

UC Davis

Dermatology Online Journal

Title

Non-tuberculous mycobacterium skin infections after tattooing in healthy individuals: A systematic review of case reports

Permalink

<https://escholarship.org/uc/item/8mr3r4f0>

Journal

Dermatology Online Journal, 21(6)

Authors

Mudedla, Sreenivasu
Avendano, Esther E
Raman, Gowri

Publication Date

2015

License

[CC BY-NC-ND 4.0](#)

Peer reviewed

Review

Non-tuberculous mycobacterium skin infections after tattooing in healthy individuals: A systematic review of case reports

Sreenuvasu Mudedla MD, Esther E. Avendano BA, Gowri Raman MD MS

Dermatology Online Journal 21 (6): 1

Center for Clinical Evidence Synthesis, Institute for Clinical Research and Health Policy Studies, Tufts Medical Center, Boston, MA, USA.

Correspondence:

Sreenuvasu Mudedla, MD
Tufts Center for Clinical Evidence Synthesis
Institute for Clinical Research and Health Policy Studies
Tufts Medical Center
800 Washington St, #63
Boston, MA 02111
Email: Shreen.amc@gmail.com

Abstract

In recent years, several case reports and outbreaks reported occurrence of non-tuberculous mycobacteria (NTM) infections within 6 months after receiving a tattoo in healthy individuals. NTM species (e.g., *Chelonae*, *Fortuitum*, *Hemophilum*, and *Abscessus*) are widespread in the environment and it is often suspected that contamination may occur through unsterile instrumentation or unsterile water used for diluting tattoo ink to dilute color. In reported cases, lesions were mainly restricted to a single color 'gray' part of the tattoo. Mycobacterium *Chelonae* was the most common cause of tattoo associated NTM infections. Less than 50% of the case reports tested tattoo ink for acid fast bacilli stains and cultures. Subjects required treatment with either clarithromycin alone or in combination with quinolones for 6 to 9 months. An increase in NTM skin infections in healthy individuals after tattooing indicates the need for sterile standards during tattooing and improved local and regional regulatory oversight.

Keywords: non-tuberculous mycobacteria, NTM, mycobacteria, tattoo, systematic review, case reports, culture.

Introduction

Permanent tattoos are increasingly popular among American adults, with an estimated 21% reported to have received at least one tattoo in 2012 [1]. Individuals getting tattoos are at a greater risk of being infected with various pathogens, some of which can be difficult to diagnose and treat. Recently, public health officials reported multiple outbreaks of non-tuberculous mycobacterium (NTM) skin infections in the United States among immunocompetent adults after recent tattooing, which on further investigation was associated with contamination of tattoo ink [2;3]. NTM species (e.g., *Chelonae*, *Fortuitum*, *Hemophilum*, and *Abscessus*) are thought to be widespread in the environment and it is often suspected that contamination may occur through unsterile instrumentation or unsterile water used for dilution of tattoo ink to obtain a gray color. Rapidly growing and slow-growing NTM species are commonly associated with traumatic wound infections, cosmetic surgery, permanent tattoo make-up, and body piercing.

NTM skin infections around the tattoo site are difficult to diagnose based on symptoms alone and may be mistaken for allergies. These skin lesions can appear as red papules or as a diffuse macular or papular rash at the tattoo site, specifically restricted to a single color region. Confirmatory diagnosis often requires skin biopsy and culture on special media that can take up to 6 weeks for a definitive diagnosis. Rapid and new diagnostic techniques such as radio-immunoassay, enzyme-linked immunosorbent assay, and polymerase chain reaction can also be used in the diagnosis, but these are more technically involved and costly and are not considered a first-line of diagnostic investigations. Misdiagnosis of NTM infections often leads to receiving ineffective treatments, necessitating prolonged periods of treatment before receiving a definitive diagnosis. Furthermore, treatment choices with antibiotics may be limited depending on the susceptibility profile of organisms infecting the tattoo site. The occurrence of NTM infection at the tattoo site has not been systematically documented. To increase awareness of these infections among patients and clinicians, we conducted a systematic review of the published literature on NTM skin infections associated with tattooing.

Methods

We used methods detailed by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. We searched MEDLINE® and EMBASE for studies of all designs examining permanent tattoo and NTM infection, which were published through November 2013. No language restriction was applied. We combined search terms for “tattoo” or “tattoo ink” with Medical Subject Heading terms for “non-tuberculous mycobacterium”. We also hand searched bibliographies of published reports and reviews. The exposure of interest was history of recent tattooing and the outcome of interest was documentation of NTM skin infection at tattoo site through culture and histopathological examination of skin biopsy.

