Technical Review on Protective Cap for Protection of Intravenous (IV) Fluid Bottles

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Abstract

The requirement for consistent quality, standardization, safety and low-cost medical components has become a big challenge for industries' survival in the global market of medical components. Companies applications depend strongly on the success of design, manufacturing and marketing strategies. That is the only way to become successful in the market, and for that, the research and development teams should also be considered. The different companies have been established to meet these requirements for the market. Very often, the design and manufacturing operations to produce medical plastics for the health care market have to be adjusted daily to satisfy increasing strict, government-regulated, bio-medical requirements in addition to all other pressures expected in this market. As a result, medical plastics always seek more systematic ways to improve product quality and produce more at minimum cost. It has now become an important point for consideration in accordance with the customers. Nowadays, Plastic is replacing MS, Aluminium, Glass etc., in all manufacturing industries. Particularly plastic protective cap is replaced with aluminium cap in pharmaceutical industries because of easy to manufacturing and low price.

Keywords: *- Medical caps, Protective caps, Intravenous fluid protective caps, Intravenous fluids, Medical caps*

INTRODUCTION

Today's fast running life offers several workloads, tensions, burdens. Under such circumstances, people need to be alert for their health regularly. Also, on the other hand, this process seems to be time-consuming for working men or women. Further, it is observed that people do not want to be attached to the measurement devices or to be conscious of continuous detecting and intensive care. Moreover, people feel more comfortable and safe in home environments compared to hospitals or clinical observation. Due to this, intravenous fluid bottles are used as they can be used at home or in the hospital under the observation of nurses for the care of patients. These caps are used for the protection of intravenous fluid bottles from fungi,

bacteria etc. Hence, intolerance is one of the permitting concepts in making health care measurements part of our everyday life. Non-invasive and non-contact measurement of vital signs like respiratory rate, respiratory pattern, pulse rate, blood oxygen saturation, temperature and blood pressure is important, both in medical and regular monitoring, especially of persons suffering from severe diseases for their health monitoring purpose. Existing standard devices are contact-based devices and aggressive in some specific cases. We can also say that leaving X-ray and radiography, no other non-contact type devices or applications are actually helpful as many are fake and of no use. But the only drawback is that it is contact type, and an advantage is that it is very helpful in many circumstances by improving the immune power. It can also be said that it is given to patients who do not eat food or drink liquids.

The structure for this manuscript includes protective caps, types of caps, intravenous fluids, medical malpractice and damaged caps, intravenous fluids on the blood level, reviews, conclusion and references.

Protective cap (P-CAPS)

Designers and employees from various companies have made protective caps to protect intravenous fluids from germs, bacteria, fungus, dust, etc. These intravenous fluids protect patients by giving them a certain amount of immunity from certain infectious bugs by increasing their immunity. They are not eating or drinking anything essential for them when they eat food or drink certain things. The cap also required rib due to the fitment issues that were complained about by a certain amount of customers with the increasing weight and thickness of the cap as well. Accordingly, changes have been made in the software according to the demand of the customers and the company.

To increase the thickness and weight of the cap, it is necessary to make changes in the punch and mould for its manufacturing. The fluids will flow around the ball check valve in as much as the ball check valve prevents fluid from leaving the bottle but does not prevent liquid from entering the bottle. Suppose it is desired to remove fluid from the bottle. In that case, this can be accomplished slowly by inverting the bottle and opening any closures on the tub- Sometimes, additions were made by using a different type of piercing spike, which is not the piercing spike used to withdraw the liquid from the bottle when in use. However, this procedure has disadvantages because it necessitates a second piercing of the stopper, which is undesirable. A protector cap for establishing a sterile seal over a port having a puncturable section in a container wall and a cylindrical neck portion projecting from the periphery of the wall section. The cap comprises a moulded housing having a ring-shaped recess for sealing the neck member and a chamber formed at least in part within a compressible handle portion. The handle portion is compressed before inserting the cap on the neck portion of the port and is subsequently released to establish a partial vacuum in the chamber. The partial vacuum assists in retaining the protector cap in position and prevents trapped air from forcing the cap off during subsequent heat-sterilization of the container. One problem with this arrangement had been the necessity of tightly affixing the protective cap to prevent it from falling off during transit or storage, due to which only ribs are used. Even the most

