BULLETIN

OF THE NEW YORK CITY SOCIETY OF HEALTH-SYSTEM PHARMACISTS

Elizabeth Palillo, Pharm.D
President
NYCSHP 2012-2013

Outgoing President's Address 2013

Good evening and welcome to the 48th Annual Installation Dinner for the New York City Society of Health-System Pharmacists.

This time last year I stood before you with nervous excitement as I stepped into my new role as President. Now that I finally have a handle on everything the president actually does, it is time for another leader to emerge.

It was important to me to really understand everything that our society was involved in throughout the year. I learned firsthand how many leaders we need to keep our society and our profession moving forward.

This year was underscored by an undeniable sense of enthusiasm not only from our leadership but from our members. We had over 100 people signing up every month to attend our CE meetings. Members sent me emails and shared feedback throughout the year, further emphasizing the importance of networking and continuing education.

I'd be lying if I said I wasn't going to miss standing in front of our members at the beginning of every CE meeting. The enthusiasm was contagious and it gave me the continued energy to press on throughout the year.

Having the opportunity and the privilege to lead this organization is a memory that I will always treasure. The friendships and professional bonds we all share help drive us to continue to deliver the best patient care.

While at times we might feel weak and frustrated as individuals, we are incredibly strong as a society. We have accomplished so much this past year, which I am proud of.

We had our first ever sports team with flag football. Even though some may say we fell short of success by traditional definitions, this dedicated team added another layer of fun to our chapter.

We also hosted our first happy hour with an impressive attendance of over 30 people at Antarctica Bar.

New York City also had the honor of hosting this year's Quad Chapter Meeting where we had over 220 attendees!

Our AIDS walk team, led by our fearless and persistent captain Charrai, reached its fundraising goal for the second year in a row – raising over $2,100!

Like any proud parent I could go on and on about the achievements of our chapter, but you all have listened to me talk enough this past year. Let me finish off with some brief thank-yous. There are so many people who played a role in the success of this year as well as the maintenance of my sanity.

Kwaku Marfo – You were a tough act to follow but I know this was a year you could be proud of. Thank you for showing me the ropes and answering my unending questions.

My Dedicated Board of Directors – Wilson, Amisha, Kanika, Yi, Michele, Honey, Basirat. You made a potentially overwhelming year feel easy and controlled. All of this year's success started with you.

Our State Council Leaders – Fran Jordan, Ted Friedman, Mark Sinnett, Joe Pinto, Karen Falk, Vickie Powell. Thank you for always guiding me and developing the future leaders of our chapter. Our chapter is so fortunate to have so many active leaders.

Mary Choy – You did an amazing job planning the CE meetings and I have no doubt you will make a fearless President. Our chapter is in good hands with your leadership.

My friends and family, especially my fiancée Lindsay – Thank you for the constant support and encouragement. You were always there to give me that extra push when my confidence waivered.

To the many other people I haven't mentioned by name, I hope I have thanked you personally throughout the year.

Handing over the role of president to Mary is a bittersweet emotion. You may not see me hogging the microphone at meetings anymore but I will still be there. Please still come over and say hi since that is one of my favorite things about meetings.

I will approach my new role of immediate past president with the same dedication and passion as my time as president. Thank you for an unforgettable year and enjoy the rest of your night.

President-Elect's Greetings

Mary Choy, Pharm.D, CGP
President-Elect,
NYCSHP 2012-2013

It has truly been my pleasure to serve as your President-elect this year. Initially, the thought of planning all the continuing education (CE) meetings for the year seemed like a daunting task, however I found the experience quite gratifying and even picked up a few event planning skills along the way.

There has been so much support from the board members and I am glad I got the chance to know the NYCSHP family better through all the chapter events.

This May, I attended the Annual Assembly for the first time and we all had a great time, from learning about medication safety to having a blast at the sports-themed dinner.

I look forward to attending future Annual Assemblies, and hope that more of our chapter members become involved, either by serving as a delegate or by attending and learning during the CE programs.

Exploring Upstate New York is also an additional benefit to attending the Annual Assembly, as it is a nice respite from everyday life.

Although my term as President-elect will soon come to an end, I look forward to serving as your President.

Moving the practice of pharmacy in New York State forward requires dedication, patience, and collaboration with others.

Some of these exciting areas include the Pharmacy Practice Model Initiative (PPMI), Collaborative Drug Therapy Management (CDTM), pharmacy technician licensing – all initiatives that will ultimately result in how our profession is viewed by the public.

