncture
- Papers in languages other than English
- Articles that could not be retrieved
6 Results

There were scarcity of good quality and high-level evidence; however, effort was made to identify available studies. Although most of the studies identified were weak they were able to inform existing knowledge and they also highlight the need for further research work. Initially six hundred and fourteen (614) potential articles were identified. Following the application of inclusion and exclusion criteria, forty-six (46) articles were finally reviewed. The identified published and unpublished papers included systematic reviews (2), cohort study (1), case control studies (3), observational studies (23), reviews (5) and guidelines (12). See Appendix 3.
# Table 2: Summary of Literature retrieved and appraised

## Epidemiology of Tattooing

<table>
<thead>
<tr>
<th>Study and Date</th>
<th>When</th>
<th>Settings</th>
<th>Sample</th>
<th>Method</th>
<th>Prevalence</th>
<th>Other Findings</th>
<th>Comments</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiona T.C. et al., 2010</td>
<td>2007</td>
<td>17 state prisons in Illinois, USA.</td>
<td>1819 (1293 men and 526 women) inmates participated in the survey</td>
<td>Mixed method-cross sectional study and focus group-randomly selected inmates and convenience sample for focus group.</td>
<td>67% had tattoos, and 60% had body piercings</td>
<td>Factors associated with tattooing in prison include incarceration for 1 year or longer and having had sex in prison among both men and women; non-heterosexual identity for women only; and for men, being 30-39 years old; incarcerated 4 or more times; having a history of sharing needles, multiple vaginal sex partners, and inconsistent condom use in the 6 months before arrest. 16% received tattoos during the current incarceration, 80% by amateur tattooist.</td>
<td>Recall bias, No history of tattoo at previous incarceration</td>
<td>3</td>
</tr>
<tr>
<td>Armstrong M.L. and Murphy K.P. 1997</td>
<td>1997</td>
<td>8 school sites in 8 states, USA</td>
<td>3,650 surveys distributed and 2,101 response. All adolescents</td>
<td>Cross sectional survey</td>
<td>10% tattooed adolescents</td>
<td>55% interested in having a tattoo. 57% (n = 121) of those tattooed claim to be &quot;risk takers&quot;; 14% (n=30) reported short-term irritations, such as redness, dryness, or tender skin following tattooing. No blood-borne diseases were reported but 68% (n = 145) cite small to large amounts of bleeding during the procedure so the potential exists.54% (n = 94) reported amateur tattoos.</td>
<td>Selection bias, recall bias</td>
<td>3</td>
</tr>
<tr>
<td>Armstrong M.I. et al, 2000</td>
<td>Prenatal clinic in South western USA.</td>
<td>41</td>
<td>Cross sectional survey</td>
<td>12.2% of 41 had tattoo. 36.6% of the dads had tattoo.</td>
<td>51.2% interested in tattoo. 48% will refrain due to fear of AIDS. All were impregnated by a tattooed person. Most had tattoo in an amateur setting. Most impulsive decision to tattoo was at age 14-16 years.</td>
<td>Small sample size, convenience sampling. Recall bias</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Armstrong M.I. et al, 2000</td>
<td>Household settings in USA</td>
<td>2004</td>
<td>Random digit dialling technology was used to obtain a national probability sample of 253 women and 500 people</td>
<td>24% had tattoos and 14% had body piercings</td>
<td>21% of non-tattooed had considered having a tattoo. Most had tattoo on their arm. Tattoo individuals more likely to have relative/friends who were tattooed. Those tattooed were more likely to have spent 3 or more days in prison. 9% had tattoo under the influence of alcohol and/or drugs. 26%, especially those younger than</td>
<td>Recall bias 33% response rate. Use of trained interviewers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Armstrong M.I. et al, 2000</td>
<td>A Midwestern military base-recruit and advanced individual trained armed officers</td>
<td>1894</td>
<td>Cross sectional survey</td>
<td>36% of 1835 had tattoos</td>
<td>48% of the soldiers were serious/very serious about getting a tattoo. 31% stated there were no reasons preventing them from having a tattoo. 22% had three or more tattoos. 64% entered the military with the tattoos. 15% had been under influence of alcohol and/or drugs. 22% used amateur tattoo. 76% reported small to moderate bleeding during procedure. 14 had skin irritation, 4 dye allergies, 3 photosensitivity, 2 skin infection. 7 sought tattooist advice and only 3 sought health professional advice.</td>
<td>Selection bias, on random/convenient selection, power calculation, recall bias</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Laumann A.E. and Derick A.J. 2006 | Household settings in USA | 2004 | Random digit dialling technology was used to obtain a national probability sample of 253 women and 500 people | 24% had tattoos and 14% had body piercings | 21% of non-tattooed had considered having a tattoo. Most had tattoo on their arm. Tattoo individuals more likely to have relative/friends who were tattooed. Those tattooed were more likely to have spent 3 or more days in prison. 9% had tattoo under the influence of alcohol and/or drugs. 26%, especially those younger than | Recall bias 33% response rate. Use of trained interviewers. |
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Sample Characteristics</th>
<th>Methodology</th>
<th>Results</th>
<th>Study Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cegolon, L. et al, 2010</td>
<td>2007</td>
<td>Six (6) public secondary schools from each of 7 Provinces of the Veneto Region, Italy</td>
<td>Cross sectional survey</td>
<td>6% had tattoo and 20% body piercing</td>
<td>Recall bias, selection bias, convenient sample</td>
</tr>
<tr>
<td>Deschesnes M. et al 2006.</td>
<td>2002</td>
<td>23 high schools in Quebec, Canada. High school students, age range 12-18. 2145 of 2180 (81%) students data analysed</td>
<td>Cross sectional survey</td>
<td>8% tattooed and 27% body pierced</td>
<td>Recall bias, convenience sampling</td>
</tr>
<tr>
<td>Harris Interactive 2012</td>
<td>2012</td>
<td>General population online survey in USA 2106 Adults, aged 18 and over.</td>
<td>Cross sectional survey</td>
<td>21% have tattoo</td>
<td>Selection bias, non random/convenience selection, power calculation, recall</td>
</tr>
</tbody>
</table>
Benjamins, L.J. et al, 2006

Four urban high schools in Texas, USA

997 minority high school students. Inner-city black and Hispanic students from 18-24 and 22% of those 18-24) and older (27% of those 40-49, 11% of those 50-64 and just 5% of those 65 and older). Women are slightly more likely than men, for the first time since this question was first asked, to have a tattoo (now 23% versus 19% in 2003/08). Women are slightly more likely than men, for the first time since this question was first asked, to have a tattoo (now 23% versus 19% in 2003/08). Age, sex, race/ethnicity, education, region and household income were weighted.

Benjamins, L.J. et al, 2006

Four urban high schools in Texas, USA

997 minority high school students. Inner-city black and Hispanic students from 18-24 and 22% of those 18-24) and older (27% of those 40-49, 11% of those 50-64 and just 5% of those 65 and older). Women are slightly more likely than men, for the first time since this question was first asked, to have a tattoo (now 23% versus 19% in 2003/08). Age, sex, race/ethnicity, education, region and household income were weighted.

Makkai, T. And McAllister I. 2001

Australia

Households

9489 Household members aged 14 and above. Randomised stratified sampling

Cross sectional survey

8.6% (86) have at least one tattoo AND 8.0% (80) have at least one body piercing

About 20% with tattoos and 60% with piercings said they would not repeat the experience. About 20% of the teens who obtained their art from a professional were not asked for proof of parental consent.