effective seal arrangement becomes unsatisfactory and potentially dangerous when it is excessively difficult or time-consuming to remove. Attention may have to be diverted from the patient undergoing treatment. Assemblies have been the impossibility of determining whether the sterile condition in the container port has been maintained. Another problem with prior art protector caps is that they were initially installed on a container neck portion. They caused air to be trapped and compressed within the neck portion. When the container was subsequently heat-sterilized in an autoclave, the compressed air expanded and, being trapped, loosened or blew off the caps. Accordingly, the present invention is generally directed to a new and improved protector cap for maintaining a seal at the port of a fluid container. The invention is further directed to a new and improved cap for maintaining a vacuum over the puncturable membrane portion of the port of a fluid container. The invention is further directed to a new and improved protector cap.

Types of caps

There are many types of caps available in the current market. It can also be said that the caps play a very small role, but that's important in the medical market. Caps available are based on the type of bottles, mainly of two types: with neck and without neck. Bottles with the neck also have many different types of caps available. Each is made to keep its monopoly in the market. For the neckless bottles, there are Euro head caps that are creating more monopoly. But it can be said that both play a very significant role in the medical market and especially in the medical bottle cap market. The figures show different types of caps available.

Fig 1Euro-head cap available in the market (medical healthcare)

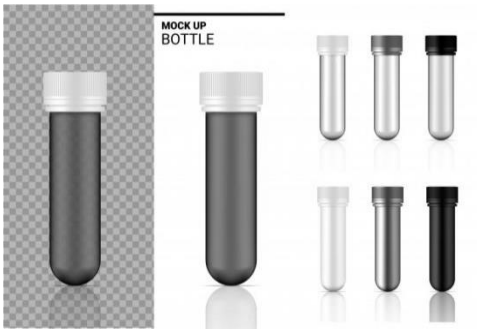

Fig 2 Other types of caps available in the market (google images)

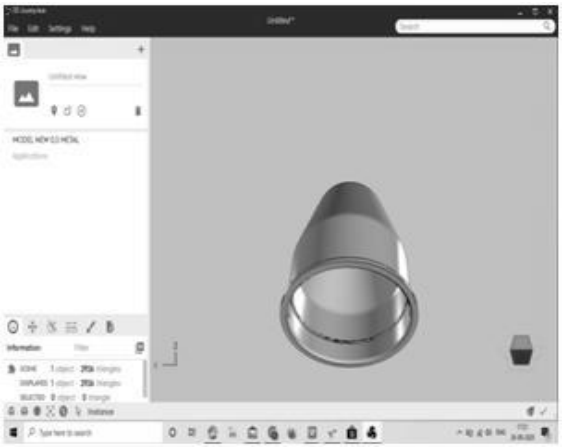

Fig 3 Cap with RIB, increased thickness and increased weight with an extension of the collar.

Intravenous fluids

Intravenous fluids are of many types, but mainly these four kinds of intravenous fluids are used

1. 0.9% Normal Saline (NS, 0.9NaCl, or NSS).
2. Lactated Ringers (LR, Ringers Lactate, or RL).
3. Dextrose 5% in Water (D5 or D5W, an intravenous sugar solution).
4. 0.45% Normal Saline (Half Normal Saline, 0.45NaCl