It is exciting to initiate change in our profession and be a part of this shift in the healthcare landscape.

Our Pass the Gavel board meeting will be in August. This will be my first official board meeting as your President for the upcoming year. I invite all of our members to become involved with the chapter, and to bring at least ONE idea to the table to be discussed, which may become a chapter goal.

This is YOUR chapter and we welcome new ideas from our fellow members – we are the most active chapter in the state and we would like to keep this momentum going.

Finally, I hope to see everyone at the Installation Dinner on June 13th as we celebrate all the accomplishments from the past year.

As always, feel free to contact me with any questions or comments. I hope you all have a wonderful summer – see you soon!

SPRING/SUMMER 2013

Inside This Issue

SPOTLIGHT ON PUBLIC HEALTH

Reflections from India

Danny Tea, Pharm.D Candidate, 2014
Touro College of Pharmacy

In the summer of 2012, Touro College of Pharmacy announced their partnership with a non-governmental organization called the Urban Health Resource Centre (UHRC) in India to provide a unique rotation experience. Six students were selected to spend one month with faculty in underserved communities in India's capital, New Delhi. Students and faculty would provide free medical screenings for hypertension, diabetes and pulmonary function to members of the community. I applied, having no idea what to expect, but after that month in India, I couldn't have been more grateful or appreciative to have been part of such an amazing experience.

Having never been out of the country, it dawned on me that my first time traveling would be to a third world country. That reality hit hard the moment we stepped off the rickshaw to begin our first day of work. The level of poverty that welcomed us was both shocking and dismaying. Limbless beggars lined the roadside next to small children who were selling fruits and water. The air was cloudy with debris and flies swarmed rampant. They were visible on the foods and merchandise sold by local street vendors. Adults and children walked barefoot despite the large amounts of trash littering the streets.

It was a shocking firsthand glimpse of the lifestyle of these residents and the challenges they faced to sustain a decent living. The majority struggled to survive, unable to afford the most basic of necessities including food to eat. I was extremely humbled to experience their reality and the hardships they faced daily. Taking in and absorbing these gut-wrenching sights and sounds not only mentally prepared me for the upcoming month but also cultured me in a way that no classroom experience could.

A typical day on this rotation consisted of setting up our "health clinics" in the home of a resident willing to accommodate us. Space in these homes was very limited and many were structurally incomplete. Some lacked roofs while others lacked doors. Those without doors made do with makeshift cardboard "doors." Once a home was chosen, we set up stations that were designated for diabetes screenings, hypertension screenings, peak flow measurements and patient interviews.

Each day we endured trying conditions and often worked a minimum of 12 hours, sometimes without lunch. The language barrier was often a major issue despite having a translator. Because of the sheer volume of patients, one translator was simply not enough. To circumvent our lack translators, we found ourselves communicating through the broken Hindi that we gleaned from everyday interactions with the residents and through the use of good old-fashioned hand gestures. We concluded each patient screening with a counseling session on lifestyle modifications and distributed patient education materials with Hindi translations.

I remember one day vividly. Three days into our trip, we were all struggling to adapt to the culture and environment in New Delhi. It was a nuisance to brush our teeth with bottled water and to wear handkerchiefs or scarves to cover our nose and mouth because the air quality was so poor. Many of us were reluctant to eat for fear of getting sick. The yearning to return home frequently crossed my mind. On day three, however, my outlook changed drastically and I realized why I came to India.

One of the women graciously opened her family's home to us. As we screened patients, I remember an elderly gentleman, who claimed that he could not feel his feet. Thinking quickly, I administered an impromptu diabetic foot exam with an earring substituting for filament. I learned the Hindi phrase "aap kasha mehsus karte hai?" Which means, "Do you feel this?" and counseled him on the significance of smoking cessation. I also taught her son how to play tic-tac-toe during down time between patients.

She was so thankful that she invited us to her daughter's birthday celebration a week later and cooked us an extravagant meal. We bought her daughter a birthday cake to celebrate, however there were no knives to cut the cake. Before we could even process that

thought, birthday cake was being served to us with bare hands. We gladly accepted and devoured the cake without hesitation. We didn't even think, our first instinct was to eat. At that moment we realized that the previous cultural barrier that divided us, no longer existed. We had just eaten a piece of cake cut with someone's BARE HANDS!!!

