Pharmaceutical product cross-contamination: industrial and clinical pharmacy practice

DMSJ;19(2) 17-19
http://dx.doi.org/10.4314/dmsj.v19i2.5
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ABSTRACT

Therapeutic consultation by patients is made complete by drug management which is expected to solve the patients' problems. Pharmaceutical product cross-contamination is a serious problem which has been detected as an obstacle towards successful therapeutic goals. In the pharmaceutical care of patients in developed countries, cross-contamination of drugs has been well addressed and controlled unlike in most developing countries including Tanzania.
This review intends to provide insight into this problem, aiming at increasing awareness on the health impacts of cross-contamination on patients in order to promote preventive strategies employed in combating cross-contamination in both industrial and clinical pharmacy practice.

INTRODUCTION

Pharmaceutical product cross-contamination refers to the process by which foreign chemical, microbial, or physical substances are unintentionally transferred from one substance or object to medicines with harmful effects that might affect the purity and quality of the pharmaceutical products leading to health impacts on human and animal users. Medicines are expected to save lives and bring back the health of patients, but cross-contaminated medicines may be life threatening and fatal[1]. Among the most hazardous contaminants are highly sensitizing materials such as sulphonamides and penicillin[2], microorganisms especially potential pathogens such as Staphylococcus aureus, E.coli, and toxic substances such as cyclosporine and daunorubicin.

Products in which contamination is likely to be most significant are those administered by injection[3] or applied to open wounds and those given in large doses and/or over a long time. Cross-contamination in pharmaceuticals has been addressed elsewhere as a serious problem with evidence of product recall[4].This review intends to provide an insight into this problem, aiming at increasing awareness on its health impacts on patients in order to promote preventive strategies employed in combating cross-contamination in both industrial and clinical pharmacy practice.

1.INDUSTRIAL PHARMACY PRACTICES

The main sources of cross-contamination in drug manufacturing are human beings, air, equipment, water, and raw materials.

Human beings carry normal flora such as Staphylococcus aureus[5] and may serve as the main source of microbial cross-contamination during manufacturing of pharmaceuticals. This contamination has clinical implications because it may be a way of introducing bacterial toxins and pathogens into medicines. In sterile preparations for injections this can cause life threatening anaphylactic reactions[6].The use of cross-contaminated medicines and medical equipment has been reported to cause Staphylococcus aureus sepsis in patients[7].Microbial cross-contamination of pharmaceuticals is associated with appearance of bacterial strains resistant to antimicrobials[8]. Antimicrobial resistance has some economic consequences because it requires a patient to buy expensive drugs which the organisms are sensitive to, increases duration of hospital stay and may require further expensive investigations[9].

The current Good Manufacturing Practices require that in a pharmaceutical industry all workers wear special clothes before entering the production area. Regular alcohol hand washing is required and regular hand swabs are taken for culture by the quality control department.

It is known that a certain proportion of the population is sensitive to penicillin[10].Therefore such products require special handling. However, penicillin products may cross-contaminate other medicines especially during campaign production[11]. Penicillin cross-contaminated products can cause severe anaphylactic reactions and death in sensitive patients[12]. Drug sensitivity does not only affect the quality of patients' life but also leads to delayed treatment and increases treatment costs. The current Good Manufacturing Practice requires that production of penicillin and other preparations liable to be contaminated such as live vaccines, live bacterial preparations and other biological materials like insulin be carried out in dedicated and self-contained areas[13].

In campaign production, more than one drug is manufactured in the same production line. This is the source of cross-contamination since residuals of former drug may be passed to the latter drug. The current Good Manufacturing Practices suggest that there should be separation in time followed by appropriate cleaning in accordance with a validated cleaning procedure[14].

Air carries a lot of materials both organic and nonorganic which may be potential contaminants in pharmaceutical manufacturing. To avoid air contamination during manufacturing it is a requirement that pharmaceutical

industries provide appropriately designed airlocks, pressure differentials, and air supply extraction systems[15].