Recall bias, selection bias - convenient sample

3

Mayers L.B. et al 2002

University, USA

454 students (218 men and 236 women). Randomly selected students

Cross sectional survey

23% had tattoos and 51% had body piercing

Most popular sites were the arms and hands for men and the back for women. Complications reported were scars and keloid.

Recall bias

3
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Setting</th>
<th>Sample Size</th>
<th>Study Type</th>
<th>Response Rate</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidoti, E. et al., 2010.</td>
<td>2010</td>
<td>University students</td>
<td>570 from humanistic sciences, (Law, Science of Education, Arts) and 630 from scientific areas, (Chemistry, Mathematics, Physics, Architecture). Survey respondents were 655 males, (55.0%) and 545 females (45.0%).</td>
<td>Cross sectional survey</td>
<td>64%</td>
<td>Unemployment, lack of partnership and family attitude towards body art, were positively associated with students’ body art. Body art was strictly associated with different unhealthy lifestyles, such as drug, alcohol and tobacco consumption, problem gambling and sexual activity before 18 years of age. A relevant part of students considered piercing and tattooing as having no consequences for infections and/or disease.</td>
</tr>
<tr>
<td>Stirn A. et al., 2006</td>
<td>2005</td>
<td>German Households</td>
<td>2043 respondents from 210 sample points in Germany, 14–93 years</td>
<td>Cross sectional survey</td>
<td>8.5%</td>
<td>Group of individuals aged between 14 and 44 years, unemployment and no affiliation to a church are positively correlated with tattooing, tattooing is significantly correlated with the perception of reduced mental health, and both tattooing and body piercing are correlated with significantly increased sensation-seeking behaviour.</td>
</tr>
<tr>
<td>Study and Date</td>
<td>When</td>
<td>Settings</td>
<td>Sample</td>
<td>Method</td>
<td>Complications</td>
<td>Frequency of complications and Other Findings</td>
</tr>
<tr>
<td>----------------</td>
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<td>----------</td>
<td>-----------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Armstrong, M.L. et al 2008</td>
<td>1985–2007</td>
<td>Clinical cases in USA</td>
<td>22 specific cases of Infective Endocarditis. 10 males, 12 females</td>
<td>Case series</td>
<td>Infective endocarditis</td>
<td>Infective endocarditis associated with piercing the tongue (seven), ear lobes (six), navel (five), lip (one), nose (one), and nipple (one), and reported in one heavily tattooed person.</td>
</tr>
<tr>
<td>Bruneau J, et al 2010</td>
<td>2004 to 2008</td>
<td>An open cohort of IDUs in Montreal, Canada</td>
<td>784 IDUs 18 years of age or older</td>
<td>Cohort study</td>
<td>HCV</td>
<td>Availability of body art facilities and body art piercing do not predict hepatitis C acquisition among injection drug users Statistically significant independent effects of recent imprisonment and frequency of recent injections.</td>
</tr>
<tr>
<td>Campello C. et al 2002</td>
<td>1994 to March 1995</td>
<td>Community-based population study in northern Italy—mainly employee in the</td>
<td>2154 participants aged 17–67 years</td>
<td>Seroprevalence study</td>
<td></td>
<td>In the multivariate analysis sex, age over 50 years, transfusion, IVDU and tattooing were confirmed as risk factors for HCV infection</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Year(s)</td>
<td>Study Design</td>
<td>Participants</td>
<td>Data Collection</td>
<td>Main Findings</td>
<td>Methodological Issues</td>
</tr>
<tr>
<td>---------------------</td>
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<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Deschesnes M. et al</td>
<td>2006</td>
<td>Cross sectional survey</td>
<td>High school students, age range 12-18. 2145 of 2180 (81%) students data analysed</td>
<td>Skin irritations, Unusual bleeding, Infection at site, Allergy to dye/metal, Swollen glands</td>
<td>158 had complications Skin irritations - 19% Unusual bleeding 10% Infection at site 7%; Allergy to dye or metal 5.1% Swollen glands 4.4%</td>
<td>Recall bias, convenience sampling</td>
</tr>
<tr>
<td>Drage, L.A. et al</td>
<td>2010</td>
<td>Case report - Outbreak</td>
<td>5 cases 3 men and 2 women with a mean age of 21 years (age range 18–23 years)</td>
<td>Mycobacterium Chelonae</td>
<td>Skin lesions in tattooed areas, all of which had been recently administered in the same tattoo parlour. The source of infection may have been either the water used to dilute the ink for obtaining the grey colour or the containers used for mixing the ink.</td>
<td>Subjective</td>
</tr>
<tr>
<td>Garland S.M. et al</td>
<td>2006</td>
<td>Case report</td>
<td>A pregnant lady</td>
<td>HIV infection associated with tattooing</td>
<td>Home visit tattooing which took place in Vietnam. Tattoo conducted by a mobile tattooist. Previous healthy child. Sexual partners and child negative for HIV. Pregnancy was terminated.</td>
<td>Subjective</td>
</tr>
<tr>
<td>Jafari S. et al</td>
<td>2010</td>
<td>Systematic review</td>
<td>124 studies were included, of which 83</td>
<td>HCV</td>
<td>Tattooing is more common among the youth and young adults and hepatitis C is very common in the imprisoned</td>
<td>Publication bias, high heterogeneity</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Setting, Location</td>
<td>Participants</td>
<td>Study Design</td>
<td>Hepatitis C Risk Factors</td>
<td>Results</td>
</tr>
<tr>
<td>-------</td>
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<td>-------------------------</td>
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</tr>
<tr>
<td>Mayers et al 2002</td>
<td>2001</td>
<td>University, USA</td>
<td>454 students (218 men and 236 women)</td>
<td>Cross sectional survey</td>
<td>Keloid and scarring</td>
<td>Most popular sites were the arms and hands for men and the back for women. Complications reported were scars and keloid.</td>
</tr>
<tr>
<td>Neal et al 1994</td>
<td>1991-1992</td>
<td>Blood donors in the UK</td>
<td>119 Blood donors in UK and 150 controls. Of the 74 cases, 46 were male (mean age 34-6 years) and 28 female (mean age 37-6) and of the 150</td>
<td>Case control</td>
<td>HCV</td>
<td>No association of HCV with professional tattooing. Association with injecting drug use, blood transfusion, sex with IDU or HCV positive person, healthcare worker, born outside the UK. Hepatitis C infection associated with amateur tattooing. Descriptions of groups of people tattooing themselves with unclean needles, given by some of the cases.</td>
</tr>
</tbody>
</table>

Studies (45 cross sectional, 30 case-control, and 8 cohort) with a total of 132 145 participants that were included in the meta-analysis from all the studies was 7 with a range of 6 to 9-9 been highest for quality. Population, Pooled odds ratio was 2.74 (2.38 3.15). In a subgroup analysis, odds ratio for hepatitis C for samples derived from non injection drug users was 5.74 (1.98–16.66). The association between tattooing and hepatitis C was significant for tattoos done in non-professional parlours or done by friends (OR 2.80, 95% CI 1.29–6.08).
controls 92 were male (mean age 34-2) and 58 female (mean age 36-6). Nishioka SD et al. 2002 Hospital-based in Brazil 182 people 18-62 years old who were admitted to the hospital, came to the outpatient clinic, or who volunteered to donate blood Cross-sectional matched study HBV HCV HIV infections Syphilis and Chagas' disease Age at first tattoo ranged from 8 to 40 years. Significant associations between an increasing number of tattoos and HBV infection, having a non-professional tattoo and testing positive for at least one blood borne virus and having 3 or more tattoos and testing positive for at least one BBV. Selection bias, non random/convenient selection, ?power calculation