Overcoming obstacles such as the language barrier and dining etiquette provided me an even greater sense of satisfaction. On this third day, my premature judgment to return home was replaced by the strong connection established with her and the rest of the community that was extremely touching and immensely gratifying.

By month's end, strangers became friends, reluctance became trust and a deep sense of gratification overwhelmed us when the entire community embraced and acknowledged us for our hard work.

The sincere reception of our group made me feel welcome in a foreign environment that was previously uncomfortable for me. Through our efforts as a group of health care practitioners and student leaders, I was able to feel that I had actually made a relevant impact on people's lives.

Finding Comfort at Iris House

Mikel Richman, Pharm.D Candidate, 2014
Touro College of Pharmacy

Many pharmacy students are unaware of the numerous opportunities available to them for professional and personal development through Advanced Practice Experiential sites. Practice experience allows students to build upon what is taught in the classroom by applying it to real world situations.

Public health experiential rotations are some of the most influential rotations offered to Touro College of Pharmacy students. Public health focuses on the prevention of disease, prolongation of life, and the promotion of health through societal efforts.

Public health experiences encourage students to promote programs in underserved communities. By doing so, students are given the opportunity to demonstrate cultural competence through day-to-day interactions with patients.

Cultural Competence can be defined as the ability of healthcare systems and individuals to provide care to patients with diverse values, beliefs, and behaviors, by tailoring delivery to meet patients' social, cultural, and linguistic needs.

Electing to have my public health experience at Iris House provided me with an opportunity that reinforced my clinical knowledge and allowed me to exercise cultural competency.

Iris House is a non-profit organization located in Central Harlem. It was established in 1993 by the Women and AIDS Working Group as a center for women living with HIV/AIDS. The goals of Iris House include: the promotion and support of independent functioning, improvement of patient's quality of life, and maintenance of optimum health status. Iris House also aims to educate policy makers, elected officials, and human health service providers on the issues and concerns affecting those diagnosed with HIV/AIDS and to advocate for changes in policy and programs that are more responsive to the needs of women and their families.

Iris House provides comprehensive services including advocacy for women, families, and communities infected with or affected by HIV/AIDS, while simultaneously providing prevention and education services for its clients and at-risk communities.

Iris House offers practical, family-centered services that promote prevention and education while addressing the day-to-day realities of those living with HIV/AIDS. Services offered include advocacy, behavioral health, case management, treatment education, food and nutrition, harm reduction, housing, and prevention services.[2]

As a pharmacy intern, my time at Iris House was devoted to the many support groups offered. One of the major advantages of this experiential practice site is that the preceptor encourages you to choose a workshop or support group that interests you the most, with the final goal of tailoring an educational forum to the clients within that workshop or support group.

During my four-week rotation, I sought to tackle as many of the Iris House goals as I could.

1. To promote and support independent functioning, I worked with clients to find simple modifications to their current HAART regimens to make them easier to remember so as not to disrupt their daily activities.

2. To improve the patients quality of life, I offered counseling to clients on the importance of adhering to medication regimens and discussed ways to alleviate some of the common side effects associated with HAART regimens.

3. To maintain optimum health status, I facilitated interactive discussions focusing mainly on HIV risk reduction. I encouraged on-site HIV rapid testing whenever feasible and distributed free condoms and safe-sex brochures to clients most at risk for HIV transmission through sexual intercourse.

My colleague and I also provided an informational session addressing patients living with HIV and hypertension, offering free blood pressure screenings to those in attendance.

Although we are exposed to medication therapy management within the pharmacy school curriculum, it is impossible to compare counseling my classmate on a prescription during a practical to speaking to actual HIV/AIDS patients

