

## SKIN INFECTION AND THE GLOBAL CHALLENGES: A REVIEW

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Received: 20 Oct 2015 Revised and Accepted: 24 Mar 2015

### ABSTRACT

The prevalence of skin infection is on the rise globally affecting millions of people. Skin infection, which was once given low priority now has better acknowledgment due to the serious impact it has on people's quality of life. The misuse or inappropriate use of antimicrobials to treat the skin infection has eventually led to the growth of emerging and spreading of microorganism. Besides that, the lack of awareness of the public on skin infection and its associated risk factors further enhances the spreading and worsening of skin infection affecting the quality of life of themselves and people around. Thus, the pharmacists play an important role to create the awareness on the appropriate use of antimicrobials for skin infection treatment among healthcare professionals as well as to educate the public on the skin infection and its risk factors for better management of skin infection.

**Keywords:** Skin infection, Quality of life, Level of awareness, Antimicrobials, Prescribing pattern, Risk factor, Role of the pharmacist

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### INTRODUCTION

Skin infection can be defined as the invasion and multiplication of microorganism such as bacteria, fungal, viral or parasites on the skin, which are usually absent within the body [1]. Skin infection can be classified into primary infection and secondary infection. Primary infections are usually caused by a single pathogen which usually enters through a break on a normal, healthy skin, and this type of infection will have a characteristic morphology and disease course. For example, *Staphylococcus aureus*, *B-hemolytic streptococci*, and *coryneform bacteria* are some of the most common pathogens causing primary infections. Whereas secondary infections appears as a superimposed condition of an already diseased skin. Hence, the clinical picture and disease course varies due to the underlying disease. The most common pathogens leading to secondary infection are *Pseudomonas aeruginosa* and gram-negative rods such as *Escherichia coli*, *Haemophilus influenzae*, *Clostridium species*, *Mycobacterium species* and *Pseudomonas species* [2]. Skin infections are mainly treated with antimicrobials such as antibiotics, antifungal, antivirals, and antiparasitic [3].

Skin conditions are a major cause for consultation in the primary care with up to 2% of consultations in general practice worldwide accounting to dermatological conditions [4]. In the Fourth National Morbidity Survey in England and Wales estimated about 10million consultations in general practice were due to skin conditions of which 2.4million were initiated due to infection [5]. Nevertheless, a study done by MA Brujinzeels *et al.* and the Weekly Returns Service (WRS) of the Royal College of General Practitioners (RCGP) reported that doctors were only consulted on a minority of occasions with only 28% of all skin problems consulting the general practitioner [6] while another study also reports that up to 80% of the population suffering with skin problems do not seek medical help [7]. However, nowadays community pharmacists have become the first-line healthcare professionals for consultations [8, 9]. This has been proven by studies which state that pharmacists play an important role in dermatological problems over the decade [10, 1]. This is because topical antimicrobials are now available as over-the-counter (OTC) medications for treatment of common skin infections.

However, the treatment of skin infection relies on three phases for a rational use of the drug. The first and most crucial phase is the appropriate diagnosis, which is merely based on physician's clinical experience and diagnostic tests. The second crucial phase of treatment is the rational prescribing which is based on the physician's knowledge on the pathophysiology of the disease, knowledge on the risks and benefits of drug prescribed. The next crucial treatment phase is the appropriate use and adherence of

patients to drugs as prescribed by the prescriber. Drugs are needed to be used rationally as irrational or non-specific drug use may produce harmful or beneficial effects. Furthermore, in developing countries, irrational use of drugs was found to cause a shortage of drug resources and an increase in expenditure and burden to treat the adverse clinical effect of the drug [12]. This is mainly due to the rising of antimicrobial resistance all over the world as new resistance mechanism is emerging and spreading globally [13]. Hence, the goal of treatment in dermatological practice is to achieve the best possible outcome in the shortest period with the least number of safe drugs at a reasonable cost to patients. This, however, can be achieved by monitoring, evaluating and therapeutically analyzing the prescribing patterns of drugs for skin condition [14].

