Editorial

Focus on Vial Sterility

The science of infection control and epidemiology has grown considerably the past few years. Yet as we progress in knowledge, we sometimes need to look back and question some of the ideas and practices that have been the building blocks of our foundation. Studies have shown that the environment in which we work is not a sterile one, and despite our attempts to preserve it, nosocomial infections continue to occur in 3% to 5% of all hospitalized patients.

The articles in this issue of *Infection Control* will present new information on two of those founding principles—vial sterility and aseptic technique. As infection control practitioners, we have long known and praised the value of aseptic technique. But does our technique make a difference in the end?

Swedish investigators conducted a study 30 years ago that noted a high frequency of contamination in vials without a preservative.[1] Today, the addition of a preservative to the majority of our injectable drugs is routine practice. Bawden et al examined multiple-dose vials after collection from hospital nursing units and after deliberate contamination.[2] Bacteria could be isolated only when the sample was tested within one hour of contamination. Only one vial was positive at 16 hours and none were positive beyond that time. No bacterial contamination was found in the vials collected from the nursing stations. Numerous other studies have addressed the possibility of contamination of multiple-dose vials during use.[3-7] Most have discovered a very low rate of contamination. So, it appears that preservatives have been the key to successful, carefree technique—or have they been the key to Pandora's box? Will our technique become so nonchalant that we end up contaminating these vials with a multitude of pathogens?

Highsmith, Allen and Greenhood have noted that several organisms survived or grew in a multiple-dose vial containing lidocaine.[8] The lidocaine solution also contained endotoxin after contamination with *Pseudomonas cepacia,* as did insulin contaminated with enterococcus. Borghaus et al reported that if a multiple-dose vial is contaminated with a particular agent that is resistant to the bacteriostatic agent present, it may very quickly become a potential source of infection to patients.[9] These researchers found that bacteria recovered from unopened vials of the anesthetic fentanyl could be grown in the drug alone and in the preservative, parahydroxybenzoic acid, with the generation time being less than four hours. Actual clinical infections resulting from contaminated multiple-dose vials have not been reported frequently in the literature. However, Olsen et al documented eight cases of *Flavobacterium meningosepticum* bacteremia caused by extrinsic contamination of multiple-dose vials by poor aseptic technique.[10]

One point is clear from these studies: bacterial contamination can and does occur in the multiple-dose vial. The question still remains as to what the actual degree of risk is of contamination and infection with the use of multiple-dose vials. A recently conducted study at The National Naval Hospital attempted to characterize this risk with respect to time-in-use, location, and medication type.[11] The well-controlled trial found no contamination from 1,223 samples. The vials were in use anywhere from one to 402 days, with a significantly shorter mean duration of use in some nursing wards (which theoretically removes the vial as a source of infection as it is used more frequently and discarded upon emptying) where injectable medications are used more frequently. The results of this study form the basis of the current hospital guidelines of the National Naval Hospital which state that a multiple-dose vial can be used until empty or until the manufacturer's expiration date occurs. Even though the researchers at the Naval Hospital did not specifically look for breaks in aseptic technique, their study does suggest that good aseptic technique helped them achieve their results. During the months of the study they found a significantly greater percentage of multiple-dose vials that were dated upon opening, even though they admit that dating has as yet unmeasured effects upon adherence to aseptic technique.

If the data on multiple-dose vial sterility is still inconclusive, perhaps a switch to single-dose vials would

solve the problem. In 1964, a study by Rosenzweig on the rubber stopper used on multiple-dose vials revealed that out of 214 vials randomly selected for leakage and culture studies, 21 showed leakage through the needle tracts caused by one or more punctures. However, only two vials from those cultured showed any contamination. The study concluded that single-dose vials were the preferred method for dispensing parenteral drugs. Similar studies by Wahlgren[12] and Bothe[3] also conclude that single-dose vials would be a more appropriate and economical system for patient use.

As pertinent as these data are, sterility still revolves around the basic concept of good aseptic technique. Without it, no system can be truly effective. Another recently completed study conducted at North Carolina Memorial Hospital examines this very point.[13] The investigators examined the sterility of single-use disposable saline vials used for suctioning intubated patients. While observing suctioning practices they detected problems in vial design and nursing technique that could compromise the sterility of the saline vial. When nurses used ungloved hands to remove the vial cap, skin contact with the vial opening resulted in a 23% contamination rate of vial contents. In some instances the organisms recovered from the vial contents were believed to be identical to the organisms isolated from the hands of the nurse who opened the vial. When good aseptic technique was followed by the nurses, the contents of the vial remained sterile. Their conclusions emphasize the importance of good aseptic technique and the relative ease in which contamination can occur.

Although we can never determine the actual prevalence of contaminated multiple-dose vials, published as well as ongoing studies provide insight that allows us to make reasonable guidelines concerning the use of multiple and single-dose containers. However, some points still need further research:

- Since there may be a relationship between contamination rate and the number of entries into a vial, could there be a relationship between needle gauge size, number of entries, and the rate of contamination?
- Were there any vials contaminated with viruses? More extensive research is needed to determine if viral growth occurred, as well as testing for the presence of endotoxins and pyrogens.
- Are we starting to discover preservative resistant bacteria, and if so, what can be done to prevent or decrease future resistance?

In today's economy-minded society, the infection control community needs to keep abreast of these new facts and ideas. With third-party prospective payments looming ahead, it is important that we try to maintain our quality of patient care, while keeping in mind the cost and feasibility of any new proposal.

REFERENCES

1. Kylin O, Ekstrand H: *Farmaceutisk Revy.* 1954; 53:29.
2. Bawden JC, Jacobson JA, Jackson JC, et al: Sterility and use patterns of multiple-dose vials. *Am J Hosp Pharm* 1982; 39:294-297.
3. Bothe J: Study shows contamination in multiple dose vials. *AORN J* 1973; 17:111-114.
4. Corley CE, Manos JP, Thomas JD: Multiple-dose vials: A source of contamination? *JSC Med Assoc* 1968; 64:461-464.
5. Kohan S, Carlin H, Whitehead R: A study of contamination of multiple-dose medication vials. *Hospitals* 1962; 36:78-80.
6. Rosenzweig AL: Potential health hazards in the multiple-dose vial. *Hospitals* 1964; 38:71-76.
7. Young JA, Collette TS, Brehm WF: Sterility of multiple-dose vials after repeated use. *Am Surg* 1958; 24:811-814.
8. Highsmith AK, Greenhood GP, Allen JR: Growth of nosocomial pathogens in multiple-dose parenteral medication vials. *J Clin Microbiol* 1982; 15:1024-1028.
9. Borghaus JGA, Hosli MTC, Olsen H, et al: Pseudomonas cepacia bacteremia due to intrinsic contamination of an anesthetic. *Acta Pathol Microbiol Scand* 1979; 87:15-20.
10. Olsen H, Frederiksen WC, Siboni K: Flavobacterium meningosepticum in 8 non-fatal cases of postoperative bacteremia. *Lancet* 1965; 1:1294-1296.
11. Longfield R, Longfield J, Smith LP, et al: Multidose medication vial sterility: An in-use study and a review of the literature. *Infect Control* 1984; 5:165-169.
12. Wahlgren S: Contamination hazards in multiple-dose containers for injections. *Dansk Tidsskrfit for Farmaci* 1970; 44:6.
13. Rutala WA, Stiegel MM, Sarubbi FA: A potential infection hazard with the use of disposable saline vials. *Infect Control* 1984; 5:170-172.

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