Intravenous injection closing device in the field of surgery and healthcare. Customarily, a duel flow device having a sharp spike is pierced through the stopper. Often the contents of the bottle are not administered as prepared by the manufacturing laboratory but are inputted according to the demand as required. Often a physician will prescribe additives to the solution based on the patient's requirement and the infection or disease he has. The additives can be introduced into the bottle by placing a syringe against the open end of the air passage. Intravenous fluids are liquids given to replace water, sugar and salt that you might need if you are ill or having an operation or can't eat or drink as you would normally. IV fluids are given straight into a vein through a drip. It can also be said that intravenous therapy can also be used in many medical cases for some patients. Suppose an additive is to be introduced into the bottle while the bottle is in use. In that case, the only procedure available is typically to remove the air filter in the atmosphere, inject the additive through the ball check valve, and then replace the air filter. This requires that the container and its contents be in a sterile sealed condition at the time of receipt by the user. No contamination of the contents occurs when a physician or medical technician opens the container before use. The problem of maintaining sterility is particularly acute at the port of the container where the container wall is punctured by the point of the cannula of an administration set or other flow system to allow removal of the fluid since the danger exists that the cannula may introduce contamination accumulated on the container housing during transport or storage into the container.

Medical malpractice and damaged caps

This examines legislation and judicial rulings on capping jury awards in medical malpractice cases, summarizes the damages caps and explores the impact of research on policy decisions by courts and legislatures. Damages caps include disagreements about whether they reduce malpractice premiums, how they might affect medical errors, and whether they fairly compensate injured patients, as that's important. Mutual insurers were created during the 1970s by physicians groups in response to malpractice insurance availability problems. Commercial and mutual insurers typically calculate rates according to geographic location and speciality area and do not base premiums on individual physicians' previous claims. But these are not covered in the general insurance. The difference is that economists have taken an econometric rather than an accounting approach. To test the effect of tort reform and determine whether or not the statute had an impact, researchers prefer that a randomly selected state impose the new statute with nothing else changing over time as the reform played out. They would then compare the frequency and magnitude of claims, the size of the jury awards, and the premiums charged to physicians before and after the law's enactment. Several studies have taken an approach superficially similar to this, with mixed results. Potential problems with these types of studies are that they consider neither the other factors that may have changed over time nor the differences among states other than the enactment of damages caps laws. There is still some controversy over whether caps reduce awards and judgments. Some studies counter-intuitively suggest that caps can increase correct

loss payouts, which is why caps play an important role.

Impact of intravenous fluids on blood glucose levels

The intravenous (IV) fluids are an integral part of preoperative management. This study was conducted to observe the effect of different maintenance fluid regimens on intra-operative blood glucose levels. A significant increase of level and was observed during the intraoperative and immediate postoperative period. Intravenous (IV) salt solutions were first used in the 1830s to treat fluid loss due to cholera, and IV saline was administered to surgical patients in the late 19th century.

The administration of IV fluids is nearly a universal practice for the patients undergoing major surgeries, where they fulfil the requirement to maintain intravascular volume at a time when that volume may be depleted due to preoperative fasting, surgical blood loss, evaporation, urinary excretion, caused by an aesthesia, loss of fluid into the third space, and capillary leak of albumin caused by inflammatory mediators. Shoemaker introduced the concept of fluid resuscitation aiming for supra-normal parameters in the 1970s and 1980s.

Usually, surgeries are considered to be the combination of multiple factors, including tissue damage, fasting, blood loss, effects of medication, and temperature changes from a metabolic point of view. The stress response to surgery is characterized by increased secretion of pituitary hormones and sympathetic nervous system activation. General anaesthesia has been shown to cause higher blood glucose concentration than local and epidural analgesia.

Research Gap

The Research gap shows that manufacturing of protective cap polypropylene H110MA material is used. Plastic material is easy to manufacture and low in price. In the past, aluminium caps were usually used to protect IV fluids bottles. Nowadays, plastic protective caps are used in IV fluid bottles because of the easy removal of caps from IV liquid bottles. Sometimes fitment issues are observed in the IV fluid bottles while using protective caps. We have to modify the design for better and proper fitment of a cap with a bottle.