Rania A.T. and Scott D.H., 2011 Various setting-hospital, community, blood donors 62 articles-case-control, cohort or cross sectional studies. Systematic review HCV The risk of HCV infection is significant, especially among high-risk groups (adjusted odds ratio, 2.0–3.6), when tattoos are applied in prison settings or by friends. Publication bias, recall bias, heterogeneity with combining studies 2++

Satchithananda, D.K., et al., 2001 1 clinical case-a 28 year old man with a congenital functionally bicuspid aortic Case report Infective endocarditis Tattooed monthly for a period of five years in a tattoo parlour Subjective study 3
<table>
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<tr>
<th>Reference</th>
<th>Year(s)</th>
<th>Study Design</th>
<th>Setting</th>
<th>Sample Size</th>
<th>Methodology</th>
<th>Outcome(s)</th>
<th>Bias</th>
<th>Notes</th>
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<tr>
<td>Pérez, C.M. et al, 2005</td>
<td>2001–2002</td>
<td>Cross-sectional survey with face-to-face interview followed by venepuncture for HCV antibody testing</td>
<td>Sample of households representative of the population in San Juan, Puerto Rico</td>
<td>964 subjects aged 21–64 years</td>
<td>HCV</td>
<td>Multivariate logistic regression revealed that tattooing practices (POR = 8.9; 95% CI 1.7–44.7), lifetime cocaine use (POR = 5.5; 95% CI 2.2–13.5), blood transfusions prior to 1992 (POR = 4.0; 95% CI 1.6–10.1), lifetime heroin use (POR = 3.3; 95% CI 1.4–7.8), and history of imprisonment (POR = 2.3; 95% CI 1.1–4.9) remained significantly associated with HCV seropositivity.</td>
<td>Recall bias</td>
<td>Response rate of 85.7%</td>
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<td>Silverman A.L, et al, 2000</td>
<td>?</td>
<td>Cross sectional study</td>
<td>Hospital outpatient clinic or emergency centre in USA, over a 6-212 patients, patients aged 18 to 55 yr.</td>
<td>Tattoo not associated with chronic HCV</td>
<td>106 (50%) had tattoos. Patients with tattoos were more likely to have a history of body piercing and more than five sexual partners than were patients without tattoos.</td>
<td>Selection bias, non random/convenient selection, No power calculation,</td>
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<tr>
<th>Study</th>
<th>Year</th>
<th>Setting</th>
<th>Case Description</th>
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<th>tattooing associated with</th>
<th>Other Health Conditions</th>
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<td>Viswanatha n U., et al., 2011</td>
<td>2008</td>
<td>Prison in the UK</td>
<td>Single case-28 year old inmate</td>
<td>Case report</td>
<td>Probably shared a 'homemade' tattoo gun</td>
<td>HBV</td>
<td>Subjective study</td>
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<td>Samuel, M. C., et al 2001</td>
<td>1995-7</td>
<td>Street-recruited injecting drug users in New Mexico, USA</td>
<td>1062 individuals, 1003 IDUs and others partners of IDUs- Participants were primarily Hispanic (73±3%), male (72±5%), and with median age 37 years (range 15±68, interquartile range 30±43)</td>
<td>Cross sectional study</td>
<td>A significant association was also observed with having received tattoos in jail/prison (OR for HBV 2.3, 95% CI;1.4-3.8 and OR for HCV 3.4, 95% CI 1.6-7.5). Tattooing linked to prison-unhygienic setting. Ninety percent of the IDUs reported sharing injection equipment. Tattoos were very common (74.6%) with most tattoos received from a friend or self (50.6%) and many received inside jail or prison (37.6%).</td>
<td>HBV HCV</td>
<td>Selection bias, responder's bias and recall bias. Non random.</td>
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<td>Study</td>
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<td>Patients</td>
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<td>Shebani, S. O. et al 2007</td>
<td>Cross sectional study.</td>
<td>600 patients with underlying cardiac conditions and 68 clinicians (81%) responded, age range (4 weeks–38 years) and Sixty two (91%) of the 68 consultants.</td>
<td>Infective endocarditis associated with those with body art.</td>
<td>Majority not aware of the risk of endocarditis associated with tattooing and body piercing among patients with congenital heart disease and paediatric cardiologists in the United Kingdom- Fifty four (62%) patients out of 78. A total of 87 (17.9%) children had body art: 86 had body piercing (78 ears, one eyebrow, four nasals, three umbilical) with a mean age of 12 years and one had a tattoo at 15 years.</td>
<td>Selection bias, responder's bias and recall bias. Non random.</td>
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<td>Brillman, J.C. et al 2002</td>
<td>Case Control</td>
<td>121 patients</td>
<td>HCV</td>
<td>Nearly all (17/19, 89.5%) of survey participants who reported IDU were HCV positive (OR 858.5, 95% CI 61.8-22,026.5). Other drug use, including intranasal cocaine (OR 15.6, CI 3.9-88.4), a history of smoking crack cocaine (OR 5.9, CI 1.7-19.5), and marijuana use (OR 19.7, CI 2.8-842.6) were associated with HCV. Survey participants who reported having a tattoo (OR 6.3, CI 1.9-24.3), sexual contact with injection drug users (OR 12.4, CI 3.3-46.9), a history of incarceration (OR 12.4, CI 2.4-66.3), and a history of hepatitis B viral infection (OR 10.8, CI 1.1-135.3)</td>
<td>Recall and response bias, Selection bias. Power calculation- small small size for multivariate analysis</td>
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were also associated with HCV serology?

| Armstrong, M.L., et al 2008 | 1985–2007 | Clinical cases | 22 specific cases of Infective Endocarditis-10 males, 12 female adolescents and young adults 15–30 years of age | Case series | Infective endocarditis- *S. aureus* | Infective endocarditis caused by the following Haemophilus aphrophilus; Haemophilus parainfluenzae; Diplococcus mucosus; Staphylococcus aureus; Streptococcus constellatus; Staphylococcus epidermidis; Streptococcus viridians. | Subjective study | 3 |
6.1 History

Although the word tattoo appears to have originated from the Tahitian word ‘tatu’, meaning ‘to mark’, the practice dates back to Neolithic times and has been practiced in every continent of the world (Makkai and McAllister, 2001; Groom, 2006; Cuyper and Perez-Cotapos, 2010). There is no continuous history on tattooing but it appears tattooing was widely practised during prehistoric Britain until the advent of Christianity (Deschesnes et al 2006; Groom, 2006; Armstrong et al., 2007; Cuyper and Perez-Cotapos, 2010; Jafari et al., 2010). Some authors even claim that the ‘Picts’ (original inhabitants of northern Britain) literally meant ‘the painted people’ and that Britain, meaning ‘people of design’ derived it name from tattoo and that the British are the most tattooed people in Europe (Groom, 2006; Wikipedia, 2012).

Tattoos were mainly associated with various cultural and societal attributes, often times conducted as a mark of status, belonging, religious affiliation, bravery, fertility, love, aesthetics, punishment and conquest (Makkai and McAllister, 2001; Cuyper and Perez-Cotapos, 2010; Sidoti, et al., 2010). Tattooing has since resurfaced, mostly used for aesthetic and self expression purposes, and has been observed amongst people of all ages, classes and occupation with society now polarised between tattooing as aesthetic/cosmetic or a sign of deviant and carefree behaviour, although the former view appears to be gaining greater ground (Armstrong and Murphy, 1997; Makkai and McAllister, 2001; Armstrong et al., 2004; Benjamins et al., 2006; Laumann and Derick, 2006; Urdang et al., 2011; Harris Interactive, 2012).

