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Clinical and Economical Considerations for IV Push Drug Delivery

Technical Paper

An overview of the historical background for IV push and a model for implementation of a successful program.

Richard Rosenfeld, RPh MBA
Executive Director of Pharmacy Management
ScrippsHealth Hospital System

Baxa Corporation
14445 Grasslands Drive
Englewood, CO 80112

tel: 303-690-4204
fax: 303-690-4804
www.baxa.com

Abstract

IV push of cephalosporin antibiotics and other drugs is an alternative method of administration that can be safe, efficacious and cost effective. This paper concentrates on the IV push of cefazolin, since it is a high-use cephalosporin with physical and chemical properties similar to other drugs that can be administered by the IV push method.

This author has personally implemented the use of IV push antibiotics within two hospital systems. During the first year that this IV push program was in place, more than 50,000 doses of cefazolin were administered by the IV push method with no occurrences of phlebitis or adverse drug events directly associated with the change in the administration method of this drug.

Historical Background

Prior to the 1970's, many intravenous (IV) medications, including antimicrobials, were given by direct infusion using a syringe that was manually controlled to infuse the drug directly into the vein via a catheter over one to five minutes (IV push). In the 1970's, and prior to payments for healthcare services by DRG (Diagnosis Related Groups), efforts were made to increase pharmacy revenues. This 'fee for service' model allowed the pharmacy to charge and collect for all services and supplies originating from the pharmacy and central supply services associated with the administration of drug admixtures. Although costly, administration of antimicrobials was performed then by diluting the antimicrobial agent into 50 to 100 milliliters of diluent (either 5% dextrose solution or 0.9% sodium chloride solution) and infusing the solution over 30 to 60 minutes (IV piggyback).[1] Also during this time period, new and more expensive adaptations to the IV piggyback method were introduced to further increase pharmacy revenues and net profits. These included the Baxter frozen piggyback, the Abbott ADD-Vantage® System, the McGaw (now BBraun) Add-A-Vial® and the Baxter Minibag Plus®. Hospitals, nursing homes, home infusion providers, physicians' offices, walk-in clinics, and emergency departments now could bill the drug, diluent, primary and secondary IV sets, and pump rental to the insurance carrier and be reimbursed based on a reimbursement schedule for each of the services provided.

With the introduction of the DRG payment methods, limits on payments were placed on reimbursements that were fixed for a specific diagnosis. Payors did not consider billings as the factor that would determine payment. The bottom line was that providers were responsible for controlling the costs incurred to deliver a service and no longer would consider costs deemed unnecessary. With this change, it was now in the hands of the provider to control the costs of caring for patients. Those who did continued to survive, but many institutions didn't change and vanished. AMI, once considered the Goliath in the for-profit hospital business, vanished because its leadership did not change with the times and failed to control costs as revenues began to fall.

A new generation of healthcare providers, unaware of past practices, has been trained to administer antimicrobials by the IV piggyback method in most clinical settings.[2] Without personal experience with IV push administration, clinicians have concerns about possible increases in the occurrence of phlebitis, infiltration, and vein irritation. Simply put, these are undesirable effects due to the infusion of a drug at the site of infusion and the area surrounding the infusion.

IV Push Overview

While there are several antimicrobials that can be given by the IV push method, this paper focuses on one drug, cefazolin. The main reasons for this drug choice include:

- Cost and availability. The product was patented in 1970 and no longer is patent protected.
- Safety and effectiveness. The safety and efficacy profile of cefazolin IV push.
- Clinical. This is a high use hospital drug based on the author's personal experience.

At the Sharp facilities, Sandy Schroeder, RN, Lead IV Team Nurse, has the responsibility of handling patients who have trouble with vein patency. With her years of experience in this field, she has seen the different types of drug administration and agrees with the data provided by the Garrelts article. She also supports this type of administration because patients who continue these medications via Sharp Home Healthcare will receive them via the IV push method of administration. This provides continuity and consistency in care, which decreases apprehensions and improves compliance, since patients have already experienced this method of administration while in the hospital. Compliance is improved since many of the patients are ambulatory and will self-administer these drugs. In addition, IV push takes less time and the patient is not confined by the IV pole and infusion device associated with the piggyback method.

The IV push method of administration also can provide improved clinical outcomes, since nurses can spend the one to two minutes of administration talking to the patients. These conversations help the nursing staff assess patient needs, which can improve the care provided.

Since many of the ScrippsHealth patients are elderly, decreased fluid loads are often required. The IV push method of administration offers this clinical benefit with decreased fluid intake. It would be difficult to get an exact percentage of patients who are fluid restricted, but age is an important factor in fluid restriction and in a recent study on simple pneumonia at a large community hospital, the mean age of the patient was 72.84 years (standard deviation=15.81). This reflects the other campuses that were analyzed in terms of distribution as well.

In addition to clinical considerations, IV push provides a surprising time saving over syringe infusion. This time saving realized by nursing is the result of the elimination of the need for retrieval of infusion pump and secondary tubing, connecting the bag to the secondary tubing, setting the pump and then

rechecking the pump during the infusion. This time now can be used to increase direct patient care, which will improve patient care.

IV push offers a safety advantage over other administration methods, since it allows nurses to monitor patients for potential adverse drug reactions while the complete dose is being infused. With an IV piggyback administration, the nursing staff doesn't stay in the room during infusion and returns only to check the pump if occluded or to turn off the pump after the infusion is complete.

After implementation of the IV push method at the Sharp facilities, a survey was completed where 49 of the 100 nurses surveyed responded. Fully one-hundred percent of the nurses who completed the survey preferred IV push to other methods of administrations, with 14% responding that they observed less phlebitis. There was no observation of increased phlebitis rates.

The economic impact of a switch to IV push administration, covered more fully in the following sections, can be realized through decreased cost to the patient and to the insurance provider.

Safety and Efficacy

Specific physical and chemical properties make cefazolin safe for IV push administration. A summary of these studies, demonstrating safety and efficacy using published literature, is presented here. Prior to the system's switch to IV push, a literature review was conducted revealing four studies documenting the safety and efficacy of administering IV push cefazolin. Specifically, these covered one gram of cefazolin diluted in 10 milliliters of sterile water in a syringe and administered by direct intravenous injection.