Data extracted from eligible articles included information on study and participant characteristics, time of onset, clinical presentation of infection, documentation of tattoo ink contamination, microbiological examination, histopathology of skin biopsy, prior treatment, time to diagnosis, culture susceptibility, and treatments. Data was extracted into a structured table in duplicate. No assessment of risk of bias or study quality was conducted because most of the identified studies were case reports. No quantitative synthesis was performed.

Results

The systematic search yielded 156 abstracts. Full-text screening identified 25 published reports [3-28] and a systematic review [29] on the occurrence of NTM infections after tattooing. Eligible reports examined a total of 114 cases that had NTM infections after receiving tattoo (**Table 1**). Clinical symptoms occurred any time after 1 week to 6 months in healthy individuals after receiving a tattoo. *Mycobacterium Chelonae* was the most common cause of NTM infection after tattooing; other less commonly associated mycobacteria were *Immunogenium*, *Abscessus*, *Fortuitum*, and *Haemophilum*. Skin manifestations appeared mostly in the form of tender erythematous papules, pustules, and nodules, predominantly within the borders of tattoos. Lesions were mainly restricted to a single color, generally the gray part of the tattoo. Definitive diagnosis was arrived in most cases with histopathological examination, culture and sensitivity, and Zeihl-Neelsen staining. In general, studies used polymerase chain reaction when acid-fast bacilli stains and cultures were negative. Ten of the 25 eligible studies reported testing tattoo ink for acid fast bacilli stains and cultures [3;7-11;13;14;17;22].

Table 1. Study Characteristics of Tattoo Site Infection with Non-Tuberculous Mycobacterium

| Reference, Country | N, Sex Age | Time of Onset | Tattoo Site Presentation | Tattoo Ink tested for NTM | Non-response to prior treatment | Tattoo Site Culture | Time to diagnosis | Susceptibility to antibiotics determined | Medication (duration) |
|-------------------------------|------------------------|---------------|--|---------------------------------|---------------------------------|---|-------------------|--|---|
| Bechara 2010, France[4] | 1, M 51 yr | 10 d | Papulopustules, erythematous plaques | No | Yes | NR | NR | Yes | Clarithromycin (1 mo) |
| Binic 2011 Serbia[5] | 2, M 26, 35 yr | 2-3 wk | Pruritic, red papules | No | Yes | M. Chelonae | NR | Yes | NR |
| Curco 2012, Spain[6] | 1, M/1, F 33, 25 yr | 1-2wk | Papulopustules | No | Yes | M. Chelonae (1 case) | NR | NR | Clarithromycin (3mo) |
| Drage 2010, USA[7] | 5, M/1, F 20-49 yr | 1-2 wk | Red papules And pustules | Yes (ink +ve for AFB) | Yes | M. Chelonae (2 cases) | 18wk | Yes | Clarithromycin (6 mo) |
| Falsey 2013, USA[8] | 5 cases NR | 1-3 wk | Red papules and pustules | Yes (ink +ve for M. Chelonae) | Yes | M. Chelonae (2 cases) M. Abscessus (3 cases) | NR | Yes | Clarithromycin or Ciprofloxacin (3 wk) |
| Giulieri 2011, Switzerland[9] | 12, F 56yr | 3 wk | Red papules or pustules or erythematous plaque | Yes (ink +ve for M. Hemophilum) | NR | M. Hemophilum (10 cases) | NR | Yes | Triple-drug combination of clarithromycin, ciprofloxacin, |

