



Antibiotic Resistance in Environment and its Public Health Risks in Iran

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The World Health Organization (WHO), in its June 2014 report announced antibiotic resistance as one of the major challenges of the current century¹. Antibiotic resistance is responsible for the death of millions of people worldwide². These factors impose a heavy financial pressure on governments and individuals. Numerous reports by researchers around the world indicate that antibiotic resistance is expanding rapidly³. While expressing a serious concern, WHO has warned the risk of returning to the era before the discovery of antibiotics¹. Antibiotic resistance is a multi-aspect issue; in other words, it has engaged not only the medical treatment sectors, but also all parts of the environment (water, wastewater, air, and soil), agriculture, and animal husbandry. Many researchers believe that antibiotic resistance, especially the one produced in medical environments, would find a way to enter other parts of the society and cause an antibiotic resistance cycle within the society⁴. For example, studies have proved that antibiotic-resistant bacteria and genes enter the environment through the produced wastewater, consequently wastewater treatment plants are the only

controlling barriers within the environment. Wastewater treatment facilities not only are unable to remove these factors (agents), but also have a synergistic effect on them⁵. Furthermore, removal of these factors requires advanced treatment processes and necessitates spending long periods of time, especially in developing countries.

Although all countries in the world are dealing with this challenge, its risk is highly serious in developing countries⁶. In these countries, the technological weakness, poor management of control systems, low per capita income, lack or weakness of antibiotic resistance-relevant laws, as well as lack of a specific program for dealing with this issue have led to the significant growth of antibiotic resistance⁷.

Iran, as one of the developing countries, is faced with this problem. Almost all studies conducted in this realm, reported antibiotic resistance and bacterial-resistant genes in medical environments^{8,9}. The important and worrying point is that antibiotic resistance in medical environments is an epidemic. Antibiotic resistance is closely associated with generation and increase of hospital

infections, increased mortality rate, as well as increased health and medical costs.

Results of studies demonstrated that the resistant bacteria and genes enter the environment through municipal and hospital wastewaters. Surprisingly, the entrance pattern of resistant bacteria and genes to the environment is consistent with entrance pattern of these factors to the medical environment. The worrying point is that a major part of the medical effluents enters the environment without being treated and the municipal and hospital wastewater treatment plants are unable to remove these factors^{10, 11}. The environmental studies in Iran have shown that the prevalence of antibiotic resistance is very high in water resources, wastewater, soil, and even hospital air¹²⁻¹⁴. Such prevalence includes almost all of the antibiotic and bacterial groups. Most of the environmental studies in Iran have reported multiple resistance^{4, 15}. Accordingly, a large part of these factors is discharged to the environment¹⁶. Researchers have shown that the resistant bacteria and genes can enter the water resources from wastewaters and then enter the water distribution network through the treated water and jeopardize the consumers' health¹⁷⁻¹⁹. Moreover, these factors were identified in farming fields, air, and other environmental areas²⁰. Therefore, it seems that antibiotic resistance within the environment, as a serious problem, has exposed the public health to serious threats. In this regard, to control the antibiotic resistance within the environment and reduce the health risks, the following solutions can be useful:

- Adopting macro-policies on antibiotic resistance control in the environment;
- Conducting comprehensive nation-wide studies on antibiotic resistance in the environment;
- Equipping water and wastewater treatment systems with advanced (modern) processes;
- Evaluating actual health-related risks resulted from resistant bacteria and genes in the environment; and
- Using successful global experiences in the field of antibiotic resistance management.

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References

1. WHO. Antimicrobial resistance: global report on surveillance: World Health Organization; 2014.
2. Roca I, Akova M, Baquero F, et al. The global threat of antimicrobial resistance: science for intervention. *New Microbes and New Infections*. 2015;6:22-9. DOI: 10.1016/j.nmni.2015.02.007
3. Abbassi-Ghozzi I, Jaouani A, Hammami S, et al. Molecular analysis and antimicrobial resistance of Salmonella isolates recovered from raw meat marketed in the area of "Grand Tunis", Tunisia. *Pathol Biol (Paris)*. 2012;60(5):e49-e54. DOI: 10.1016/j.patbio.2011.07.005
4. Aali R, Hosseinpour S, shahryari A, et al. Diversity of genes coding of antibiotic resistance in municipal wastewaters. *Rahavard Salamat Journal*. 2016;2(3):1-14. Available from: <http://rsj.iuums.ac.ir/article-1-33-en.html> [Cited June 15, 2017].
5. Shrivastava R, Upreti RK, Jain SR, et al. Suboptimal chlorine treatment of drinking water leads to selection of multidrug-resistant *Pseudomonas aeruginosa*. *Ecotoxicol Environ Saf*. 2004; 58(2): 277-83. DOI: 10.1016/S0147-6513(03)00107-6
6. Okeke IN, Laxminarayan R, Bhutta ZA, et al. Antimicrobial resistance in developing countries. Part I: recent trends and current status. *Lancet*