Robinson et al.[3] evaluated 26 intravenous antimicrobials to determine their stability for low volume administration. Based on these findings, cefazolin was found to have a safety and efficacy profile that would allow low volume peripheral vein administration.

Sherry and Sweeney[4] explored the frequency of phlebitis in 127 chemotherapy patients who received IV push antibiotics, including cefazolin, in both inpatient and outpatient settings. In this study, differences in patient acuity, therapy regimen, infusion duration, and the higher use of the IV push method of antimicrobial administration were associated with a 9% lower occurrence of phlebitis in the outpatient setting and a 25% lower incidence in the inpatient setting.

Garrelts et al.[5] compared antibiotic administration by IV push with the IV piggyback method in a hospital setting. Again, cefazolin was one of the antibiotics that was compared. In this study of 155 patients and 315 catheter sites, there was no difference in the frequency or severity of post-infusion phlebitis between IV push and IV piggyback administration (41% and 47% respectively). In addition, the study found that catheters used for the IV push method lasted longer than those used for administration by IV piggyback (45 and

36 hours, respectively). Garrelts et al.[6] continued their comparison of IV push versus IV piggyback administration in a cost avoidance study that proved the economic benefit of the IV push method of antimicrobials used in perioperative prophylaxis. The study noted that there were no adverse drug events, nor any occurrence of phlebitis by either method of administration.

Finally, Kreitman and Grass[7] demonstrated that the IV push method of antimicrobials, including cefazolin, was cost-effective and safe in a hospital setting.

The non-irritating nature of a direct intravenous solution can be attributed to the osmolarity and the pH of the solution. A solution will be non-irritating, when directly injected in the vein, as long it is neutral compared to body fluid, neither hypertonic nor hypotonic, and its pH (acidity or basicity) is compatible with the pH of body fluids.

Clinical Uses

This section presents the common uses of cefazolin. The detail as to the clinical pharmacology, microbiology, mechanism of action, adverse reactions and dosages of cefazolin are beyond the scope of this paper and can be accessed easily through a variety of sources, including the insert that accompanies each package of the drug.

The most common clinical treatment uses for cefazolin are:[8]

- Respiratory tract infections
- Genitourinary tract infections
- Skin and skin-structure infections
- Biliary tract infections
- Bone and joint infections
- Endocarditis

In addition to the use of cefazolin for the treatment of infections, it is also recommended as the drug of choice for antimicrobial prophylaxis in many types of surgeries.[9] These include:

- Cardiac
- Gastrointestinal
- Gynecological and obstetric
- Head and neck
- Neurosurgery
- Orthopedic
- Thoracic
- Vascular

It has been the author's personal experience that cefazolin is the highest used intravenous antibiotic (by number of doses dispensed) in the hospital setting. When Kreitman and Grass[10] implemented the initial program at DePaul Health Center in Bridgeton, Missouri, cefazolin was the first product that was given by the IV push method because of the high volume of use.

Factors contributing to high use of cefazolin are:

- Wide application and uses
- Acceptance as the drug of choice for prophylaxis in surgical procedures
- Low cost – the cost to dispense cefazolin in the current dispensing vehicles exceeds the cost of the drug itself

Stability

With the variety of factors that can affect drug stability, this is a significant influence on the choice of delivery technology. The most important factors influencing the rate of drug decomposition are solution pH and temperature.[11] Other factors to consider are drug concentration and light exposure.

It is not the intent of this paper to detail the chemistry of cefazolin and the chemical properties that influence its stability. For the purposes of this discussion, product stability will be presented with published stability studies, after a brief description of the factors that can influence the stability of cefazolin when mixed in 10 milliliters (10 mL) of sterile water for injection.

The Effects of pH

The pH of a drug solution is a measurement that describes whether the solution is a base or an acid. The degradation of many drugs is catalyzed by extremes in pH. Drug reaction rates are generally less at intermediate pH values than high or low ranges.[12] The pH of cefazolin in solution is relatively stable at a pH of 4.5 to 8.5.[13] Buffers are added to the cefazolin to maintain the pH within this slightly basic or slightly acidic range, which maintain the stability of the product. Solutions that are slightly acidic have a decreased rate of degradation.

The Effects of Temperature

Temperature is another primary variable affecting the rate of drug degradation reactions. Each elevation in temperature may increase reaction rates from twofold up to fivefold.[14] Although this estimated effect may be accurate for some drugs, the rule cannot be indiscriminately applied. Some drugs are not affected by a 10°C temperature change, while other drugs may undergo extreme degradation.[15]

The Effects of Light and Drug Concentration

Exposure to light can greatly influence the degradation rate of drugs that undergo extensive photodegradation. Cefazolin should be protected from light.[16] This statement indicates that prolonged exposure to sunlight can affect the drug's stability. Increases in drug concentration can also increase the degradation rates.

With these factors in mind, it was worthwhile to perform a simple test of the degradation rate for one gram of cefazolin diluted in 10 milliliters of sterile water for injection in a syringe at frozen, refrigerated, and room temperatures. Data indicate that one gram of cefazolin diluted in 9.5 milliliters of sterile water (total volume = 10 mL) and stored in plastic Monoject® syringes is stable for 48 hours at room temperature (25º C); 28 days refrigerated (4º C); and 90 days frozen (-

20º C).[17] These stability recommendations are within the limits to manufacture, deliver, and utilize the product if commercially available.

Methods of Administration

In order to fully understand the cost advantages of the IV push method of administration, it is helpful to review how IV therapy is administered. It will then be clear why there are significant cost advantages to this method of administration, when compared to conventional types of administration.