| Reference, Country | N, Sex Age | Time of Onset | Tattoo Site Presentation | Tattoo Ink tested for NTM | Non-response to prior treatment | Tattoo Site Culture | Time to diagnosis | Susceptibility to antibiotics determined | Medication (duration) |
|-----------------------------------|--------------------|---------------|--|----------------------------------|---------------------------------|---|-------------------|--|--|
| | | | (Permanent makeup) | | | | | | and rifampin (7 mo)^ |
| Goldman 2010,France[10] | 30 cases NR | 3-35 d | Papules and pustules | Yes (ink +ve for M.Chelonae) | NR | M. Chelonae (43% cases) | 2 mo (mean) | NR | Clarithromycin in 41 patients + tobramycin (10 patients)** |
| Hamsch 2010, Germany[11] | 7, F Age NR | 2wk | Granulomatous, purulent skin reactions, swelling of the loco-regional lymph nodes (Permanent makeup) | Yes (ink +ve for M.Lentiflavum) | NR | M. Haemophilum (2 of 7) | NR | NR | Systemic tuberculostatic therapy ethambutol, clarithromycin, and rifampicin (3 patients)** |
| Kappel2011, USA[12] | 1,M 41 yr | 6 wk | Tender erythematous Plaques and pustules | NR | Yes | M.Chelonae | 2 wk | NR | Clarithromycin (6 mo) |
| Kay2009, USA[13] | 2,M 35, 44 yr | 1-8 wk | Pustulo-nodular skin infection | Yes (ink -ve for NTM) | Yes | M. Haemophilum (1 case) | NR | Yes | Rifampin, ciprofloxacin, and clarithromycin (6 mo) |
| Kennedy 2012, USA[3] | 13, M/6 F 35 yr | 3wk | Erythematous rash | Yes (ink +ve for M.Chelonae) | NR | M. Chelonae | NR | Yes | NR |
| Kluger 2008, France[14] | 6,M/2, F 23 yr | 10-21 d | Papules, pustule | Yes (ink +ve for AFB) | Yes | None* Culture results were negative | 2-5 mo | NR | Minocycline hcl. (1 mo) |
| Mitchell 2011, USA[15] | 1,F 18 yr | Several mo | Erythematous painful papules, nodules | NR | NR | M. Immunogenum (16s rRNA gene sequencing) | NR | Yes | Clarithromycin (9 to 12 mo) |
| Peterson 2011, USA[16] | 1,F 56 yr | 6 mo | Erythematous plaques | No | Yes | None | 2 mo | NR | Clarithromycin (4mo) |
| Preda 2009,Australia[17] | 1,M 32 yr | 3 wk | Erythema, edema and painful nodules | Yes (ink +ve for M.Chelonae) | Yes | M.Chelonae | 2 mo | Yes | Clarithromycin and Moxifloxacin(4 mo) |
| Ricciardo 2010,Australia[18] | 1,M 23 yr | 1wk | Tender, erythematous, non- pruritic papules | NR | Yes | M. Abscessus | NR | Yes | Clarithromycin (5mo) |
| Rodríguez- Blanco 2010, Spain[19] | 3,M/2,F 21 yr | 3-30 d | Red papules,superficial hyperkeratosis | No | Yes | Culture positive (3 patients), molecular methods positive (2 cases) | NR | Yes | Clarithromycin (3-5 mo), topical gentamicin 2xd (3 patients)! |
| Schwartzman 2012, USA[20] | NR | 4 wk | Erythema, tenderness, and nodular rash. | No | Yes | M. Chelonae | NR | NR | Clarithromycin (9 mo) |
| Scott-Lang 2012, UK[21] | 1, M 42yr | NR | Rash | NR | NR | M. Chelonae | NR | NR | Clarithromycin (NR) |
| Sergeant2012, UK[22] | 3, M/1, F 21-35 yr | 2wk | Erythematous papules, with overlying scales, and small pustules | Yes (ink +ve for M.Chelonae) | Yes | M. Chelonae | NR | Yes | Clarithromycin (6mo) |
| Shinohara 2012, USA[23] | 1,F 35 yr | 3 wk | Erythematous papule | NR | NR | M. Chelonae | 2 wk | Yes | Clarithromycin (4 mo) |
| Suwanasuthi 2012, Thailand[24] | 1, M 25 yr | NR | Erythematous papules | NR | Yes | M. fortuitum | 2 wk | Yes | Clarithromycin and ciprofloxacin (10 mo) |
| Winthrop 2012, USA[25] | 1,F 29 yr | 2 wk | Papules | NR | NR | M. Chelonae | 19 d | Yes | Linezolid 600 mg (2 mo) |

| Reference, Country | N, Sex Age | Time of Onset | Tattoo Site Presentation | Tattoo Ink tested for NTM | Non-response to prior treatment | Tattoo Site Culture | Time to diagnosis | Susceptibility to antibiotics determined | Medication (duration) |
|--------------------------|------------|---------------|---|---------------------------|---------------------------------|-------------------------------------|-------------------|--|--|
| | | | | | | | | | azithromycin 250 mg (3 mo), and vitamin B6 100 mg (2 mo) |
| Wolf 2003, Israel [26] | 1,F 27yr | 3 mo | Erythematous nodules | No | NR | No 65-kd antigen gene was positive. | NR | NR | Patient refused systemic antibiotic therapy |
| Wollina2011, Germany[27] | 1,F 46 yr | 8 wk | Erythematous nodules (Permanent makeup) | No | Yes | M. Haemophilum | NR | Yes | Clarithromycin and ciprofloxacin (3 mo) Rifampin (6 mo) |