Continued from previous

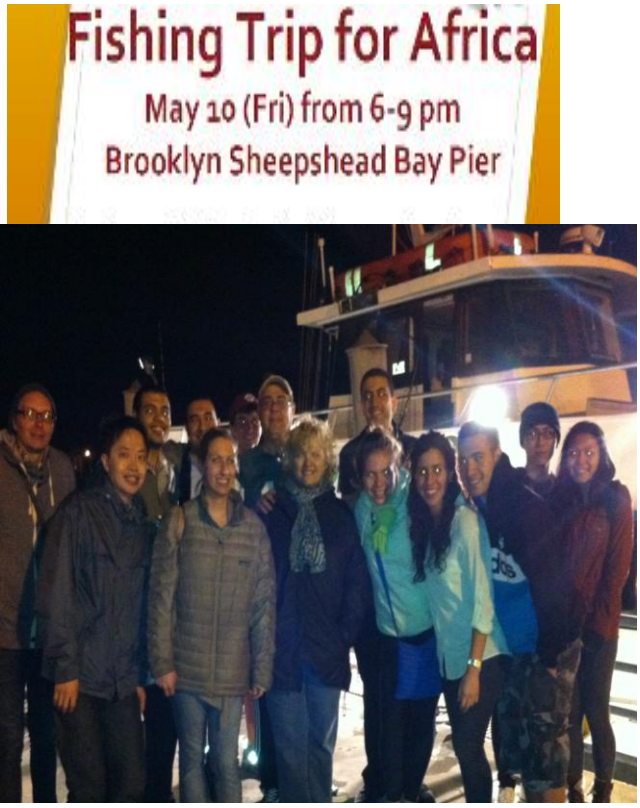
in underserved communities.

It was the open communication with the clients that helped me to empathize and understand the health disparities that exist simply due to cultural differences. My increasing ability to recognize and alter the way I communicate with members of different communities depending on their beliefs and attitudes brought me closer to achieving cultural competence.

It is crucial for pharmacy students to communicate with one another regarding previous experiences at their sites. Students should seek challenging experiential sites that promote their advancement in the profession.

While many practice experience sites offer the development of clinical knowledge, public health experiences provide students with the opportunity to become well-rounded clinicians.

I would highly recommend any pharmacy student with the option to register for a public health experience to consider Iris House.



IrisHouse
20 Years of Saving Lives

Can Cephalosporins Be Used to Treat Methicillin-resistant *Staphylococcus aureus* (MRSA)?

Jennifer Miao, St. John's University Pharm.D Candidate, 2014
Faculty Preceptor: Tran H. Tran, Pharm.D, BCPS Assistant Clinical Professor

Background: The increase of multidrug-resistant pathogens, particularly methicillin-resistant *Staphylococcus aureus* (MRSA) has been a growing concern in recent years. While vancomycin has historically been the drug of choice for treatment of MRSA infections, vancomycin resistance and a steady increase in MICs have created the need for new antimicrobial agents. Ceftaroline fosamil (Teflaro, Forest Laboratories, Inc.) is a new 5th generation cephalosporin with activity against multidrug-resistant gram-positive organisms as well as typical gram-negative pathogens. Ceftaroline received FDA approval on October 29, 2010 for the treatment of acute bacterial skin and soft structure infections (ABSSSI) as well as community acquired bacterial pneumonia (CABP) in adults.

Mechanism of Action: In accordance with other beta-lactam antibiotics, ceftaroline exerts time-dependent bactericidal action by binding to pencillin-binding proteins (PBPs). This inhibits bacterial cell wall synthesis, ultimately leading to cell lysis. Ceftaroline has affinity for PBPs 1-3 as well as PBP2a, associated with MRSA resistance, and PBP2x, which is a feature of resistant strains of *Streptococcus pneumoniae*.

Microbiology: Ceftaroline is the first FDA-approved cephalosporin with activity against MRSA. Additionally, this cephalosporin has also shown in vitro activity against vancomycin resistant *Staphylococcus aureus* and daptomycin nonsusceptible strains. Ceftaroline also possesses gram negative coverage against that is comparable to the third-generation cephalosporins however it is inactivated by extended spectrum beta-lactamase (ESBL) producing strains.

Table 1: Antimicrobial Spectrum

Gram Positive	Gram Negative
Staphylococcus aureus	***Haemophilus influenza***
MSSA, CA/HA MRSA, hVISA, VISA,	***Moraxella catarrhalis***
VRSA, Daptomycin nonsuscpetible	***Escheria coli***
Streptococcus epidermidis	***Klebsiella pneumoniae***
Streptococcus pneumoniae	***Proteus mirabilis***
Viridans group streptococci	***Citrobacter freundil***
Streptococcus agalactiae	***Only active against non-ESBL strains**
Streptococcus pyogenes	

*Ceftaroline has limited activity against anaerobic isolates

Pharmacokinetics: Ceftaroline fosamil is a prodrug that is rapidly converted to ceftaroline by plasma phosphatases. The drug distributes primarily in the fluid compartment with a Vd of 0.37 L/kg. Therefore dose adjustment is not required in obese patients however lower plasma concentrations may occur in patients who are fluid overloaded. Animal studies examining ceftaroline's penetration into the cerebral spinal fluid and bone have so far been favorable however further studies are needed to confirm its clinical efficacy in treating these types of infections.