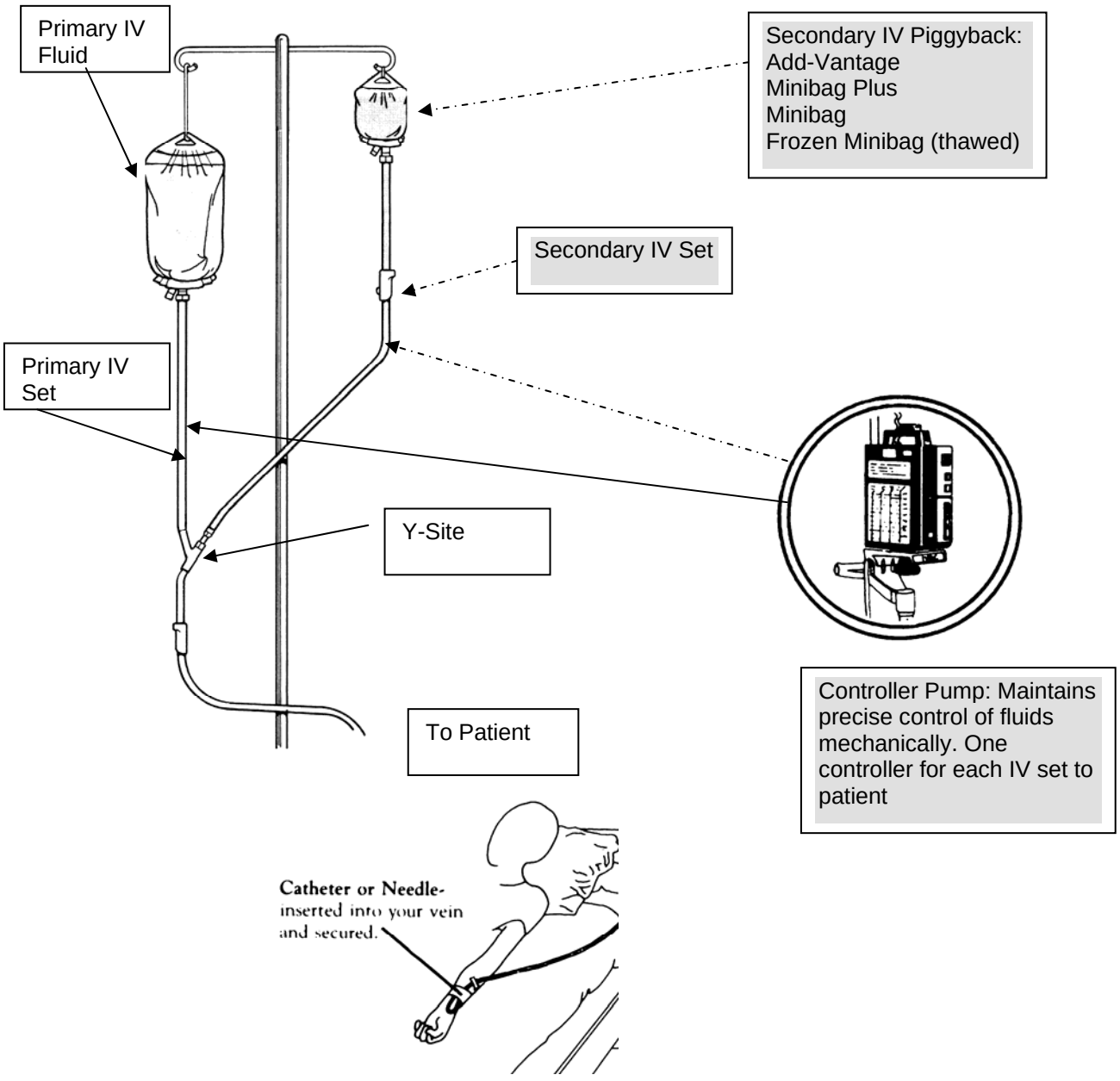


Figure 1.

For syringe infusion, a primary intravenous solution is connected to a primary IV set and the patient's infused volume per specified time is controlled via a controller pump. The primary IV set is connected to the patient via a catheter

needle that has been inserted in the patient's vein. If there is not a primary solution, then the catheter that is connected to the patient for other drug administration is usually called a heparin lock. This name is derived from the fact that small amounts of heparin are used to keep the catheter free from clots.

Current administration methods use a bag with 50 to 100 milliliters of solution that contains one gram of cefazolin, which is connected to the primary IV set or the heparin lock via a secondary set. The infusion is then controlled by a second infusion pump to the patient. If a pump is not available, then a secondary drip set is used, which is manually adjusted by the nurse so that there is a known rate of solution delivery to the patient based on the number of drops per minute that the set delivers. Since this type of drug delivery in most settings is costly in terms of nursing time to adjust and the high costs of the sets themselves, this type of controlled delivery is not common with cefazolin.

The dashed arrows and shaded boxes in Figure 1 indicate where the cost savings with the IV push of cefazolin occurs. Not only will savings be obtained by using the syringe for the delivery of the solution, but also the secondary set and the controller pump will not be necessary.

The following are examples of commercial products are available to administer cefazolin:

Minibag

Cefazolin vials and minibags are purchased separately. The vial of cefazolin is dissolved in 9.5 mL of diluent (sterile water, normal saline or 5% dextrose). The contents of the vial are withdrawn and transferred to a syringe using an attached needle, then added to the minibag via the addition port.

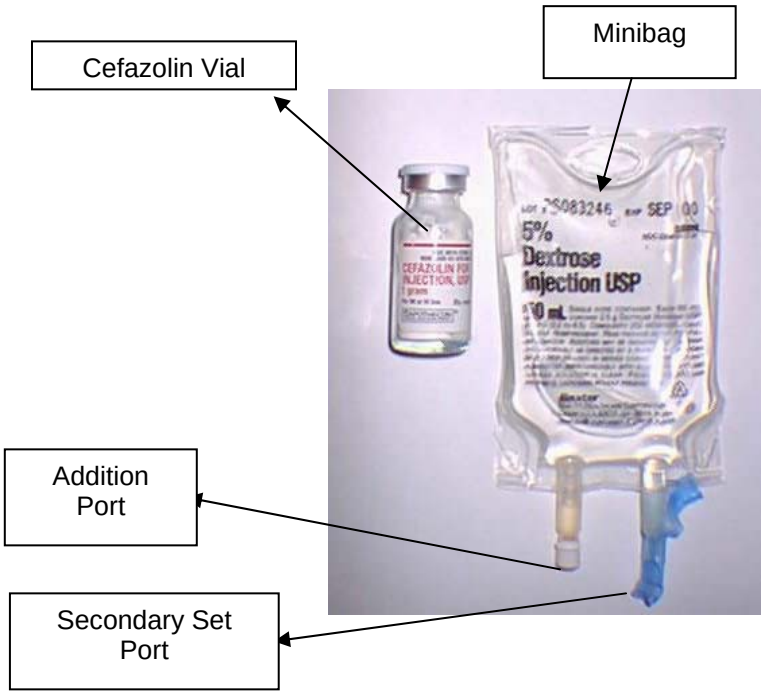


Figure 2.