* Acid-fast bacilli staining of a sample from the bottle of tattoo ink used for all the patients proved positive

^ 10 pts who did not respond after 2 mo of therapy underwent partial parotidectomy, local eyebrow excision and selective neck dissection

! 2 of 5 patients were lost to follow-up

Spontaneous healing in 1 patient (Hamsch 2010) and 6 patients (Goldman 2010)

d = days; M = mycobacterium; mo = month, NR = not reported; wk = week; yr = year.

Patients were initially treated with topical antibiotics such as fusidic acid, bacitracin, neomycin, topical steroids, or oral antibiotics without much benefit. Subsequent histopathological examination showed lymphocytic infiltration and granulomatous reaction with central necrosis; in most cases cultures grew *Mycobacterium Chelonae*, which was sensitive to clarithromycin. Treatment regimens varied considerably across reports; a majority of the studies reported using clarithromycin either alone or in combination with quinolones for 6 to 9 months [12]. Despite the slow response and prolonged treatment period, studies in general reported improved outcomes. Two studies reported spontaneous resolution of infection in some patients [12;22].

Side-effects related to prolonged administration of systemic antibiotics were reported in one study that included gastrointestinal symptoms, including loose stools and abdominal pain. Two patients experienced vaginal candidiasis and one patient developed tinea corporis [8].

Discussion

Our review results indicate that a number of case reports published recently documented the occurrence of NTM infections associated with tattooing among healthy individuals. *Mycobacterium Chelonae* is the most common cause of NTM infections after tattooing; other less commonly associated *Mycobacterium* include *Immunogenium*, *Abscessus*, *Fortuitum*, and *Haemophilum*. Reported cases of skin manifestations were mainly restricted to the gray parts of the tattoo, suggesting infection may have occurred through unsterile water used for dilution of tattoo ink to obtain a gray color. According to these reports, patients were initially treated with topical antibiotics without much benefit. The diagnosis was established by histopathological examination and microbiological cultures. Polymerase chain reaction can be useful in detecting a common antigen to all mycobacterium species, especially when acid-fast bacilli stains and cultures are negative.

Although case studies and out-breaks of NTM skin infections have been reported, incidence rates of NTM infections secondary to tattooing still remains unknown. The first case of tattoo-related skin infection related to unclassified species of NTM was identified by polymerase chain reaction analysis in 2003 [26]. According to the recent Harris poll in 2012, approximately one in five US adults (21%) receive at least one tattoo, which is up from the 16% and 14% in 2003 and 2008, respectively [30]. Owing to the growing popularity of tattooing, NTM-related tattoo infections are gaining importance as a public health issue. Recently, CDC disseminated a public health alert to inform the public about NTM skin infections in healthy individuals following reports of *Mycobacterium Chelonae* skin infections after tattooing in fourteen New York residents in January 2012 [2]. Most often patients consult their primary care physicians. An increased awareness among clinicians is needed to better diagnose and treat cases of tattoo-related NTM infections.

Infections with NTM, such as *Mycobacterium Chelonae*, *Abscessus*, *Haemophilum*, which are ubiquitous, and rapidly-growing acid-fast bacilli have been described as the most common causes of infections complicating dermatological procedures. These infections typically occur 4 to 6 weeks following tattooing [31]. It is important to recognize that infections associated with tattooing may occur with rapidly-growing or slow-growing NTM. Tap water is considered to be the major reservoir for human

NTM pathogens [32]. Some case studies have attempted to establish the source of infection through AFB staining and culture of tattoo ink from tattoo parlors. Tattoo inks are a mixture of pigments and diluents. The majority of pigments are considered biologically inert. Different shades and colors are obtained by combining different pigments or diluting with water. The Federal Drug Administration considers tattoo inks to be cosmetics and traditionally has not exercised its regulatory authority [33]. In the US, the practice of tattooing is regulated by state and local jurisdictions.

The limitations of this review reflect – to a large extent – limitations of the data available in primary studies. This is a review of case reports. Therefore, it could not establish incidence rates. Although skin manifestations appeared within weeks in majority of the cases, causes for delayed presentation up to six months are not discernible. Although cultures grew NTM sensitive to clarithromycin in some cases, specific guidelines on the length of treatment for tattoo-related NTM infections are lacking. Though many patients responded to both macrolide and quinolone, efficacy of one over the other in the treatment of tattoo-related NTM infections remain to be established.