Metabolism and Elimination: Ceftaroline does not undergo hepatic metabolism through the CYP450 system and therefore does not pose a major risk for drug interactions. Serious drug interactions have yet to be seen. Protein binding for ceftaroline is approximately 20% and the drug is primarily eliminated through the kidneys with 88% of the drug excreted unchanged in the urine. Patients with renal dysfunction will require dose adjustments (see Table 2).

Dosage and Administration: The FDA recommended dosing of ceftaroline is 600 mg every 12 hours by intravenous infusion over 1 hour. Every 8-hour dosing has also been used to treat more severe infections however clinical evidence is lacking to support improved efficacy with this approach.

Table 2: Renal Dosage Adjustments

Estimated CrCl (mL/min)	Recommended Dosage
> 50	**No dose adjustment necessary**
>30 to ≤50	**400 mg IV every 12 hr**
≥15 to ≤30	**300 mg IV every 12 hr**
End-stage renal disease	**200 mg IV every 12 hr – **given after dialysis****

Medication Safety: So far, ceftaroline has not been associated with serious adverse reactions. The drug's side effect profile is similar to other cephalopsorins with the most common complaints being diarrhea, itching, headache, and insomnia. Although ceftaroline is considered to have broad-spectrum coverage, the incidence of Clostridium difficile infection with this medication has been relatively low with only 2 cases reported in phase three clinical trials.

Role in Clinical Practice: Ceftaroline utility in clinical practice is strongest in the treatment of MRSA infections. While other anti-MRSA agents such as vancomycin, daptomycin, and linezolid are available and effective treatments, these agents are all associated with serious adverse reactions such as nephrotoxicity, peripheral neuropathy, and myelosuppression. Ceftaroline also comes with advantages from a cost perspective. The average wholesale price of ceftaroline is $110/day whereas intravenous linezolid costs $290/day, and daptomycin is $363/day. Despite these advantages, treatment of ceftaroline is still uncommon due to our limited clinical experience and lack of long-term safety data. Currently, ceftaroline has begun to appear on hospital formularies for the treatment of MRSA in patients with intolerance or contraindications to daptomycin or linezolid. As more data emerges ceftaroline will hopefully develop a greater role in the treatment of resistant gram-positive infections.

References

1. **Teflaro (ceftaroline fosamil) [package insert]. Forest Laboratories, Inc.; 2012.**
2. **Jorgenson MR, DePestel DD, Carver PL et al. Ceftaroline fosamil: a novel broad-spectrum cephalosporin with activity against methicillin-resistant Staphylococcus aureus. Ann Pharmacother. 2011 Nov;45(11):1384-98.**
3. **Lodise TP, Low DE. Ceftaroline fosamil in the treatment of community-acquired bacterial pneumonia and acute bacterial skin and skin structure infections. Drugs. 2012 Jul 30;72(11):1473-93.**
4. **File TM Jr, Wilcox MH, Stein GE. Summary of ceftaroline fosamil clinical trial studies and clinical safety. Clin Infect Dis. 2012 Sep;55 Suppl 3:S173-80.**
5. **Thomson Healthcare/Thomson PDR. Red book: pharmacy's fundamental reference. 2012; PDR Network, LLC, Montvale, NJ. Accessed 28 March 2013.**

PATIENT CASE

JB is a 43-year-old man admitted with community-acquired pneumonia (CAP). He has a past medical history of congenital heart disease s/p 2 orthoptic heart transplants, restrictive lung disease requiring 3-4 L home oxygen, stage IIIb chronic kidney disease (CrCL=21 mL/min), and depression treated with venlafaxine and mirtazapine. He is currently on immunosuppressive therapy for his heart transplant and has a history of recurrent left lower extremity cellulitis and CAP.

JB was started empirically on levofloxacin 250 mg IV every 48 hours. Respiratory cultures returning on day 2 of admission were positive for MRSA.

Antibiotic	Susceptibility	MIC (µg/mL)
Levofloxacin	**Resistant**	**>4**
Clindamycin	Resistant	>4
Vancomycin	Susceptible	2
Linezolid	Susceptible	4

Should JB be started on ceftaroline, why or why not?