Regardless of the rationale for tattooing and the societal norm, tattooing remains a risky practice with the potential for life threatening and irreversible complication, especially when practised under unhygienic conditions.

6.2 Prevalence

Majority of the published literature that provided information on prevalence of tattooing were cross sectional studies, usually with convenient sampling, conducted in developed countries. There are limited, if any, published literature on the absolute prevalence of tattooing in the UK. Prevalence of tattooing varies across other developed countries. Three recent studies conducted, two in the United States (in 2008 and another in 2012) indicated a prevalence of 21% of those aged 18 and above (an increase from 14% observed in 2008) (Harris Interactive, 2012). The second study conducted in Germany (in 2005) had a prevalence of 8.5% of those aged 14 to 93 years old (Stirn et al., 2006).
Other articles identified conducted prevalence study amongst different age groups in different settings i.e. educational institutions, armed forces settings, clinics and prisons (Benjamins et al., 2006; Cegolon et al., 2010; Sidoti et al., 2010). Prevalence of tattoo appears to be higher in prisons with a prevalence of 25.2 to 67% of inmates (Weild et al., 2000; Armstrong et al., 2004; Poulin et al., 2007; Abiona et al., 2010; Jafari et al., 2010). Prevalence in an armed forces setting was about 25.2% to 37.4% (Armstrong et al., 2000; Cuyper and Perez-Cotapos, 2010). Note that those recruited into these studies had either had the tattooing before joining these setting or had them whilst in those settings.

Tattoos tend to be more amongst males than females (with a new shift observed in the USA in 2012—more females than males) (Armstrong and Murphy, 1997; Harris Interactive, 2012). Tattoos are placed in any part of the body and most tattoos are located in areas of the body that could be covered by clothing (Laumann and Derick, 2006; Cuyper and Perez-Cotapos, 2010). The highest prevalence noted were amongst those aged 25 to 39 years (Cuyper and Perez-Cotapos, 2010; Harris Interactive, 2012), with what appears to be an increasing trend in adolescents observed (range 6–23%) (Benjamins et al., 2006; Laumann and Derick, 2006; Cegolon et al., 2010; Harris Interactive, 2012; Rania and Scott, 2012).

Many studies found a significant association between tattooing and risky behaviour, especially amongst adolescents (Armstrong and Murphy, 1997; Silverman et al., 2000; Hellard et al., 2004; Benjamins et al., 2006; Deschesnes et al., 2006; Laumann and Derick, 2006; Sidoti et al, 2010). These behaviours include the use of legal and illegal drugs, alcohol, and high-risk sexual behaviour.

Although the context and study designs varied, so did the possible cofounders. However, the findings appear to be consistent. See Table 2 for a summary table on literature appraised.

6.3 Review of Practices

Tattoo is conducted in various settings. These settings include dedicated parlours, mobile units, auxiliary settings e.g. hairdressing salons; institutional settings i.e. prisons, armed force bases and even domestic settings.

The procedure involves the injection of a colorant (dyes/pigments) into the skin using certain instruments. The type of instrument used varies from standard electrical powered vertical vibrating instruments to pencils, pens, and sewing needles, guitar strings and homemade devices (Armstrong and Murphy, 1997; Armstrong et al., 2000; Laumann and Derick 2006; Cuyper and Perez-Cotapos, 2010; Rania and Scott, 2012). These instruments are inserted in the tattoo inks (which contain various dyes/pigments, contents of which are often not known) and then injected into the skin at levels that are dependent on the skills and experience of the tattooist, the type of tattoo and to a large extent the type of tattooing device used (Cuyper and Perez-Cotapos, 2010).
There are two distinct types of practice, which are dependent on the context of the procedure; these are amateur and professional tattoo practice (Cuyper and Perez-Cotapos, 2010). It appears that most of the risks of complications are attributed to amateur practices that tend to conduct tattoo under unregulated and unhygienic conditions (Armstrong et al., 2000; Nishioka et al., 2002; Cuyper and Perez-Cotapos, 2010; Rania and Scott 2012). However, a significant number of complications can be traced to professional practice (Haley and Fischer 2001; Cuyper and Perez-Cotapos, 2010). Often, the definition of a professional practice in these situations (i.e. with link to reported complications) is blurred by different criteria for definition i.e. practitioner in a dedicated parlour who complies with regulation, practitioner with a tattoo gun, practitioner who has conducted a lot of tattoos, practitioner who displays evidence of attendance at a training/course. Irrespective of the definition, common theme amongst these professional practices is the poor understanding of aseptic practice, poor after-care knowledge and understanding, and poor awareness of complications that could arise from their practice. It is often the case that the clients are also not aware of these, either.

Complications tend to arise in the immediate hours (e.g. bleeding, swelling and itching) or in the weeks following the procedure (e.g. infections, psychosocial issues) and these latter complications are sometimes long term with irreversible consequences.

### 6.4 Training and Qualifications

There is no formally recognised training or qualification for tattooing in the UK. Most professional tattooist learn through apprenticeship, some (in the USA) attend accredited courses while others (most amateur tattooist) learn through watching videos; a significant number of these practitioners are registered with an association that encourages professional practice, the Tattoo and Piercing Industry Union (TPI), being the most prominent association in the UK (Alan Beswick and Calderdale Council, 2008; Wikipedia, 2012).

There have been suggestions that tattooist should attend a relevant course and be supervised by someone with at least 5 years experience in tattooing (Alan Beswick and Calderdale Council, 2008; Whiteman-hoyte and London Special Treatment Nurses’ group, 2011). There was an initiative by Health and Beauty Industry Association (HABIA) several years ago to work with industry to develop occupational standards for tattooing and body piercing. Tattoo and Piercing Industry Union (TPI) i.e. the organisation representing the industry carried this initiative forward. More recently, the TPI have suggested an apprenticeship type of training as a minimum training/qualification requirement (Alan Beswick and Calderdale Council, 2008). None of these suggestions has been formally agreed hence no minimum training/qualification is currently enforceable.
6.5 Complications

Generally, the risk of complications depends on the following (Cuyper and Perez-Cotapos, 2010):

The tattooist i.e. pre-existing medical condition, training/skills, standards of infection control, provision of accurate information on risk and aftercare to clients, reflection on practice through adequate record keeping and checks.

The environment and materials used i.e. aseptic environment, sterile instruments, and appropriate space for practice, sterile and licensed pigments.

The client i.e. the client’s pre-existing medical condition, their genetic predisposition, aftercare knowledge and the attitude of the client to aftercare.

Most noted complications are:

6.5.1 Allergies

Most of these are attributed to materials used, mainly azo dyes, with specific reactions to mercury salt, nickel sulphate, crunabar, quinacridon, cadmium sulphide (Deschesnes et al., 2006; Cuyper and Perez-Cotapos, 2010). More recently are reactions from sunlight and laser induced chemical change in tattoo pigments (Cuyper and Perez-Cotapos, 2010). It appears most of the allergies are attributed to red and yellow tattoos.