In the future, careful documentation of tattoo-related infections will be needed to establish incidence rates and rapid accurate diagnostic methods. When assessing a patient with a tattoo reaction, a very high degree of suspicion is needed for diagnosing tattoo-related NTM infections because of the variability in clinical presentation. Additional studies are needed in this population to assess the efficacy of various treatment modalities and to establish the optimal duration of treatment options for NTM skin infections. Efforts should be made to reach out to the public, tattoo artists, ink and pigment manufacturers, and health care professionals to warn them of the potential for NTM infection after tattooing. Sterile standards during tattooing and improved local and regional regulatory oversight are needed to promote better tattooing practices and to prevent occurrence of tattoo associated NTM infections.

References

1. Braverman S. One in five U.S. adults now has a tattoo: yet over two in five without a tattoo say adults with tattoos are less attractive; Harris Interactive. 2012. New York, NY.
2. Centers for Disease Control and Prevention. Tattoo-Associated Nontuberculous Mycobacterial Skin Infections — Multiple States, 2011–2012. *Morbidity and Mortality Weekly Report (MMWR)* 2012;61:653-656. [PMID:22914227]
3. Kennedy BS, Bedard B, Younge M, Tuttle D, Ammerman E, Ricci J, Doniger AS, Escuyer VE, Mitchell K, Noble-Wang JA, O'Connell HA, Lanier WA, Katz LM, Betts RF, Mercurio MG, Scott GA, Lewis MA, Goldgeier MH. Outbreak of *Mycobacterium chelonae* infection associated with tattoo ink. *N Engl J Med.* 2012;367:1020-1024. [PMID:22913660]
4. Bechara C, Macheras E, Heym B, Pages A, Auffret N. *Mycobacterium abscessus* skin infection after tattooing: first case report and review of the literature. *Dermatology.* 2010;221:1-4. [PMID:20558973]
5. Binic I, Jankovic A, Ljubenovic M, Gligorijevic J, Jancic S, Jankovic D. *Mycobacterium chelonae* infection due to black tattoo ink dilution. *Am J Clin Dermatol.* 2011;12:404-406. [PMID:21797287]
6. Curco N, Prat C, Tarroch X, Vives P. Cutaneous infection in a tattoo due to *mycobacterium chelonae*: a report of 2 cases and a review of the literature. *Actas Dermosifiliogr.* 2012;103:840-843. [PMID:22749366]
7. Drage LA, Ecker PM, Orenstein R, Phillips PK, Edson RS. An outbreak of *Mycobacterium chelonae* infections in tattoos. *J Am Acad Dermatol.* 2010;62:501-506. [PMID:19733936]
8. Falsey RR, Kinzer MH, Hurst S, Kalus A, Pottinger PS, Duchin JS, Zhang J, Noble-Wang J, Shinohara MM. Cutaneous inoculation of nontuberculous mycobacteria during professional tattooing: a case series and epidemiologic study. *Clin Infect Dis.* 2013;57:e143-e147. [PMID:23704119]
9. Giulieri S, Morisod B, Edney T, Odman M, Genne D, Malinverni R, Hammann C, Musumeci E, Voide C, Greub G, Masserey E, Bille J, Cavassini M, Jatton K. Outbreak of *Mycobacterium haemophilum* infections after permanent makeup of the eyebrows. *Clin Infect Dis.* 2011;52:488-491. [PMID:21258102]
10. Goldman J, Caron F, de QJ, Pestel-Caron M, Courville P, Dore MX, Picard D, Duval-Modeste AB, Bravard P, Joly P. Infections from tattooing. Outbreak of *Mycobacterium chelonae* in France. *BMJ.* 2010;341:c5483. [PMID:20978041]
11. Hamsch C, Hartschuh W, Enk A, Flux K. A Chinese tattoo paint as a vector of atypical mycobacteria-outbreak in 7 patients in Germany. *Acta Derm Venereol.* 2011;91:63-64. [PMID:21103853]
12. Kappel S, Cotliar J. Inoculation of *Mycobacteria chelonae* from a tattoo. *J Am Acad Dermatol.* 2011;64:998-999. [PMID:21496711]
13. Kay MK, Perti TR, Duchin JS. Tattoo-associated *Mycobacterium haemophilum* skin infection in immunocompetent adult. 2009. *Emerg Infect Dis.* 2011;17:1734-1736. [PMID:21888807]
14. Kluger N, Muller C, Gral N. Atypical mycobacteria infection following tattooing: review of an outbreak in 8 patients in a French tattoo parlor. *Arch Dermatol.* 2008;144:941-942. [PMID:18645149]
15. Mitchell CB, Isenstein A, Burkhart CN, Groben P, Morrell DS. Infection with *Mycobacterium immunogenum* following a tattoo. *J Am Acad Dermatol.* 2011;64:e70-e71. [PMID:21496684]
16. Peterson J, Kiripolsky M, Goldman M. Methicillin-Resistant *Staphylococcus aureus* Superinfection Delaying the Diagnosis of an Atypical Mycobacteria Infection: Report of a Case. *J Cosm Derma.* 2011;24:170-173.