### Level of awareness of skin infection

Skin infection can be caused by many factors, but nevertheless, the lack of awareness remains the main factor. Good knowledge of skin infection will increase the awareness level so that the skin infection can be treated accordingly as well as avoid the risk factors leading to skin infection for a better QoL. A study was done by Goonmatee K. *et al.* revealed that the majority of the study carried out were from middle household income and had tertiary education, had good knowledge and were aware of skin infection. Hence, the respondents who were knowledgeable in skin infection practiced good hygiene and were aware of risk factors causing skin infection. For instance, 73% of respondents knew to use and sharing cosmetics was a risk factor while 78% respondents were aware that the sharing of personal belonging was a risk factor of skin infection [15]. This has been further proven by a study which shows that acne patients who were emotionally more affected were more likely to adhere to treatment as they are more aware of the condition which leads to a better outcome and improved quality of life (QoL) [16]. Besides that, psoriasis patients also prove that insufficient knowledge can cause the patient to undermine their decision making in daily life affecting their QoL [17]. The level of awareness can be improved by providing the public with proper health education and healthcare system which eventually highlights the significance of firm awareness of health information.

### Prescribing pattern of drug

There is a lack of studies on the prescribing patterns of antimicrobials by the pharmacist for skin infections in the community pharmacy settings. However, worldwide, there are many studies which were carried out on prescribing patterns of drugs prescribed by general practitioners. The data collected from these studies were then used to constitute guidelines to improve drug

utilization, modify the prescription of drugs for better therapeutic outcome and decreased adverse effect [12], identify polypharmacy and drug-drug interaction, implement economic aspects in the chain of drug use [14], assist in providing rational and cost-effective medical care [18,9] and finally implement standards of medical treatment in the healthcare system [12]. Nevertheless, over the recent decade, antimicrobial resistance is still on the rise in many countries, despite the efforts to control it. The inappropriate or misuse of the antimicrobials is the main reason for the development of resistance pathogens and the emergence of superbugs [13, 9].

Nevertheless, the antimicrobial resistance development can be narrowed down to the overuse of antibiotics leading to the selection of resistant bacteria in the commensal selection [20-2]. In the Europe, studies found that over 90% of all antibiotics for human use are prescribed in the primary health care [21, 3]. Inappropriate treatment with antibiotics will lead to the limited effectiveness to the patient, causes the unnecessary cost to the health care system and finally further increases the antimicrobial incidence [24-6]. Besides, a study by Bronzwear *et al.* shows resistance to be more prevalent in countries where antibiotic is used at a particularly high rate [27]. Thus, the appropriate use of antibiotics is important to limit the emergence of the resistant organism [28]. WHO also added that the health workers and pharmacist can help prevent resistance by only prescribing and dispensing the right antibiotics to patients only when they are truly needed [13]. Several studies have also advocated cautious and appropriate prescribing of antibiotics to control the antimicrobial emergence [24, 9]. This can be carried out providing empirical treatment with antibiotics only if necessary and should ideally also include appropriate agents which are effective against most common pathogenic agents [29].

#### Rising risk factors of Skin Infection

Besides the misuse and inappropriate use of drugs, poor infection prevention and control practices also contributes to further emergence and spread of microorganism [13] lead to worsening of skin infection. This is mainly due to the lack of awareness of the public about risk factors causing skin infection. For instance, the public has yet to realize that sharing of cosmetic between women and sharing of belongings such as toothbrush, towel, razors, soaps, and combs is one of the main risk factors of skin infection [30,1]. This has been proven by studies which shows that lip cosmetics could spread contagious *herpes simplex virus* causing cold sores on lips [30]. Besides that, tattoo and piercing have become a worldwide mainstream fashion among adults in the last 10-20years leading to the rise of skin infection [32]. According to a review by Barn P *et al.*, 1 case-control study, 1 outbreak investigation, 3 reviews and 24 case reports were reported on skin infection due to piercing caused mainly by bacteria, such as *Pseudomonas*, *Streptococcus* and *Mycobacterium* and another 2 studies reporting on viral infection [33]. Fisher *et al.* and Keener *et al.* also reported cartilage piercing posted a higher skin infection risk compared to earlobe piercing [34,5]. While studies by Kay *et al.*, shows that tattoo has caused outbreaks of *M. Haemophilium* in two males in Washington State [36] while Drage *et al.* reported 6 individuals infected with *M. Chelonae* in the United States due to the use of municipal water for tattooing [37]. The second outbreak was reported by Goldman *et al.* in France when two tattooists were implicated with 48 patients suffered from a skin infection around the tattooed area with cultures from open tattoo ink bottle being positive for *M. Chelonae* [38].