DISCUSSION

While microbiological cultures reported susceptibility to vancomycin and linezolid, several factors can lead the clinician to choose ceftaroline as the safest and most efficacious treatment for JB's pneumonia.

- Vancomycin should be avoided in JB due to the relatively high MIC reported.
- Linezolid should be excluded due to the potential for drug interactions with JB's antidepressant medication.
- Daptomycin is not an option due to its lack of efficacy in the lung.

While ceftaroline does not have an indication for MRSA community acquired pneumonia, its efficacy against MRSA makes it an attractive option for JB.

Based on available culture data and rationale against first and second line therapies, the patient was switched to salvage therapy with ceftaroline 300 mg IV every 12 hours. Therapy was dosed according to the patient's renal function and continued for 14 days.

Highlights from the NYSCHP 52nd Annual Assembly – A Student's Perspective

In May, I had the pleasure of attending the New York State Council of Health-System Pharmacists' (NYSCHP) Annual Assembly at the Turning Stone Resort and Casino in Verona, NY. The central theme of the meeting was medication safety and many corresponding continuing education opportunities were provided throughout the weekend, not to mention many occasions for fun and networking.

Some of my personal favorites included the keynote address from Christopher Jerry, father of Emily Jerry and founder of the Emily Jerry Foundation. Christopher Jerry spoke about his beautiful two year-old daughter who heartbreakingly died after being given chemotherapy mixed in hypertonic saline rather than normal saline. He is an advocate for pharmacy technician certification to improve medication safety for all patients.

I also enjoyed Assistant Dean of Albany College of Pharmacy, Dr. Sarah Scarpace's lecture concerning oncology medication safety and New England College of Pharmacy's Associate Professor, Dr. Edward Li's presentation on preparing your practice for biosimilars.

The Greater New York Hospital Association, along with NYSCHP, co-sponsored a disaster preparedness luncheon that highlighted what three New York City-area hospitals had learned in the wake of Hurricane Sandy.

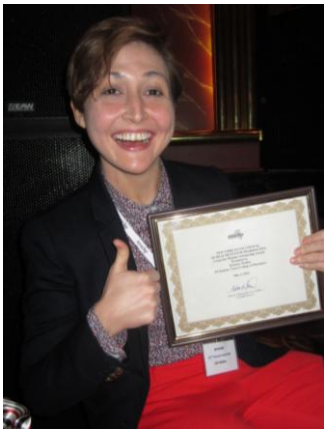
Presenters not only discussed how Hurricane Sandy affected their infrastructure and information systems, but what they were doing to meet the demands in the aftermath and preventative strategies for the future.

A banquet on Saturday night ushered in the installation of new NYSCHP President, Dr. Qazi Halim, of Brookdale Hospital and allowed Immediate Past President Dr. Mark Sinnett, of Montefiore Medical Center a chance to present awards and acknowledge his year of service.

Also installed, were NYSCHP Chapter Presidents, which included our very own Dr. Mary Choy for the NYC chapter. During the course of the evening, I (very gladly!) accepted a Corporate Essay Award for an essay on the appropriate use of social media in the professional environment, entitled "Social Media Friend or Foe?"

From the amazing venue and themed parties to the networking with potential employers and informative educational sessions, a good time was had by all!

I would encourage any interested party, student or faculty, to take part in the 2014 Annual Assembly.



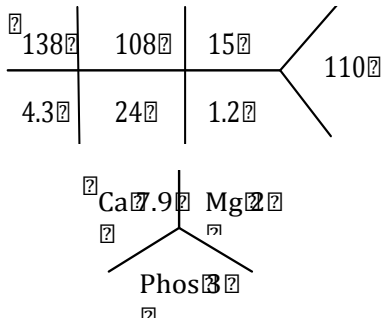
Brit Wallen –
Touro College of Pharmacy
Class of 2013

Read Part 1 of our new series "Electrolyte Refreshers" for a quick overview of Calcium and see if you can answer this patient case

PATIENT CASE

JM is a 65-year-old female who presents to the clinic for physical exam.

Tmax = 37C BP = 124/78 HR = 70 RR = 18 AO x 3



Albumin = 3 g/dL

Denies chest pain, SOB, paresthesias, tetany, anxiety, and fatigue.

What is the most appropriate therapy for JM?

1. **Start IV calcium CHLORIDE 1 gram over 20 minutes**
2. **Start calcium CARBONATE 500 mg BID**
3. **Bolus IV calcium GLUCONATE 1 gram over 5 minutes**
4. **No need for calcium replacement**

UPCOMING EVENTS

Save the Date!