- Infect Dis. 2005; 5(8): 481-93. DOI: [http://dx.doi.org/10.1016/S1473-3099\(05\)70189-4](http://dx.doi.org/10.1016/S1473-3099(05)70189-4)
7. Byarugaba D. Antimicrobial resistance in developing countries and responsible risk factors. *Int J Antimicrob Agents*. 2004; 24(2):105-10. DOI: 10.1016/j.ijantimicag.2004.02.015
 8. Behrooozi A, Rahbar M, Jalil V. Frequency of extended spectrum beta-lactamase (ESBLs) producing *Escherichia coli* and *Klebsiella pneumonia* isolated from urine in an Iranian 1000-bed tertiary care hospital. *Afr J Microbiol Res*. 2010; 4(9): 881-4. Available from: http://www.academicjournals.org/article/article-1380211512_Behrooozi%20et%20al.pdf [Cited June 10, 2017].
 9. Leylabadlo HE, Poulrak T, Aghazadeh M, et al. Extended-spectrum beta-lactamase producing gram negative bacteria in iran. *Afr J Infect Dis*. 2017; 11(2): 39-53. DOI: 10.21010/ajid.v11i2.6
 10. Szczepanowski R1, Linke B, Krahn I, et al. Detection of 140 clinically relevant antibioticresistance genes in the plasmid metagenome of wastewater treatment plant bacteria showing reduced susceptibility to selected antibiotics. *Microbiology*. 2009; 155: 2306–19. DOI: 10.1099/mic.0.028233-0
 11. Hadi M, Shokoohi R, Ebrahimzadeh Namvar A, et al. Antibiotic Resistance of Isolated Bacteria from Urban and Hospital Wastewaters in Hamedan city. *IranJHealth& environ*. 2011; 4(1): 105-14. Available from: <http://ijhe.tums.ac.ir/article-1-91-en.html> [Cited July 15, 2017].
 12. Aali R, Nikaeen M, Khanahmad H, et al. Monitoring and comparison of antibiotic resistant bacteria and their resistance genes in municipal and hospital wastewaters. *Int J Prev Med*. 2014;5(7):887. PMID: PMC4124567
 13. Mirhoseini SH, Nikaeen M, Khanahmd H, et al. Monitoring of airborne bacteria and aerosols in different wards of hospitals–Particle counting usefulness in investigation of airborne bacteria. *Ann Agric Environ Med*. 2015;22(4):670-3. DOI: 10.5604/12321966.1185772
 14. Samadi N, Aali R, Asgari E, et al. Identification of clinically antibiotic resistant genes Aac (3)-IIa and Aac (6’)-Ib in wastewater samples by multiplex PCR. *Environmental Health Engineering and Management Journal*. 2015; 2(2): 47-52. Available from: <http://ehemj.com/article-1-72-fa.pdf> [Cited June 30, 2017].
 15. Aali R, Nikaeen M, Hatamzadeh M, et al. The role of Hospital Wastewaters in Dissemination of Antibiotic Resistant Bacteria and Resistance Genes to the Environment. *Journal of Environmental Health Engineering*. 2016;3(3): 239-48. Available from: <http://jehe.abzums.ac.ir/article-1-243-en.html> [Cited July 17, 2017].
 16. Farshchian MR, Roshani M, Dehghanzadeh Reihani R. Determination of Antibiotic Resistance Pattern in Bacteria Isolated from Municipal Wastewater Treatment Plant. *Journal of Mazandaran University of Medical Sciences*. 2015; 25(126): 11-21. Available from: <http://jmums.mazums.ac.ir/article-1-5912-en.html> [Cited July 25, 2017].
 17. Xi C, Zhang Y, Marrs CF, et al. Prevalence of Antibiotic Resistance in Drinking Water Treatment and Distribution Systems. *Appl Environ Microbiol*. 2009;75(17):5714-8. DOI: 10.1128/AEM.00382-09
 18. Armstrong JL, Calomiris J, Seidler RJ. Selection of antibiotic-resistant standard plate count bacteria during water treatment. *Appl Environ Microbiol*. 1982;44(2):308-16. PMID: PMC242011
 19. Ramteke P, Gaur A, Pathak S, et al. Antibiotic resistance of coliforms in drinking water in rural areas. *Indian J Med Res*. 1990;91:185-8. PMID: 2397939
 20. Christou A, Aguera A, Bayona JM, et al. The potential implications of reclaimed wastewater reuse for irrigation on the agricultural environment: The knowns and unknowns of the fate of antibiotics and antibiotic resistant bacteria and resistance genes - A review. *Water Res*. 2017;123:448-67. DOI: 10.1016/j.watres.2017.07.004