Moreover, several case reports reported 4 mycobacterial infection case and 2 *Pseudomonas aeruginosa* and *Streptococcus pyrogens* cases [33]. Furthermore, sweating is also another risk factor of infection usually neglected by many. Wearing tight and non-cotton clothes can cause sweating which eventually leads to the increased risk of skin infection. This has been proven by a new study which shows that people with hyperhidrosis, which is excessive sweating are more prone to skin infection caused by bacteria, fungi and viruses [39]. Thus, it is important to educate the patients on the risk factors causing skin infection to create awareness so that the risk factor can be avoided or reduced in order for a better QoL.

#### The role of pharmacist and antimicrobial stewardship programs

The antimicrobial stewardship program is used to improve patient outcomes while minimizing unintended consequences of antimicrobial use in the practice settings of health systems. The American Society of Health-System Pharmacists (ASHP) believes that pharmacist plays an important role in antimicrobial stewardship program and also takes part in the infection prevention and control programs on the health system. The responsibilities of the pharmacist in this system are to promote the optimal antimicrobial use, hence, reducing the infection transmission as well as educating the patients, health professionals, and the public. Besides that, they should participate in all efforts to prevent and reduce infection transmission among the patients and health care systems [40]. The pharmacist can take part in educational activities to educate the health professionals, patients and the public on the antimicrobial use as well as provide knowledge on the risk factors of skin infection to bring awareness among them to reduce the occurrence and spreading of skin infection for a better QoL [41]. This can be done by providing clinical conferences, newsletters or educational forum for health professionals on antimicrobials and resistance. Besides that, pharmacists can educate and counsel patients about the adherence to prescribed antimicrobial medications and the prevention and control of infection. Furthermore, public health education and awareness programs should be carried out aimed to controlling the incidence and spreading on infection [40].

#### CONCLUSION

Skin infection rises globally as the emergence of microorganism throughout the world increases mainly due to the lack of awareness of the public on skin infection and the misuse or inappropriate use of antimicrobials to treat skin infections. Hence, many studies have been carried out throughout the world to assess the level of awareness of the public on skin infection as well as the prescribing patterns of antimicrobials for the treatment of skin infection which is lacking in Malaysia. Thus, further studies need to be conducted in Malaysia so that dermatological educational programs can be encouraged among pharmacist to bring awareness on skin infection among the public and educate the healthcare settings on the appropriate use of antimicrobials.

#### CONFLICT OF INTERESTS

Declare none

#### REFERENCES

1. Seldon ST. Intertrigo, Medscape. Available from: <http://emedicine.medscape.com/article/1087691>. [Last accessed on 15 Oct 2015].
2. Aly R. Microbial infections of skin and nail. In: Baron S. editors. Medical Microbiology. 4<sup>th</sup> ed. Galveston (TX):University of Texas Medical Branch at Galveston; 1996.
3. Topical products used for the treatment of common skin infection. Infectious Disease in Children. Infectious Diseases in Children; c2002. Available from: [www.healio.com/pediatrics/dermatology/news/print/infectious-diseases-in-children/{7c3c5d78-1dee-4c2e-8911-c3190345e2c7}/topical-products-used-for-the-treatment-od-common-skin-infections](http://www.healio.com/pediatrics/dermatology/news/print/infectious-diseases-in-children/{7c3c5d78-1dee-4c2e-8911-c3190345e2c7}/topical-products-used-for-the-treatment-od-common-skin-infections). [Last accessed on 15 Oct 2015].
4. Saravanan Kumar RT, Prasad GS, Ragul G, Mohanta GP, Manna PK, Moorthi CK. Study of a prescribing pattern of topical corticosteroids in the department of dermatology of a multi speciality tertiary care teaching care teaching hospital in south India. Int J Res 2012;3:685-7.
5. McCormick A, Fleming D, Charlton J. Morbidity statistics from general practice. Fourth Natl Study 1991-1992. London: HMSO; 1995.
6. Bruijnzeels MA, Foets M, van der Wouden JC, van den Heuvel WJ, Prins A. Everyday symptoms in childhood: Occurrence and general practitioner consultation rates. Br J Gen Pract 1998;48:880-4.
7. Williams HC. Epidemiology of skin diseases. Rook's Textbook of Dermatology. 7th edition. Oxford: Blackwell Science; 2004.