Minibag Plus®
A vial of cefazolin is attached by the healthcare professional to the vial attachment device. The seal is then broken, which allows some of the fluid from the bag to enter the vial of powdered drug. The drug is dissolved and the bag is inverted to allow the dissolved drug to flow back into the bag. A secondary set is attached and the drug is infused into patient.

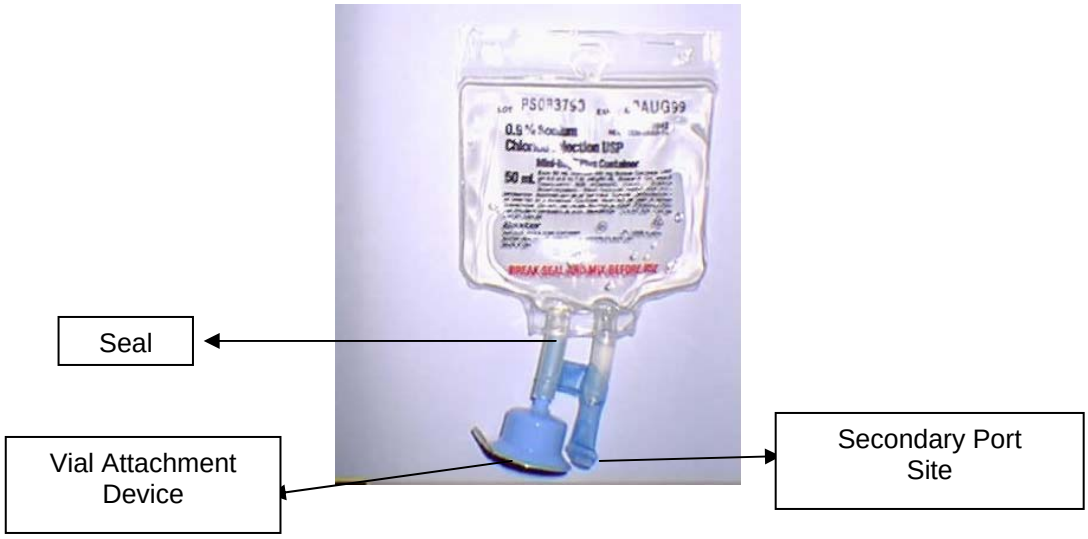


Figure 3.

ADD-Vantage® System
Vials of cefazolin that have the ADD-Vantage screw top are attached to the ADD-Vantage bag after the top of bag and vial are exposed by removing the sterile covers. By turning the vial approximately three turns, the bag and vial are mated. Users then must remember to break the seal between bag and the bottle, invert the bag, mix the solution and powder, then connect the bag to IV set for connection to controller pump.

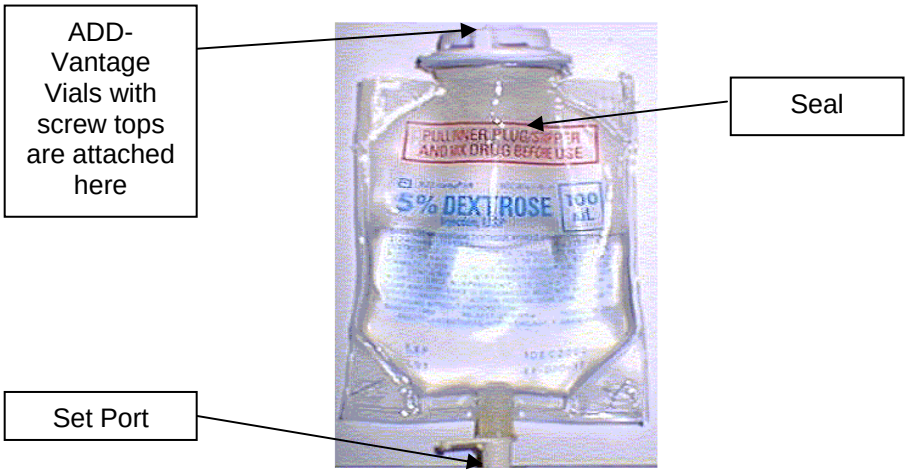


Figure 4.

Frozen Minibags

Frozen pre-mixes of cefazolin are available from Baxter Corporation. These products are shipped frozen. Users must thaw, then attach to an IV set and controller pump and deliver to the patient.

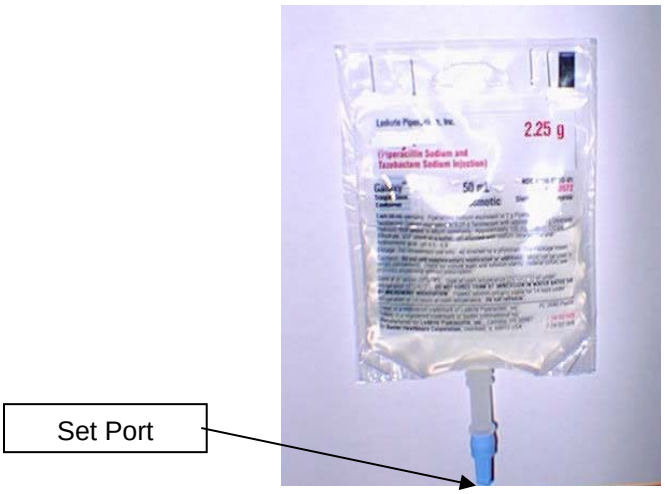


Figure 5.

Add-A-Vial™

The Add-A-Vial System, offered by B Braun, is an administration method that is very similar to the Baxter Minibag Plus, however the plastic adapter is purchased separately, attached to any minibag then the drug vial is attached to the adapter. The adapter seal is squeezed to mix the powder and solution. The IV set is then connected and drug is infused via a controller pump.