6.5.2 Infections

Infections after tattooing procedure are mainly dependent on hygienic measures in place, the expertise of the tattooist, and often the tattooist or client’s underlying medical condition. Commonly found infections are those due to bacterial infections at site of tattoo and commonly implicated pathogens are streptococcus pyogenes and staphylococcus aureus (Cuyper and Perez-Cotapos, 2010). These infections have resulted in secondary infections like cellulitis, sepsis, abscess, endocarditis, and gangrene (Satchithananda et al., 2001; Shebani et al., 2007; Cuyper and Perez-Cotapos, 2010).

Other pathogens associated with tattooing were Mycobacterium tuberculosis (TB), Mycobacterium Chelonae, Mycobacterium leprae (Leprosy) and Syphilis (Nishioka et al., 2002; Cuyper and Perez-Cotapos, 2010; Drage et al., 2010).

Viral infections noted include hepatitis A, B, C and D, HIV and Herpes simplex (Neal et al., 1994; Brillman et al., 2001; Samuel et al., 2001; Campello et al., 2002; Nishioka et al., 2002; Pérez et al., 2005; O’Brien et al., 2008; Bruneau et al., 2010; Cuyper and Perez-Cotapos, 2010; Jafari et al., 2010; Rania and Scott, 2012; Tohme and Holmberg, 2012). Less common were association with some systematic fungal infections like candidiasis (Cuyper and Perez-Cotapos, 2010).
6.5.3 Others

Psoriasis, lichen planus, sarcoidosis and keloids have been observed as concomitant disease triggered by tattooing (Mayers et al., 2002; Papameletiou et al., 2003; Cuyper and Perez-Cotapos, 2010; Sidoti et al., 2010).

The context and study designs for the evidence on complications reported varied from case reports, case reviews to systematic review; hence the level and grade of evidence will vary. However, the findings of this literature review indicate some of the complications associated with tattooing. The implication are discussed in section 6.7, 6.8 and 10 below, also see Table 2 for a summary of literature on complications.

6.6 Frequency of complications

Three articles collected data on frequency of complications (Armstrong and Murphy, 1997; Armstrong et al., 2000; Deschesnes et al., 2006). None of which could adequately capture frequency of blood borne virus infection because of the study design. The study design was cross sectional study that relied only on questionnaires which were specific to symptoms reported, some people could be asymptomatic following infection with blood borne virus. The adverse effects commonly reported were short term irritations like small to large amounts of bleeding, redness, dryness and tender skin. See Table 2 for a summary of literature on frequency of complications.

6.7 Blood Borne Viruses and Tattooing

The majority of the articles identified that specifically considered the risk of transmission of blood borne virus as a complication of tattooing, focused on hepatitis B and C. Two of the evidence identified was both systematic reviews, the highest level of evidence. The two systematic reviews concluded that tattooing was associated with the transmission of hepatitis C. Systematic review and meta-analysis by Jafari et al. (2010) were of good quality, however, heterogeneity of the study was high and so was publication bias observed. Tohme and Holmberg (2012) conclusions from their systematic review were consistent with those of Jafari et al. (2010). A significant number of the studies in the systematic reviews could not be combined, as it appears there were huge variations in the study design, exposure indicators and outcome measure.

Most of studies identified from the literature review conducted have asserted that tattooing is associated with blood borne virus while others have claimed that there is no association. A number of these studies were mostly observational studies and had limitations that could affect their internal and external validity. The studies that indicated an association between tattooing and blood borne viruses were
predicated on the practice of tattoo under unhygienic conditions. See Table 2 for a summary of literature on tattooing and blood borne virus.

These systematic reviews are more robust and are the higher level of evidence. The systematic review suggest that tattooing is associated with blood borne viruses, especially with hepatitis C, when tattooing is practised under unhygienic conditions.

6.8 Infections and risk of transmission

Some of the articles identified from this literature review were able to deduce some plausible means of infection transmission. These were either based on independent risk factors associated with infection in some of the analytical studies or on case report observation.

* Tattooist practise e.g. saliva

A case report by Goldstein (1979) implicated a tattooist, who had the habit of putting the instruments in their mouth while tattooing, as the main source infection and the vehicle for the spread in a syphilis outbreak (Cuyper and Perez-Cotapos, 2010). Although the tattoo appeared to have been performed by an amateur in an unregulated environment, it is never the less a possible practise amongst tattooist and that poses a significant risk for infection transmission.

* Area covered by tattoo.

The length of a tattoo procedure and the area of the body covered in relation to acquiring blood borne virus have been explored. Robotin et al., (2004) in their study observed that those who had tattoo that covered an area greater than 1cm² were more at risk of blood borne virus infections than those who don’t have tattoo, with those that have tattoo covering an area greater than 20cm² having the greatest risk. It also appears that the larger the area covered the longer the time it takes to complete the tattoo and this could result in lax aseptic practise. This analytical evidence was a robust analysis of retrospective data from the Australian hepatitis C surveillance data for the period 1997 to 2000.

* Number of tattoos

Nishioka et al. (2002) observed that increasing number of tattooing was associated with the risk of hepatitis B infection, further asserting that those having three or more tattoos were associated with at least one blood borne virus. The finding from this study is plausible, however, this was a cross sectional
study which used a convenient sample and with concerns on ascertainment of some variables that could bias the findings, hence caution with interpretation.

Contaminated materials e.g. dyes

The risks associated with tattooing treatments have been acknowledged over many years and, as mentioned above, the primary concern is of potential blood-borne virus transmission from client to client, or between client and operator (Haley and Fischer, 2001; Cuyper and Perez-Cotapos, 2010). Additional risks associated with tattooing include the potential for localised bacterial skin infections as well as dermal allergies to ink components, and complications have been reported following tattooing treatments (Cuyper and Perez-Cotapos, 2010). Microbiological contamination of inks may result from contamination at source, or due to subsequent environmental contamination, and chemical contamination is a direct result of the composition of the ink at the point of formulation.

Reports of metal sensitivity following tattooing have been published, and dermatological responses have been linked with particular ink colours, especially red products [some containing mercury] and greens/blue/yellow [chromate/cobalt/cadmium sulphide] (Papameletiou et al., 2003; Cuyper and Perez-Cotapos, 2010). Also, there are concerns that some of the constituent of the inks used may be cause cancer (Cuyper and Perez-Cotapos, 2010).

Unsterilized instrument

Most of the articles identified that indicated some complications with tattoo, especially blood borne virus, observed that there were unhygienic practise in place- mainly that instruments were unsterilized or inadequately sterilized (Abiona et al., 2010; Cuyper and Perez-Cotapos, 2010; Jafari et al., 2010; Tohme and Holmberg; 2012). These instruments were subsequently shared, with the potential of infection spread from tattooist to client or from client to client. See Table 2 for a summary of literature on mode of transmission.

7 Current Guidelines

There are a number of guidelines on regulation and safe practise of body art but none of these guidelines has been formally recognised as a national (infection control) guideline for body art. Key regulatory guidelines are the Local Authority Circulars (LAC), more specifically LAC 14.1 and LAC 76-2, which covers most of the regulatory requirement for body art practise.

The above documents provide detailed guidance on safe practise. They cover infection control, waste disposal, aftercare advice, record keeping, cleaning and decontaminations. Other guidelines that covered advice on safe practise and were mainly based on the original document produced by the Chartered Institute of Environmental Health and Barbour Index, and the document produced by the Working Party of London Consultants in Communicable Disease Control and Community Infection Control Nurse were identified (see Appendix 5). The common themes in all of these guidelines are as below:

- Legal framework of body art practice
- Requirement of the premises
- Guidelines on safe practice and cleaning of the premises
- Guidelines on operator’s health
- Standard infection control precautions
- Guidelines on cleaning, disinfecting and sterilizing instruments
- Generic standard procedures

Local authorities also publish information for practitioners and the public about the risks of tattooing.