CONCLUSION

The caps are used to protect the intravenous fluids and the patients as well, in accordance with their treatment. It is also useful for satisfying the customers. The modification in the looks is also done with issues related to fitment as it is an essential aspect of the protection of intravenous fluid. The intravenous fluid is also a necessary part as it provides immunity. At times, some other liquid is also injected into the intravenous fluid according to the patient's needs and the doctor's suggestion. It is also said that proper medical insurances are necessary to eliminate or reduce medical malpractices etc. So it can be concluded that the caps are actually small but very necessary part of medical applications.

REFERENCES

1. Aspden P, Wolcott J, Bootman L, Cronenwett LR, editors. Preventing Medication Errors. Washington, DC: National Academies Press; 2006. [Google Scholar]
2. Centres for Disease Control and Prevention (CDC) Healthcare-associated infection. Available at: www.cdc.gov/hai. Accessed January 5, 2011. [Google Scholar]

3. Klevins MR, Edwards JR, Richards CL, et al. Estimating healthcare-associated infections and deaths in US hospitals, 2002. Public Health Reports March–April. 2007;122(2):160–166. [PMC free article] [PubMed] [Google Scholar]
4. Burke JP. Infection control—a problem for patient safety. N Engl J Med. 2003;348:651–656. [PubMed] [Google Scholar]
5. CDC Healthcare Infection Control Practices Advisory Committee and the HIC-PAC/SHEA/APIC/IDSA Hand Hygiene Task Force Guideline for hand hygiene in healthcare settings. Morb Mortal Wkly Rep. 2002 October 25;51 No. RR-16, Available at: www.cdc.gov/mmwr/pdf/rr/rr5116.pdf. Accessed January 5, 2011. [Google Scholar]
6. McGuckin M, Waterman R, Govednik J. Hand hygiene compliance rates in the United States: A one-year multicenter collaboration using product/volume usage measurement and feedback. Am J Med Qual. 2009;24(3):205–213. Available at: http://ajm.sagepub.com. Accessed January 7, 2011. [PubMed] [Google Scholar]
7. Infusion Nurses Society. Infusion Nursing Standards of Practice. Philadelphia: Lippincott Williams & Wilkins; 2006. [Google Scholar]
8. Eggimann P, Harbarth S, Constantin MN, Touveneau S, Chevrolet JC, Pittet D. Impact of a prevention strategy targeted at vascular-access care incidence of infections acquired in intensive care. Lancet2000; 355:1864-8.11.
9. Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, et al.Guidelines for management of intravascular catheter-related infections. Clin Infect Dis 2001;32:1249-72.12. Coopersmith CM, Rebmann TL, Zack JE, Ward MR, Corcoran RM, Schallom ME et al.
10. Effect of an education program on decreasingcatheter-related bloodstream infections in the surgical intensive care unit.Crit Care Med 2002;1:59-64.13.
11. Warren DK, Zack JE, Mayfield JL, Chen A, Prentice D, Fraser VJ, et al.The effect of an education program on the incidence of central venous catheter-associated bloodstream infection in a medical ICU. Chest2004;126:1612-8.14.
12. O'Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, MakiDG et al. Guidelines for prevention of intravascular catheter-related infections. MMWR Recomm Rep 2002;51(RR-10):1-29.15. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM.
13. CDC definitions for nosocomial infections. Am J Infect Control 1988;16:128-40.16. Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically. 5th ed. Approved Standard M7–A5.
14. Wayne (PA): Clinical and Laboratory Standards Institute; 2000.17. Performance standards for antimicrobial susceptibility testing. Sixth In-formational Supplement M100-S6. Wayne (PA): Clinical and Laboratory Standards Institute;
15. Berenholtz SM, Pronovost PJ, Lipsett PA, Hobson D, Earsing K, Farley JE, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. Crit Care Med 2004; 32:2014-20.19.
16. Lobo RD, Levin AS, Gomes LMB, CasinoR, Park M, Figueiredo V B, et al. impact of an educational program and policy changes on decreasing catheter-associated bloodstream infections in a medical intensivecare unit in Brazil. Am J Infect Control 2005;33:83-7.20.