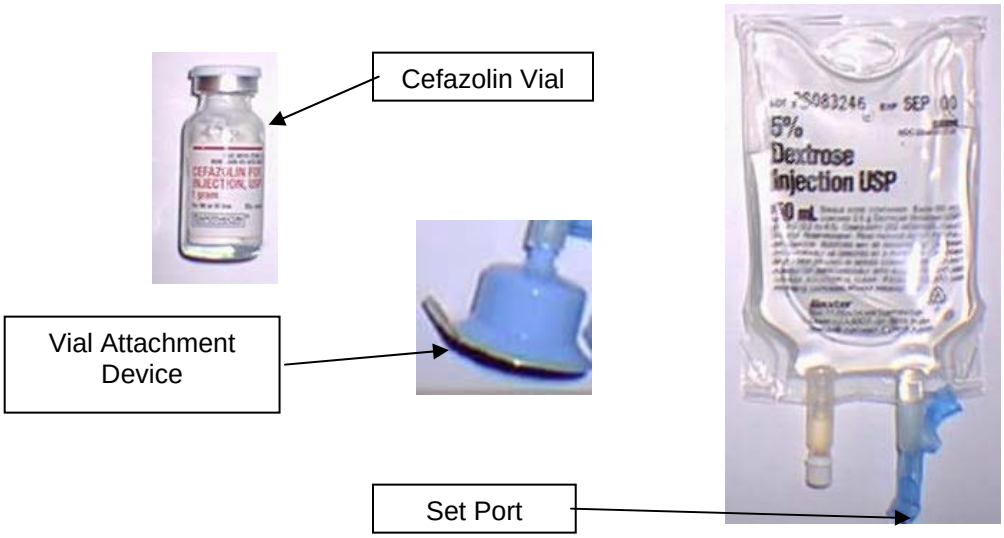


Figure 6

Although there may be variations on these administration systems, many only increase the costs to dispense the dose and will not be reviewed or considered. If the primary end result is to administer a gram of cefazolin, and the safety and efficacy of the delivery systems are equal, then cost should be a primary consideration when making the decision as to the most appropriate system. If a supplier can produce an equal or better product at a lower cost, this should

differentiate that product in the marketplace and make it desirable to the target market. The next section describes the costs associated not only to purchase the products, but also to deliver them to the patient.

Cost of Administration

When considering the cost of a drug dose, it is important to understand that there is not only a cost associated to purchase the drug, but also a cost to prepare and administer the dose. Although these costs vary to some extent from facility to facility, and from Group Purchasing Organization (GPO) to Group Purchasing Organization, the actual range is quite narrow.

Since purchasing cost data is considered confidential, the costing of the various administration types noted is an average of two GPOs that were available at the time of the review. The GPOs, sources and specific costs will remain anonymous, but the data contained in this cost analysis is an accurate representation of the current market.

Several factors that affect cost are included. In Figure 1, the shaded boxes indicate costs associated with commercially available administration types that are unnecessary with IV push administration. These costs are included in the total cost to administer a one gram dose of cefazolin, and include:

- Bag vehicle. This cost is included in the cost to prepare the drug.
- Secondary set. Necessary for the other forms of administration, but not when administering by IV push. Every hospital has a policy that is dictated by their Infection Control department mandating set changes at a specific time interval. Since these policies vary from facility to facility, and for ease of this analysis, a 48-hour set change policy was used. With a secondary set cost of $1.50, the additional cost per dose is $0.25. This figure is based on a dosage of one gram given three times daily, which is the normal dosing profile for cefazolin. This cost is included in the administration cost of the drug.
- Controller Pumps. With a high volume of doses being infused via a controller pump, switching to the IV push method to administer cefazolin decreases the demand on pumps that would normally be assigned to this administration and therefore reduces the need for hospitals to purchase additional pumps at the end of the pumps' life cycle. Based on an average pump cost of $2500 (not including 'smart pumps,' which are more costly), a straight-line, five-year depreciation rate and three doses administered daily, the cost to purchase, and maintain a pump is $0.46 per dose. This cost is included in the administration cost of the drug.
- Another consideration included in this analysis is the labor cost to prepare and administer the drug. Federal and State laws permit a pharmacy technician to prepare intravenous solutions under the direct supervision of a licensed pharmacist. Solutions prepared in the pharmacy will include the labor necessary to prepare the solutions and the supply costs associated with the preparation.
- There are also laws that control who can administer drugs intravenously to the patient. Only registered nurses are permitted to administer drugs

intravenously. These costs will be differentiated in the IV push and the IV piggyback methods of administration.

In a time-motion study,[18] the IV push method of administration averaged 3.6 minutes of nursing time per dose compared to 4.74 minutes per dose by the IV piggyback method. The extra time noted was spent retrieving and assembling the pump and set initially, setting up the controller pump and returning to the room to check the pump, and to turn off the pump after the infusion.

Based on the facts explained this far, the cost per dose breakdown follows. This breakdown includes all the supplies necessary to prepare the dose and the costs associated with the administration.

Minibag Preparation and Administration

Preparation		*Administration*	
Minibag	$0.91	Secondary Tubing	$0.25
Cefazolin 1 gm	$0.95	Pump	$0.46
10 mL Syringe[19]	$0.012	RN Labor[20]	$2.765
Needle[21]	$0.018	Total Admin Cost=	$3.475
Alcohol Swab	$0.007		
Tech Time[22]	$0.40		
RPh Time[23]	$0.66		
Total Prep Cost=	$2.957		

Total cost to deliver cefazolin 1 gm by the IV piggyback method: $6.43

Minibag Plus Preparation and Administration

Preparation		*Administration*	
Cefazolin 1 gm	$0.95	Secondary Tubing	$0.25
Minibag Plus	$1.61	Pump	$0.46
Tech Labor[24]	$0.20	RN Labor[25]	$2.765
Total Prep Cost=	$2.76	Total Admin Cost=	$3.475

Total cost to deliver cefazolin 1 gm by the Minibag Plus method: $6.24

ADD-Vantage System Preparation and Administration

Preparation		*Administration*	
Cefazolin 1gm	$1.35	Secondary Tubing	$0.25
ADD-Vantage Bag	$1.61	Pump	$0.46
Tech Labor[26]	$0.20	RN Labor[27]	$2.765
Total Prep Cost=	$2.90	Total Admin Cost=	$3.475