### 8 Guidelines in other countries

Only guidelines that were available online and in English were retrieved and reviewed. These guidelines were from Northern Ireland, Wales, Scotland, Australia, New Zealand and Canada. The themes from these guidelines are as highlighted below:

#### 8.1 Northern Ireland
(Belfast City Council, 2011)
- Tattooing of minors
- Client health, pre-treatment warnings, consent of client and record-keeping
- Hygiene of premises and treatment areas
- Hygiene of equipment
- Hygiene of tattooists and Immunization.
- Aftercare advice
- Waste disposal
- First aid
- Useful contacts

8.2 **Wales Model Bye law** (Welsh Government, 2011)

- Cleanliness of premises and fittings
- Cleansing and so far as is appropriate, the sterilization of needles, instruments, jewellery, materials and equipment
- Cleanliness of operators

8.3 **Scotland** (Health Protection Scotland and the Royal Environmental Health Institute of Scotland, 2011)

The Scottish guideline was produced in December 2011 to guide regulators on how to implement the Scottish Body Piercing and Tattoo Regulatory Order of 2006. It also provides information on good practises. The themes covered were:

- Cleaning, disinfection and sterilisation arrangements
- Arrangements for waste and sharps disposal
- Operator and equipment requirements
- Client information, consent forms and record keeping
- Treatment area and waiting area requirements
- General state of repair of the premises

8.4 **Australia** (Australian Capital Territory Health, 2006; Queensland Government, 2007)
There are varying guidelines across the states of Australia; however the guidelines cover many infection control practices, this includes:

- Provision of written “after care” advice;
- Use of single use and reusable equipment;
- Premises construction;
- Handling and disposal of sharps and clinical wastes;
- Personal protective equipment and immunization;
- Aseptic technique and skin disinfectants;
- Environmental cleaning including dealing with blood and body substance spills.
- The reprocessing/sterilization of appliances.

8.5 New Zealand

Although there is no specific legislation on body art practice in New Zealand, there are guidelines produced for practitioners. These guidelines cover the following:

- How to minimize risk of transmitting blood borne and other infections by the use of standard precautions during skin piercing procedures;
- How to ensure appliances are clean and sterile before being used for skin piercing;
- How to minimize the risk of transmitting micro-organisms between the operator, the appliances used and other clients; and
- How to further promote a safe work environment for workers performing skin-piercing operations

8.6 Canada (Alberta Health and Wellness, Canada. 2002)

There are widely published standards and guideline for body piercing and tattooing practitioners in Canada. These guidelines were based on the Health Canada-Infection Control guideline. The Key themes covered were:

- Equipment requirements
- Preparation and handling of Instrument and Equipment
- Consent, Client preparation and post treatment care
- Waste disposal
- Record keeping and Incident Management
• Cleaning, Disinfection and Sterilisation
• Personal Protective Equipment

The guidelines identified, within and outside the UK, have common themes and broadly capture the issues that are peculiar to body art practise, however, they do not specifically address some of the day-to-day practise of the body art practitioner. Areas requiring more details are clarity on cleaning, sterilisation and decontamination i.e. water temperature for cleaning, use and frequency of change of cleaning brush and storage of sterilised instruments; use of gloves, especially latex gloves while also using petroleum-based lubricants e.g. Vaseline; clarity on disinfectant to use for cleaning body fluids; and clarity on layout of dirty-clean-sterilisation stations. See Appendix 3 for a summary of identified guidelines.

9 Discussion

This literature review appraised both published and unpublished literature on key aspects that enables the understanding of the practice of tattooing and its associated issues and concerns. The areas specifically reviewed were the history and the prevalence of tattooing, the complications associated with the practice and the routes of transmitting infections during the practice of tattooing. Also, a brief review of guidelines for the practice of tattooing in other developed countries for common themes was conducted.

Robust online literature searches were conducted and so also were experts on the subject consulted in order to retrieve both published and unpublished literature. Following this search, inclusion and exclusion criteria were applied to the identified literatures, which resulted in exclusion of a considerable number of literatures. Relevant literatures that could inform a good representation of available evidence may have been excluded as a result.

The literatures identified during this review were mostly of low-level grade evidence (SIGN grade 3) however they are sufficient to enable a good understanding of the subject, given the paucity of higher-level grade evidence. Although most of the literatures identified were cross sectional studies, which the SIGN grade system does not specifically grade, the reviewer assigned a grade 3 for cross sectional studies. Some of the cross sectional studies may be of higher grade than assigned, since some were more analytic and robust than others. Guidelines and reviews identified were not graded as these are often not considered as conventional evidence and were also not graded by the SIGN grade.

The SIGN grading was used because it is one of the popular grading tools and since this grading tool had been previously used in the literature review on body piercing, using it in this review enables consistency. The SIGN grading system allows for ranking of different literatures on the basis of potential for bias, chance, confounder and inference in terms of causality.
The search and retrieval of literature was conducted using resources from University of Birmingham Library, the CIEH library, the HPA library and experts in the subject. Solely, the author conducted the identification and appraisal of relevant literature and this could have inadvertently led to bias.

9.1 History and Prevalence

Tattooing is historical, practised in every continent and while it may still denote an art associated with high-risk behaviour its practice continues to grow. The recent resurgence of tattooing is encouraged by societal acceptance, more so as it is now one of the adornments of societal models and mentors. There was no literature identified during this review that explored or conducted a prevalence study on tattooing in the UK. Given the above deductions, it appears there are limited, if any, literature on absolute prevalence of tattoos in the UK. The prevalence of tattooing in the UK could probably have been ascertained through record kept by tattooist however this may be restricted for commercial reasons, if such information is routinely kept. Also, not all tattoos would have been conducted in these practices. There could be inconsistency on record keeping across tattoo practices, which may also lead to poor case ascertainment.

This lack of documented evidence on the prevalence of tattooing in the UK highlights a need for research/study to ascertain the prevalence of tattoo in the UK. This will give a true indication of the scale and potential impact of tattooing and some of its associated complications in the UK. Studies conducted in other developed countries suggested a prevalence in the range of 8.5-21% of the population and that the practice appears to be growing, with higher prevalence in institutional settings notably universities, prisons and the military setting. Most of these studies were of good quality and were appropriate for the settings. However, there were a few internal and external validity concerns therefore inference to the UK population may not be ideal.

It appears the practice spreads across all strata of the society and with varying reasons for choosing to have a tattoo. Whatever the reason chosen, one thing that is clear and consistent from the literature is that the practice of tattooing is growing and gaining greater acceptability in the society-this may also translate to an increase in complications.

9.2 Complications

The majority of the immediate complications described relate to the site of the tattoo and these are mainly due to immediate inflammatory reaction to direct puncture, chemicals used or microorganisms. These complications, to a large extent, depend on the standard of hygienic practice, the skill of the
tattooist, the duration and area of the body covered by the tattoo, the aftercare information given to the client and the attitude of the client to the wound/tattoo site.

Allergic reactions documented have been due to some of the chemicals mentioned, an issue that can potentially be addressed at source i.e. by the producer. Another potential issue is the possibility of contamination of the ink with microorganisms either at source or during use by the tattooist, which may be a challenge to address, at the tattooist centre than at source.

In view of published literature, and because of anecdotal information from local authority enforcement teams, concerns over tattoo ink quality have already been acted upon at the national and European level. Requirements therefore already exist for ink products to be sterile at first use and chemically inert (non-toxic and non-allergenic) (Council of Europe, 2008).