8th Annual New York City Regional Pharmacy Residency Conference 2013
Date: Friday, June 21st, 2013
Location: Arnold & Marie Schwartz College of Pharmacy
Long Island University, Brooklyn, New York

Student Program
Date: Thurs, Aug. 15th, 2013
Location: Touro College of Pharmacy
New York, New York

Tri-State Assembly
Date: Fri, Sept. 20th, 2013
Location: Dolce IBC Center
Palisades, New York

Correct answer: D. No need for calcium replacement

Corrected Calcium = 0.8 * (4 – pts albumin) + Serum Calcium

Patient's corrected calcium is 8.7 mg/dL, and therefore does not have hypocalcemia.

A &B (wrong): Patient does not need either intravenous or oral replacement

C (wrong): Possible severe cardiac dysfunction when calcium is infused too rapidly

Electrolyte Refresher – Calcium

Hanlin Li, St. John's University Pharm.D Candidate, 2014
Faculty Preceptor: Tran H. Tran, Pharm.D, BCPS Assistant Clinical Professor

	HYPOcalcemia	HYPERcalcemia
Normal Calcium: **8.5 to 10.2 mg/dL**	**Serum calcium concentration <8.5 mg/dL** **Ionized calcium concentration <1.1 mmol/L** ▪ *Ionized calcium is the active form of calcium and is recommended as the monitoring standard for ICU patients*	**Serum calcium concentration > 10.5 mg/dL** ▪ **Mild to Moderate:** <13 mg/dL; ▪ **Severe:** ≥ 13 mg/dL ▪ **Hypercalcemic Crisis:** acute elevation of total serum calcium >15 mg/dL
Clinical Pearl	**For each 1g/dL decrease in serum albumin concentration (<4 g/dL), serum calcium concentration decreases by ~ 0.8 mg/dL** **<u>For serum Albumin concentrations <4g/dL</u>, use the corrected calcium equation for accurate calcium measurements:** **Corrected calcium (mg/dL) = serum Ca (mg/dL) + 0.8 (4.0 – serum albumin (g/dL))**	
Causes	Acute pancreatitis Blood transfusion Drug-induced Hyperphosphatemia Hypomagnesemia Hypoparathyroidism Vitamin D deficiency	Adrenal insufficiency Drug-induced Immobilization Malignancy Paget's disease Primary hyperparathyroidism Rhabdomyolysis Tuberculosis
Clinical Manifestations	**Cardiovascular:** HYPOtension, decreased myocardial performance **Dental:** Dental hypoplasia **Dermatologic:** Brittle and grooved nails, hair loss, dermatitis, eczema **Neurologic:** Paresthesias, tetany, depression, anxiety, memory loss, confusion	**Cardiovascular:** HYPERtension, deposition of calcium in heart valves, shortened QT interval, ventricular tachyarrhythmias **Neurologic:** Anorexia, nausea, vomiting **Renal:** Nephrolithiasis, renal tubular dysfunction
Treatment	**Asymptomatic:** ▪ Oral elemental calcium 1 – 3 grams/day ○ Monitor serum calcium every 24 – 48 hours, then 1 – 2 times weekly **Symptomatic:** ▪ I.V. calcium CHLORIDE 1 gram ▪ I.V. calcium GLUCONATE 2 – 3 grams over 10 minutes ▪ Continuous infusion at 0.5 – 2 mg/kg per hour ○ *Infusion rate should not exceed 0.8 – 1.5 mEq/min due to potential risk for arrhythmias* **Severe symptomatic refractory to intermittent bolus doses:** ▪ Re-bolus IV and titrate up maintenance infusion rate Monitor serum calcium every 4 – 6 hours during IV therapy	**Mild:** ▪ Hydration and ambulation **Severe:** ▪ I.V. 0.9% sodium chloride infusion ▪ I.V. loop diuretics once volume status is restored ▪ Hemodialysis if needed **Hypercalcemia due to malignancy:** ▪ Bisphosphonates: ○ etidronate 7.5 mg/kg/day over 2 hours for 3 – 7 days ○ pamidronate I.V. 60 – 90 mg infused over 2 – 4 hours ○ zoledronic acid I.V. 4 mg infused over 15 minutes ▪ I.V. hydrocortisone 100 – 300 mg daily or oral prednisone 40 – 60 mg daily for 3 – 7 days

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