8. Roque F, Soares S, Breitenfeld L. Attitudes of community pharmacists to antibiotic dispensing and microbial resistance: a qualitative study in Portugal. *Int J Clin Pharm* 2013;35:417-24.
9. Fabbro SK, Mostow EN, Helms SE. The pharmacist role in dermatological care. *J CPTL* 2014;6:92-105.
10. Tucker R, Duffy J. The role of community pharmacists in the management of skin problems. *J Pharm Care Health Systems* 2014;1:105-8.
11. Tucker R. An exploratory study of UK community pharmacist's perceptions of the skin conditions they encounter: Prevalence, Reasons for Referral and over-the-counter dermatological wish list. *Self-Care* 2013;4:3-17.
12. Bijoy KP, Vidyadhar RS, Palak P. Drug prescribing and economic analysis for skin diseases in dermatology OPD of an Indian tertiary care teaching hospital: a periodic audit. *Indian J Pharm Pract* 2012;5:28-33.
13. Antimicrobial resistance. World Health Organization (WHO). Available from: <http://www.who.int/mediacentre/factsheets/fs194/en/>. [Last accessed on 15 Oct 2015].
14. Sweileh WM. Audit of prescribing practices of topical corticosteroids in outpatient dermatology clinics in the north Palestine. *Eastern Mediterranean Health J* 2006;12:161-9.
15. Goonmatee K, Rajesh J. What factors contribute to a higher frequency of skin infections among adults in Mauritius? *Our Dermatol Online* 2013;4:297-302.
16. Jonas-Caballero M, Pedrosa E, Penas PF. Self-reported adherence to treatment and quality of life in mild to moderate acne. *Dermatology* 2008;217:309-14.
17. Cristin R, Cristin DP, Paolo G, Chinni LM, Fazio M, Ianni A, *et al.* Insufficient knowledge among psoriasis patients can represent a barrier to participation in decision-making. *Acta Derm Venereol* 2006;86:528-34.
18. Tiwari H, Kumar A, Kulkarni SK. Prescription monitoring of antihypertensive drug utilization at the Panjab University health center in Indai. *Singapore Med J* 2004;45:117-20.
19. Shankar PR, Pai R, Dubey AK. Prescribing patterns in the orthopedics outpatient department in a teaching hospital in Pokhara, western Nepal. *Kathmandu Uni med J* 2007;5:16-21.
20. Den HCDJ, Van BEME, Paget WJ, Pringle M, Goossens H, Bruggeman CA, *et al.* Prevalence and resistance of commensal *Staphylococcus aureus*, including methicillin-resistant *Staphylococcus aureus*: a European cross-sectional study. *Lancet Infect Dis* 2013;13:409-15.
21. Goossens H, Ferech M, Vander SR, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet* 2005;365:579-87.
22. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *Br Med J* 2010;340:2096.
23. Muller A, Coenen S, Monnet DL, Goossens H. European surveillance of antimicrobial consumption (ESAC): outpatient antibiotic use in Europe 1998-2005. *Eur Surveill* 2007;12:3284.
24. European Commission: Staff working paper of the services of the commission on antimicrobial resistance; c2009. Available from: [http://ec.europa.eu/food/food/biosafety/salmonella/antimicrobial\\_resistance.pdf](http://ec.europa.eu/food/food/biosafety/salmonella/antimicrobial_resistance.pdf). [Last accessed on 15 Oct 2015].
25. Zetola N, Francis JS, Nuermberger EL, Bishai WR. Community-acquired methicillin-resistant *Staphylococcus aureus*: an emerging threat. *Lancet Infect Dis* 2005;5:275-86.