In 2003 the UK Government published byelaws, for use by local authority environmental health officers (EHOs) to aid enforcement (Department of Health, 2006). The Welsh Assembly has also published its own byelaws to accommodate this area of enforcement and, like the UK model byelaws that preceded them, these stipulate that ‘...for the purposes of tattooing or semi-permanent skin-colouring, only sterile inert pigment, dispensed into single use pots or pre-packed in single use vials, is used.’ (Welsh Government, 2011)

However, two key challenges exist to monitoring the quality of inks used within UK premises:

1. The application of existing bylaws and the Council of Europe resolution is difficult to achieve and not comprehensive within the UK. It would involve a change in culture for the industry, i.e. routine ink quality checks by all manufacturers, which do not currently exist; and,

2. At present, largely as a result of (1) above, there are very few independent data to confirm the quality of inks used in the UK, and accompanying product quality data is not universally available with purchased inks.

Despite published case studies and some literature reviews that have considered the issue of ink contamination, data remain sparse in this topic area. Although further data is likely to be published in future, the limited existing points of reference mean that any related recommendations for the tattooing sector remain outside the scope of this document. Although best practice for injected materials would logically require the availability of appropriate product information, until the published evidence base expands and legislation supports it, this is unlikely to become an enforcement requirement.

Infective endocarditis was another complication reported and these findings were mainly from case reports or case series. There appears to be a controversy on how best to approach the prevention of infective endocarditis following a tattoo visit especially amongst those with underlying medical condition. However, recent advice from the British Society from Antimicrobial Chemotherapy states that anyone who has had previous heart surgery, or been diagnosed with a heart condition, should
consult their doctor before having a piercing involving a mucous membrane (nose, lip, tongue or genitals), as there may be a risk of potentially serious infection. It is recommended that local authorities inform businesses of this advice so that they ask relevant clients to consult their GPs. The Department of Health is alerting GPs to this advice via its GP Bulletin (Robb, 2012). This finding further highlights the need for adequate pre-health check, the understanding of the implications of tattoo on someone with history of underlying medical (especially cardiac) condition and the need for the tattooist to discuss this with the client and also to ensure adequate aseptic measure is in place.

9.3 Blood borne virus and Tattooing

Most of the long-term complications identified were mainly blood borne virus infection. The debate on the possible transmission of blood borne virus during tattooing in modern times is ongoing and findings suggest that this is now a controversial subject. However the highest level of evidence identified in this review, which is a systematic review, by Rania and Scott (2012) asserts that tattooing is associated with Hepatitis C, further complimenting previous systematic review with meta-analysis by Jafari et al. (2008). Both studies had similar issues with heterogeneity but when adjusted there was still a significant association observed between having a tattoo and acquiring a Hepatitis C infection.

Hayley et al (2003) had argued that the reason for what appears to be equivocal findings on tattooing and blood borne virus may be explained by a biological plausibility that those having tattoo are less likely to develop symptoms and infection when compared to those who had direct inoculation to the blood i.e. injecting drug users, because intra dermal exposure will lead to injection of smaller quantity of blood borne virus. Also, they claimed that there is poor reporting of tattoo as a risk factor for blood borne virus during notification hence less robust data to analyse and draw significant conclusions from.

Hepatitis B has previously (in the 1990s) been reported as a common infection associated with tattooing, more than the others i.e. HIV and HCV. Fewer studies have mentioned this in recent time despite HBV being the most transmissible when compared to HCV and HIV. This may be so with the availability of a vaccine for HBV and post-exposure prophylaxis to HIV, hence less vulnerability to HBV and HIV.

The conclusions that could be drawn from the literatures is that needle stick injury and exposure prone procedures are predisposing factor for the transmission of blood borne virus and tattoo fits under these definition i.e. needle stick injury and exposure prone procedure. This therefore implies that the need for strict aseptic practice cannot be over emphasised.
Following the critical appraisal of the literature identified, the conclusions that could be drawn were that tattooing carries a risk that could lead to irreversible consequences, one of which is infection by a blood borne virus, especially HCV.

10 Conclusion

There is no information on the prevalence of tattoo in the UK but evidence from other developed countries suggest that the practice of tattooing continues to grow and in fact has come to stay, especially so with increasing societal acceptance. It appears about 8.5-21% of the general population in these countries could have one or more tattoo. There is a need to conduct a prevalence study on tattooing in the UK. This will enable a better understanding of the scale of tattooing and the associated complication especially, as it relates to the UK. The conduct of this study will provide an opportunity to explore the association between blood borne virus, high-risk behaviour and tattooing in the UK.

Although available literature on tattooing appears to be weak, identified literatures have highlighted some of the issues and concerns related to tattooing. The practice of tattoo has been associated with adverse effects/complications, some of which are long term and irreversible i.e. blood borne viral infection. Most of these complications (including the blood borne viruses) are attributed to settings that are unregulated and where there are poor hygienic measures in place. There is the need to develop and implement a national infection control guideline on safe practice of tattooing in the UK, for both the tattooist and regulators, to work with. Also, in relation to the above, there is a need to explore how the practice of unregulated amateur tattooing can be curtailed.

Other complications still observed in regulated and hygienic settings often result from contaminated materials used i.e. dyes, which are currently difficult to regulate. More emphasis should therefore be placed on how best to address this issue, through collaborative work with manufacturers and practitioners.

One of other key concerns that apply to the UK is the lack of a nationally recognised minimum training standard for tattooist. The keen engagement of practitioners and regulators in the UK offer an opportunity to develop a nationally recognised minimum standard of training or competence required of a tattooist.

The above findings have often been the underlying reason for some of the cases of adverse effects from tattooing, when reported. Both practitioners and regulators can address some of these concerns. Also, the public should be sensitised to the implications and expectations of tattoo practice, through health promotion campaign, both locally and nationally.
### Appendix 1: Scope of Guideline: adapted from the Civic Government (Scotland) Act 1982 (licensing of skin piercing and tattooing) order 2006: Local Authority implementation Guide