17. Preda VA, Maley M, Sullivan JR. *Mycobacterium chelonae* infection in a tattoo site. *Med J Aust.* 2009;190:278-279. [PMID:19296796]
18. Ricciardo B, Weedon D, Butler G. *Mycobacterium abscessus* infection complicating a professional tattoo. *Australas J Dermatol.* 2010;51:287-289. [PMID:21198529]
19. Rodriguez-Blanco I, Fernandez LC, Suarez-Penaranda JM, Perez del Molino ML, Esteban J, Almagro M. *Mycobacterium chelonae* infection associated with tattoos. *Acta Derm Venereol.* 2011;91:61-62.[PMID:21264454]
20. Schwartzman WA. *Mycobacterium chelonae* illnesses associated with tattoo ink. *N Engl J Med.* 2012;367:2356-2357. [PMID:23234523]
21. Scott-Lang V, Sergeant A, Holme A. *Mycobacteria* introduced by tattoos. *Brit Med J.* 2012;345:e8331.
22. Sergeant A, Conaglen P, Laurenson IF et al. *Mycobacterium chelonae* infection: a complication of tattooing. *Clin Exp Dermatol.* 2013;38:140-142.[PMID:22831709]
23. Shinohara MM, Nguyen J, Gardner J, Rosenbach M, Elenitsas R. The histopathologic spectrum of decorative tattoo complications. *J. Cutan Pathol.* 2012;39:1110-1118. [PMID:23046178]
24. Suvanasthi S, Wongpraparut C, Pattanaprichakul P, Bunyaratavej S. *Mycobacterium fortuitum* cutaneous infection from amateur tattoo. *J Med Assoc Thai.* 2012;95:834-837. [PMID:22774631]
25. Winthrop K, Varley C, Sullivan A, Hopkins R. Happy Buddha? *Clin Infect Dis.* 2012;54:1670-1671. [PMID:22573894]
26. Wolf R, Wolf D. A tattooed butterfly as a vector of atypical *Mycobacteria*. *J Am Acad Dermatol.* 2003;48:S73-S74. [PMID:12734482]
27. Wollina U. Nodular skin reactions in eyebrow permanent makeup: two case reports and an infection by *Mycobacterium haemophilum*. *J Cosmet Dermatol.* 2011;10:235-239. [PMID:21896137]
28. Philips RC, Hunter-Ellul LA, Martin JE, Wilkerson MG. *Mycobacterium fortuitum* infection arising in a new tattoo. *Dermatol Online J.* 2014;20. [PMID:24945647]
29. Conaglen PD, Laurenson IF, Sergeant A, Thorn SN, Rayner A, Stevenson J. Systematic review of tattoo-associated skin infection with rapidly growing mycobacteria and public health investigation of a cluster in Scotland, 2010. *Euro Surveill.* 2013;18(32):pii=20553. [PMID:23968828] Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20553>".
30. Harris Interactive. 2014. <http://www.harrisinteractive.com/>
31. Wagner D, Young LS. Nontuberculous mycobacterial infections: a clinical review. *Infection.* 2004;32:257-270. [PMID:15624889]
32. Brown-Elliott B, Wallace RJ. Infections caused by nontuberculous mycobacteria. In: Mandell G, Bennett J, Dolin R, eds. *Mandell, Douglas, and Bennett's principles and practice of infectious diseases.* 6 ed. Philadelphia: Elsevier; 2005;2909-2916.
33. Ortiz AE, Alster TS. Rising concern over cosmetic tattoos. *Dermatol Surg.* 2012;38:424-429. [PMID:22093105]