Total cost to deliver cefazolin 1 gm by the ADD-Vantage System method: $6.38

Add-A-Vial System Preparation and Administration

Preparation		*Administration*	
Cefazolin 1 gm	$1.35	Secondary Tubing	$0.25
Minibag	$1.61	Pump	$0.46
Add-A-Vial Device	$0.80	RN Labor[28]	$2.765
Tech Labor[29]	$0.20		
Total Prep Cost=	$2.86	Total Admin Cost=	$3.475

Total cost to deliver cefazolin 1 gm by the Add-A-Vial System method: $6.34

Frozen Premix

Preparation		*Administration*	
Cefazolin 1 gm	$3.25 (Premix)	Secondary Tubing	$0.25
		Pump	$0.46
		RN Labor[30]	$2.765
Total Prep Cost=	$3.25	Total Admin Cost=	$3.475

Total cost to deliver cefazolin 1 gm by the Frozen Premix System method: $6.73

IV Push

Preparation		*Administration*	
Cefazolin 1 gm	$0.95	RN Labor[31]	$2.10
Syringe/Cap	$0.15	Total Admin Cost=	$2.10
Tech Labor	$0.20		
Total Prep Cost=	$1.30		

Total cost to deliver cefazolin 1 gm by the IV Push method: $3.40

Based on an average cost of $6.42 per dose for the conventional methods of administration, IV push represents a potential savings of approximately $3.00 per dose. Based on the author's experience, if the safety and efficacy are equivalent to the other methods of administration, this amount of savings per dose would make it difficult not to make a change to the IV push method of administration.

Satisfaction Survey

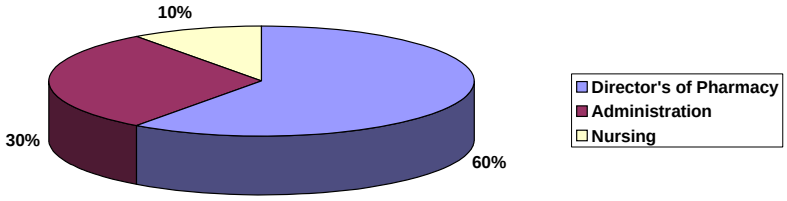
The use of a syringe to 'push' a drug by the intravenous route into the bloodstream of a patient is not new to the pharmaceutical or healthcare world. Long before infusion pumps existed, the delivery method was through the use of a syringe. This fact overcomes the biggest dilemma facing the introduction of a new methodology, product, idea or the resurrection of an old methodology – that of proving efficacy and safety to other healthcare providers. Since this was a non-issue in this case, the emphasis of this section will focus on who currently 'pushes' cefazolin.

In order to ensure a successful implementation of an IV push program with both the nursing and the pharmacy staff, it was determined that some research needed to be conducted that was dedicated to establishing the acceptance or rejection of this methodology within the hospitals in which it was currently being used. Also, this author wanted to ascertain some idea as to the strengths and weaknesses of the current practice, while gauging the level of acceptance, after the implementation of the IV push method of administration of cephalosporins at several hospitals.

The first phase of the research was concerned with how well the current practice of IV push is accepted at the hospitals that have implemented this form of administration. It was decided that a survey aimed at the nursing staff (end user) would establish the acceptance level and satisfaction with the IV push methodology.

Nurses were chosen because of their ability to affect change from the bottom up. There are three groups within a hospital setting that have the power to change methodologies and procedures regarding drug-related clinical matters. The following graph represents the groups, and their power to affect change, relative to each other.

The Groups Power To Effect Change (Expressed As A Percent) Relative To Each Other



The above graph can be interpreted as 60 percent of the decision making authority is in the hands of the Director's of Pharmacy, 30 percent is in the hands of administration, and 10 percent is in the hands of the nursing staff. Therefore, if one wants to go about changing the way a hospital administers a given drug, such as cefazolin, then a strategy must be developed to either start at the top and work down, or vise versa.

Research Methodology and Objectives

Following the IV push implementation, it was decided that the best way to collect data on current practice methods would be a written survey, one page in length, targeted at the nursing staff. The survey was e-mailed or faxed to the contact person at the hospitals in the San Diego area that agreed to participate in the

survey and that currently 'push' cefazolin. The contact person would then be responsible for distributing the survey to the nursing staff.

Sampling Methodology
Surveys were distributed to a 'convenience sample' of the nurses working at the hospitals that met the criteria (location, willingness to participate and using IV push). Since the sample of respondents is not randomized, the author has not made reference to the sphere of inference or the sampling error associated with the survey responses. This is purely an observational study, aimed at investigating the issues the author considered to be important for this application.

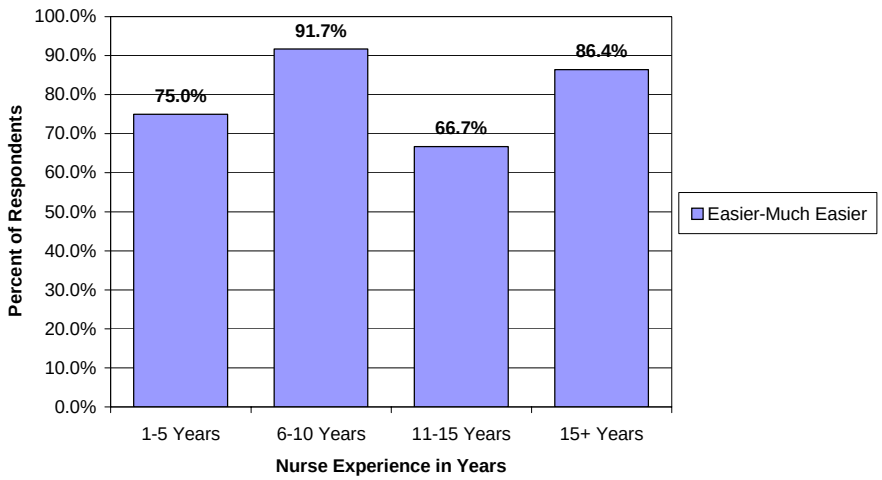
The survey was designed to answer several questions regarding the 'push' methodology. The author determined the questions asked; exploring five issues of known clinical importance, using this as a basis for measuring satisfaction with the IV push methodology. The intent was to establish the following through the use of a written survey:

- Is the 'IV push' method considered superior to other methods of administration?
- What is the nursing staff's overall satisfaction regarding the 'IV push' methodology?
- Do the above values change across nursing experience and/or area of practice?
- Which issues have the greatest impact on overall satisfaction?