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Description</th>
<th>Covered?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acupuncture</strong></td>
<td>Insertion of needles into living tissue for remedial or therapeutic purposes</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>Beading</strong></td>
<td>Insertion of beads under skin to create 3-dimensional effect</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
<tr>
<td><strong>Bio skin jetting</strong></td>
<td>Injection of skin below wrinkles to promote formation of new tissue containing young collagen and elastic fibres which fill out the wrinkle</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>Botox</strong></td>
<td>Injection of <em>Clostridium botulinum</em> toxin through the skin and into specific muscles to fill out frown lines</td>
<td>NO</td>
<td>Botox not currently licensed for cosmetic use in UK – requires prescription from medical operator</td>
</tr>
<tr>
<td><strong>Braiding</strong></td>
<td>Form of scarification which involves cutting strips of skin, leaving one end attached, braiding adjacent strips and re-attaching the ends of the strips to skin</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
<tr>
<td><strong>Branding</strong></td>
<td>Form of scarification in which hot metal is used to burn the skin and scar in a desired design</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
<tr>
<td><strong>Chiropody</strong></td>
<td>Treatment of problems associated with the feet and lower limbs</td>
<td>NO</td>
<td>CIEH / Barbour provides best practice guidance on this procedure</td>
</tr>
<tr>
<td><strong>Collagen Injections</strong></td>
<td>Injection of collagen under creased or sunken areas of the face to plump up and reduce their appearance</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>Colon Hydrotherapy</strong></td>
<td>Use of warm water, introduced into the colon via the rectum, to disperse stored waste</td>
<td>NO</td>
<td>CIEH / Barbour provides best practice guidance on this procedure</td>
</tr>
<tr>
<td><strong>Cutting</strong></td>
<td>A form of scarification which involves cutting or slitting the skin to leave permanent scarring</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
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<tr>
<td>---------------------</td>
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<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Dermal Punches</strong></td>
<td>Surgical instruments used for body modifications and large gauge piercings</td>
<td>NO</td>
<td>Normally large gauge piercings in the cartilage or other part of the body</td>
</tr>
<tr>
<td><strong>Ear piercing</strong></td>
<td>Piercing of the ear which could include lobe, upper cartilage, tragus, conch or rook</td>
<td>YES</td>
<td>Order requirements differ for piercing of different parts of the ear using different techniques</td>
</tr>
<tr>
<td><strong>Earlobe Stretching</strong></td>
<td>Gradual enlargement of an earlobe piercing. Tissue is stretched, micro-tears are formed which are then allowed to heal before further stretching takes place.</td>
<td>NO</td>
<td>Can be carried out on piercings at other sites of the body but earlobes are most common</td>
</tr>
<tr>
<td><strong>Electrolysis</strong></td>
<td>Removal of body hair by electrocution of the hair roots with an electrified needle</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td><strong>Eyebrow piercing</strong></td>
<td>Insertion of jewellery through the eyebrow</td>
<td>YES</td>
<td>Caution required to avoid nerves just below the eyebrow</td>
</tr>
<tr>
<td><strong>Genital piercing</strong></td>
<td>Piercing of the clitoral hood, labia, triangle or fossette (females) or glans, foreskin, scrotum or urethra (males)</td>
<td>YES</td>
<td>Some female piercings may be in contravention of the Prohibition of Female Circumcision Act 1985</td>
</tr>
<tr>
<td><strong>Implants</strong></td>
<td>Insertion of 3-dimensional objects under skin to create raised effect</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
<tr>
<td><strong>Lip piercing</strong></td>
<td>Piercing of upper or lower lip area</td>
<td>YES</td>
<td>Piercing of the coloured part of the lips is not recommended</td>
</tr>
<tr>
<td><strong>Micro-pigmentation</strong></td>
<td>Insertion of semi-permanent dye or pigment into the dermis of the skin</td>
<td>NO</td>
<td>HELA LAC 14/1 provides additional information on this procedure</td>
</tr>
<tr>
<td><strong>Navel piercing</strong></td>
<td>Piercing of either the skin surrounding the navel or the umbilicus</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td><strong>Nose piercing</strong></td>
<td>Piercing either through the septum or nostril</td>
<td>YES</td>
<td>Nose piercing cannot be carried out using dedicated ear piercing guns</td>
</tr>
<tr>
<td><strong>Scarification</strong></td>
<td>Cutting and peeling of the skin to create permanent scarring</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
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<td>-------------------</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Stapling</strong></td>
<td>Insertion of metal staples into the skin</td>
<td>NO</td>
<td>Could be classed as physical assault and would require police investigation on case-by-case basis</td>
</tr>
<tr>
<td><strong>Surface Piercing</strong></td>
<td>Piercing of flat surface skin, typically on the neck or forearms</td>
<td>YES</td>
<td>Very often rejected by the body – particularly in areas where skin is tight across piercing</td>
</tr>
<tr>
<td><strong>Tattooing</strong></td>
<td>Insertion of permanent dye or pigment underneath the epidermis of the skin</td>
<td>YES</td>
<td>Definition used within the Order covers both permanent and semi-permanent tattooing (micro pigmentation)</td>
</tr>
<tr>
<td><strong>Tongue Piercing</strong></td>
<td>Piercing of the central area of the tongue</td>
<td>YES</td>
<td>Caution is required to avoid major blood</td>
</tr>
</tbody>
</table>
Appendix 2: Search Terms

(Blood borne virus or blood borne disease or hiv or hepatitis b or hepatitis c) and (tattoo* or body pierc* or tattooing or body art*) and (complications) and (prevalence) and (transmission) and (operational standards) and (risk) and (infection) and (national policies) or (international policies)
**Appendix 3: List of guidelines, within and outside the UK, identified.**

<table>
<thead>
<tr>
<th>Author</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Party of London Consultants in Communicable Disease Control and Community Infection Control Nurse (2002) (Revised by Bernadette Whiteman-Hoyte/ London Special Treatment Nurses’ group in October 2011)</td>
<td>Guidelines for the control of infection in special treatments {tattoo, body piercing, micro pigmentation, acupuncture and beauty therapy}</td>
</tr>
<tr>
<td>Essex Health Protection Unit revised February 2010</td>
<td>Infection control guidelines for tattooists, body piercers and acupuncturists</td>
</tr>
<tr>
<td>Dartford Borough Council 2009</td>
<td>Code of practice for hygienic skin piercing</td>
</tr>
<tr>
<td>Health and Safety Executive (HSE) 21.08.06</td>
<td>LAC 14-1 Micro pigmentation, semi-permanent tattooing and semi-permanent make up</td>
</tr>
<tr>
<td>Health and Safety Executive (HSE) April 2005</td>
<td>LAC 76-2 Enforcement of skin piercing activities -tattoo</td>
</tr>
<tr>
<td>Wandsworth Collaborative Body piercing Working group-March 2003</td>
<td>Body piercing - aftercare advice sheet</td>
</tr>
<tr>
<td>MSW Collaborative Special Treatment Working Group-July 2002</td>
<td>Tattoo/body piercing consent form</td>
</tr>
<tr>
<td>MSW Collaborative Special Treatment Working Group-July 2002</td>
<td>New tattoo aftercare advice sheet</td>
</tr>
<tr>
<td>HPA, London</td>
<td>LA officer checklist assessment for tattooist and body piercing premises in London prior to commencing service provision</td>
</tr>
<tr>
<td>South West London Health Protection Unit</td>
<td>Checklist assessment for tattooist and body piercing premises in SW London sector prior to commencing service provision</td>
</tr>
<tr>
<td>South West London Health Protection Unit</td>
<td>Audit tool for infection control assessment of tattoo/ piercing licensed premises</td>
</tr>
<tr>
<td>Reference</td>
<td>Textual Information</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>ACDP Guidelines</td>
<td>Prevention of infections including BBV in the work place. Not published yet.</td>
</tr>
<tr>
<td>Alberta Health and Wellness, Canada (2002)</td>
<td>Health Standards and Guidelines for Tattooing Health Standards and Guidelines for Body and Ear Piercing</td>
</tr>
<tr>
<td>Australian Capital Territory Health, Australia 2006</td>
<td>Infection Control Guidelines for office practices and other community based services.</td>
</tr>
</tbody>
</table>
References


De Nishioka SA, Gyorkos TW, Joseph L, Collet J-P and MacLean JD., 2002. Tattooing and risk for transfusion-transmitted diseases: The role of the type, number and design of the tattoos, and the conditions in which they were performed. Epidemiology and Infection, 128(1): 63–71.


Samuel MC et al., 2001. Association between heroin use, needle sharing and tattoos received in prison with hepatitis B and C positivity among street-recruited injecting drug users in New Mexico, USA. Epidemiol Infect 127:475


Sun, DX, Zhang, FG, Geng, YQ, et al., 1996. HCV transmission by cosmetic tattooing in women. Lancet. pp 347: 541