26. Cosgrove SE, Carmeli Y. The impact of antimicrobial resistance on health and economic outcomes. *Clin Infect Dis* 2003;36:1433-7.
27. Beattie PE, Lewis-Jonas MS. A comparative study of impairment of quality of life in children with skin disease and children with other chronic diseases. *Br J Dermatol* 2006;155:145-51.
28. Fleming DM, Elliot AJ, Kendall H. Skin infections and antibiotic prescribing: a comparison of surveillance and prescribing data. *Br J General Practice* 2007;57:569-73.
29. Carrie AG, Zhanel GG. Antibacterial use in community practice: assessing the quantity, indications and appropriateness, and relationship to the development of antibacterial resistance. *Drugs* 1999;57:871-81.
30. Infection Protection. Parents of Kids with Infectious Disease PKIDs Online; c2004-2010. Available from: [http://www.pkids.org/infection\\_protection/infectious\\_disease\\_workshop.html](http://www.pkids.org/infection_protection/infectious_disease_workshop.html). [Last accessed on 15 Oct 2015].
31. Bachai S. When sharing is not caring: 6 personal health items you should never share, and what happens if you do. *Medical Daily*; c2014. Available from <http://www.medicaldaily.com/when-sharing-not-caring-6-personal-health-items-you-should-never-share-and-what-happens-if-you-do>. [Last accessed on 30 Sep 2015].
32. Ngan V. Tattoo-associated skin reactions. *DermNet NZ*; c2014. Available from: <http://www.dermnetnz.org/reactions/tattoo-reaction.html>. [Last accessed on 30 Sep 2015].
33. Barn P, Chen T. Infections associated with personal service establishments: piercing and tattooing. National Collaborating Centre for Environmental Health; c2012. Available from: [http://www.academia.edu/1770003/Infections\\_Associated\\_with\\_Personal\\_Service\\_Establishments\\_Piercing\\_and\\_Tattooing](http://www.academia.edu/1770003/Infections_Associated_with_Personal_Service_Establishments_Piercing_and_Tattooing). [Last accessed on 30 Sep 2015].
34. Fisher CG, Kacica MA, Bennett NM. Risk factors for cartilage infections of the ear. *Am J Prev Med* 2005;29:204-9.
35. Keene W, Markum AC, Samadpour M. Outbreak of *Pseudomonas aeruginosa* infections caused by the commercial piercing of upper ear cartilage. *JAMA* 2004;291:981-5.
36. Kay MK, Perti TR, Duchin JS. Tattoo-associated *Mycobacterium haemophilum* skin infection in immunocompetent adult 2009. *Emerging Infect Dis* 2011;17:1734-6.
37. Drage LA, Ecker PM, Orenstein R, Phillips PK, Edson RS. An outbreak of *Mycobacterium chelonae* infections in tattoos. *J Am Acad Dermatol* 2010;62:501-6.
38. Goldman J, Caron F, de Quatrebarbes J, Pestel-Caron M, Courville P, Doré MX, *et al.* Infections from tattooing. The outbreak of *Mycobacterium chelonae* in France. *Br Med J* 201;340:5483.
39. Miller M. Excessive sweating (hyperhidrosis). Skincare. Available from: <http://www.webmd.com/skin-problems-and-treatments/hyperhidrosis2>. [Last accessed on 30 Sep 2015].
40. ASPH Statement on the pharmacist's role in antimicrobial stewardship and infection prevention and control. *Am J Health-Syst Pharm* 2010;67:575-7.
41. Dellit TH, Owens RC, McGowen JE, Gerding DN, Weinstein RA, Burke JP, *et al.* Infectious diseases society of America and the society for healthcare epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007;44:159-77.