Analysis of Results
A total of 69 completed surveys were returned from nursing staff respondents. These results were entered into the Minitab™ Statistical Software and analysis performed with both Minitab and WinCross™. An analysis by survey question follows:

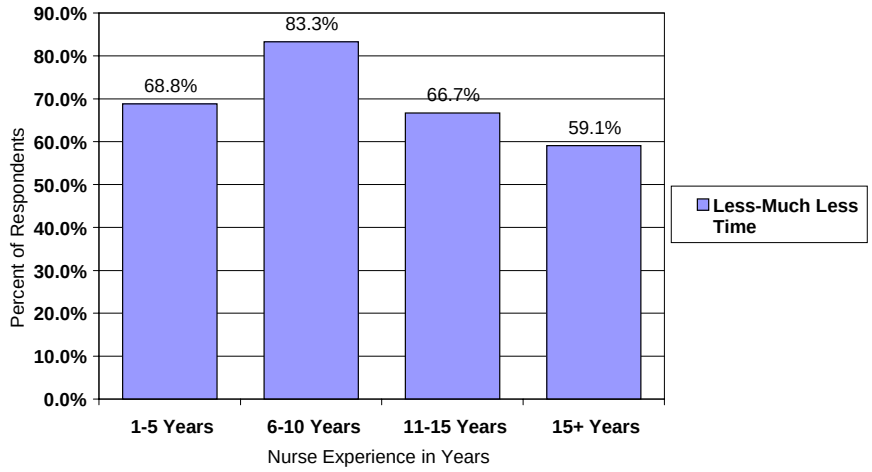
<u>Is the Push Methodology Superior?</u>
Survey question #3: "How does the IV push method of administration of antibiotics compare in ease of administration to other methods?" The nursing staff as a whole responded with 79.7 percent rating the IV push method as easier or much easier. The following graph breaks the ratings down by years of experience.

How Does I.V. Push Compare in Ease of Administration to Other Methods



Survey question #4: "Compared to other methods of administration, the IV push method takes more or less time than other methods?" The nursing staff responded with 68.1 percent agreeing that the IV push method takes less to much less time than other methods. The following graph breaks the ratings down by years of experience.

Compared to Other Methods of Administration, The I.V. Push Method Takes...



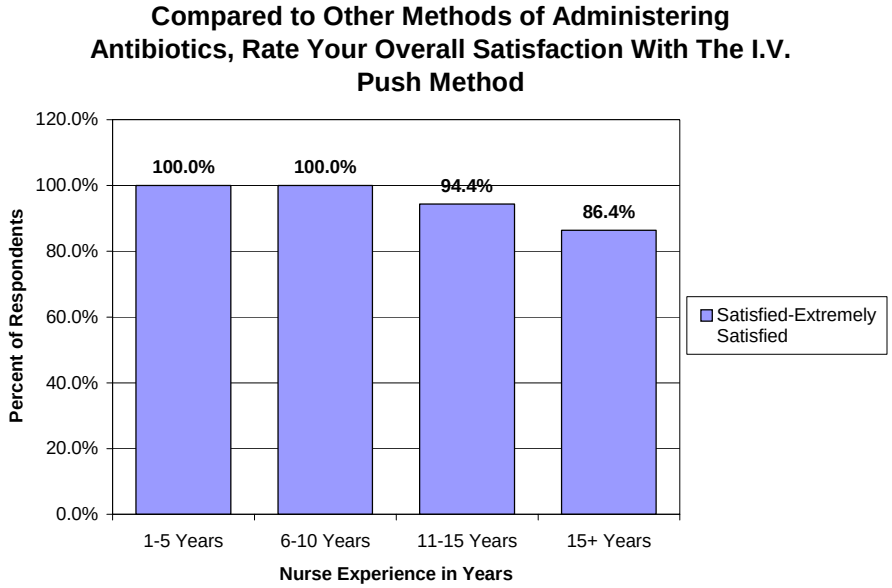
Survey question #5: "Compared to previous methods of administration, is there a difference in patient discomfort?" Of the 69 respondents, 63.2 percent of the nursing staff said there was no difference in patient discomfort. Also, when asked about the development of post-infusion phlebitis, 60.3 percent of the nursing staff said there was no difference in the development of post-infusion phlebitis. When asked about vein patency or catheter life span, 66.7 percent of all nursing staff reported that there was no difference in the observed vein

patency or the catheter life span. This observation is supported by clinical data as reported by Garrelts.

With regard to these issues, there is evidence that the IV push method of administration excels above other methods in several areas, while at the same time not increasing the incidence of problematic areas associated with 'pushing' various forms of pharmaceutical drugs. This was seen by this author as very positive information regarding the current practice of the IV push methodology.

What is the Nursing Staff's Overall Satisfaction with IV Push?

By far the most encouraging piece of information from the survey comes from survey question #8: "Compared to other methods of administering antibiotics, please rate your overall satisfaction with the IV push method." Of the nurses who responded, 94.2 percent said they were satisfied to extremely satisfied with the IV push method of administering antibiotics. The following graph breaks the ratings down by years of experience.