Pipes used for conveying distilled or de-ionized water and, where appropriate, other water pipes should be sanitized and stored according to written procedures that detail the action limits for microbiological contamination and the measures to be taken.

2.CLINICAL PHARMACY PRACTICE

In the hospital setup the main sources of drug contamination depend on human practices such as preparation of drugs for intravenous administration[16], poor dispensing practices, and poor adherence to medicine storage conditions.

Dispensing practices in most medicine outlets including some public hospital pharmacies observed in Tanzania are not satisfactory, probably due to insufficient skilled pharmaceutical human resources[17]. For instance, it was observed in most medicine outlets including community pharmacies that a single dispensing tin is used in counting the number of medicines. A problem is likely to occur if a tin used to count cotrimoxazole tablets, for instance, is again used to count paracetamol tablets which are to be dispensed to a patient who is allergic to sulpha drugs. Poor storage of medicines in homes is also a source of contamination. It is presumed that improved packaging of products in blisters may eliminate this problem.

Most solid dosage forms have low water activity thus are less liable to contamination but under poor storage conditions a local increase in water content may permit microbial growth[18].

A recently conducted study in one of the public hospitals in Dar es Salaam revealed about 50% of the analyzed non sterile pharmaceutical products to be heavily contaminated with microorganisms[19.] Such cross-contamination is not only a risk of infection to patients but also a risk of deterioration of the medicinal product. Medicines are manufactured with some additives which ensure that the active ingredient is safely delivered for the clinical therapeutic indication. Therefore microbial contamination of drugs with pathogenic or non-pathogenic organisms may bring about changes in their physical characteristics, including breaking of emulsions, thinning of creams, fermentation of syrups, and appearance of turbidity or deposits thus producing ineffective products.

Multiple-drug vial and single vial use in the wards creates a high risk of microbial contamination which poses a risk of infection and septic shock [20.] However, contamination may also occur during reconstitution of powders for parenteral injections, and via tips of injection needles [21.]

Cross-contamination of medicines contributes to most of the nosocomial infections occurring in hospitals[22]. It also accounts for most of the postsurgical infections and deaths occurring in hospitals[23].

Cross-contaminated medicines weaken the relationship between patients and healthcare givers. This occurs mostly in the event of drug resistance and treatment failure, but also infections due to contaminated medicines make patients lose trust in their health care givers. This has economic impacts in terms of health business because one may lose clients.

Based on risk and pharmaco-economic analyses, some authors have proposed that clinical pharmacy and ready to use syringes are the most promising safety tools regarding medication use in hospitals24.It is unfortunate that clinical pharmacy practice is lagging behind in Tanzania.

CONCLUSION

Cross-contamination of medicinal products is not a rare phenomenon in both clinical and pharmaceutical industrial practice; therefore it should not be overlooked. This article provides useful information to health care practitioners and the community at large on the cross contamination of medicines and its impact on the community.

RECOMMENDATIONS

- A training program for health care workers about the risk of cross-contamination in hospitals and safe ways of preparing solutions for parenteral use should be put in place.
- Conducting regular training for pharmaceutical dispensers on good dispensing practices.
- Alcohol hand hygiene in hospitals, observance of the manufacturer's recommendations and appropriate storage conditions for medications should be insisted upon.
- Regulatory bodies should conduct regular inspection of manufacturing industries to ensure adherence to good manufacturing practices, and of drug premises to ensure adherence to storage conditions as well as good dispensing practices.
- Proper counseling of patients on proper use of medicines and proper storage of medicines in homes should be provided on dispensing.
- To reduce the risk of medicine cross-contamination, government and stakeholders should increase the number of well-trained pharmaceutical human resources.
- More studies which will cover many parameters on medicine cross-contamination should be conducted to ascertain the problem and address the situation in a more scientific way.
- Pharmacists should focus more on clinical practice, pharmaceutical care of patients and specialization in clinical pharmacy so as to save patients from this problem.

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