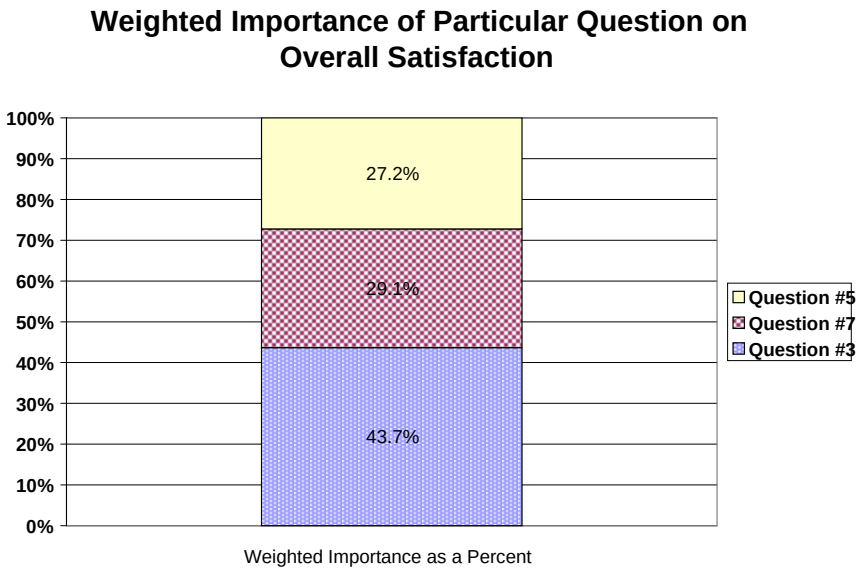


It is interesting to note that the 15+ Years category above has the least satisfaction overall with the IV push method of delivering cefazolin. With reference to this survey, for whatever the reason, the more experienced nurses seem less satisfied. It is important to note that this is not a statistically significant difference.

Of the Five Issues, Which Ones Have the Greatest Impact on Overall Satisfaction?

This question was posed in an effort to determine which of the issues are the most important to nursing staff as it relates to their satisfaction level. Through a statistical technique called regression, the five questions in the survey are regressed on the overall satisfaction question at the end of the survey. The resulting estimated coefficients are then standardized and the standardized value is assigned as a weight to the corresponding question. The question from the survey that has the greatest impact on overall satisfaction is question number 3: "How does the IV push method of administration of antibiotics compare in ease of administration to other methods?", with a standardized

coefficient of 0.437. The following graph shows the three significant (according to p-value) questions that are included in the model.



Survey Conclusion

The survey results indicate that, overall, the nursing staff is very positive about the IV push method of delivering cefazolin. This information can be used to help influence nursing staff in other hospitals where IV push is not accepted as the primary method of delivering cefazolin. This author believes that the preceding results again affirm the plausibility of implementing the IV push method pre-filled syringe for high use cephalosporins.

Implementation of an IV Push Program

In order to ensure a successful program, there are three major steps that need to be taken.

1. Sell the process to the nursing staff, using the advantages of the IV push method.

    a) IV sites last longer
    b) Patients not confined by IV pole
    c) More quality time with patient
    d) Easier scheduling of multiple antibiotics
    e) Fewer delayed doses or compatibility problems
    f) Nursing administration time reduced by not needing to acquire administration sets and pumps; and not needing additional trips to patients' rooms to check on infusion
    g) Improved ability to detect adverse reactions
    h) Decreased fluid intake
    i) Decreased costs to patient and hospital

2. Sell the process to the pharmacy staff just as you did with nursing.

3. Set up processes that will ensure the integrity of the product.

    a) Set up production schedules that make it convenient for your staff
    b) Have good processes to rotate stock properly so that syringes do not outdate and become unusable

Summary

Every hospital is unique in its approach to producing sterile IV products. It is not the intent of this paper to describe how this should be done at your facility, but to propose cost-effective and clinically justified recommendations for exploring IV push for administration of intermittent antibiotics. While there are a number of considerations for successful implementation of an IV push program at a facility, there are significant data to support decisions around product stability, sterility and other requirements. A number of the studies are included in the Reference section of this paper. The Appendix includes a list of the stability of commonly pushed preparations.

Baxa provides technical papers and products that support programs for IV push to reduce costs and improve patient care. IV push has worked exceptionally well for our hospitals for over 10 years and could do the same in many other institutions.

About the Author

Rick Rosenfeld RPh, MBA is the Executive Director of Pharmacy Management for the ScrippsHealth Hospital System in San Diego, California. He has responsibility for all system pharmacy services through his position with Cardinal Technology and Services.

Prior to joining the ScrippsHealth team, Rick served as a consultant at Sharp Healthcare, a five-hospital IDN in San Diego, California where the IV push method of administration for cephalosporins was implemented.

About ScrippsHealth

ScrippsHealth is a non-profit system that includes five uniquely different hospitals providing a wide range of services. These hospitals specialize in a few major areas including med/surg, cancer, cardiology and a specialty hospital that provides bone marrow transplants, kidney transplants and liver transplants. There are about 300,000 patient days in the system, with the two largest hospitals providing about 100,000 each and the smaller three about 35,000 each. The entire pharmacy system is managed through a matrix-organized hospital management team. ScrippsHealth has more than 11,000 employees and 2,600 physicians.

Under Rosenfeld’s management, the Scripps pharmacy has been moving toward a more clinical model since 1999. Pharmacists cover almost every floor in a clinical capacity, even in the smallest hospital. One residency program with two residents is in place and another is in process. There is a clinical director of

pharmacy, with five clinical managers, one system director, five directors of pharmacy and two assistant directors. Six med safety coordinators (3 pharmacists and 3 technicians), a data analyst, an IS pharmacist, two IS technicians and an information services educator have been hired for specialized services. The hospital system pharmacy service includes more than 200 full-time equivalents of pharmacist and technician staff.

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[19] One syringe used to prepare 10 bags. Each syringe is $0.12.

[20] 4.74 minutes with an average salary with benefits of $35.00 per hour.

[21] One needle to be used to prepare 10 bags. Each needle is $0.18.

[22] Assuming a technician can make 50 bags per hour with an average rate with benefits of $20.00 per hour.

[23] Assuming it will take a pharmacist one minute to check technician's work with an average rate with benefits of $40.00 per hour.

[24] Assuming a tech can prepare 100 bags per hour with an average rate with benefits of $20.00 per hour.

[25] 4.74 minutes with an average salary with benefits of $35.00 per hour.

[26] Assuming a tech can prepare 100 bags per hour with an average rate with benefits of $20.00 per hour.

[27] 4.74 minutes with an average salary with benefits of $35.00 per hour.

[28] 4.74 minutes with an average salary with benefits of $35.00 per hour.

[29] Assuming a tech can prepare 100 bags per hour with an average rate with benefits of $20.00 per hour.

[30] 4.74 minutes with an average salary with benefits of $35.00 per hour.

[31] 3.6 minutes with an average salary with benefits of $35.00 per hour.