# bioMérieux connection

March 2011 ▪ VOL 1 NO 1

In this Issue:



## The Art of VITEK® 2 bioArt® Rules: Rules To Enhance Accurate Susceptibility Reporting pg 2

**Also in This Issue:**

*Klebsiella oxytoca* and Antibiotic-**Associated Hemorrhagic Colitis pg 4**

**LIVE** article **pg 5**

*C. difficile*-**chromID™ pg 6**

Check the **Calendar on pg 6** to See What's New!

ASM 2011 New Orleans **Knowledge Forums Update pg 7**

BIOMÉRIEUX

# Utilizing VITEK® 2 bioART® Rules To Enhance Accurate Susceptibility Reporting

**Bridget Blumer, B.S. MT (ASCP)**
*ACL Central Laboratory*
*Rosemont, Illinois*

Here at the ACL Central Laboratory in Rosemont, Illinois, the Microbiology laboratory performs Microbiology testing for eight hospitals (three of which are teaching facilities) and receives an equal volume of tests from Outreach clients. One-third of our staff of 75 technologists are trained to report susceptibilities from three VITEK® 2 systems connected to two separate Laboratory Information Systems (LIS). The LIS system for hospital inpatient results (SunQuest) uses real-time quality assurance parameters. The second, less sophisticated, LIS system (Commercial Lab) reports outreach results and all quality assurance is performed manually.

Susceptibility reporting is one of the most dynamic and complex areas in clinical microbiology. Each year new CLSI recommendations are published; new mechanisms of organism resistance are discovered and need to be identified; and new antibiotics are added. In order to implement and support these changes we had relied on "cheat sheets", sticky notes, and email notifications to inform the staff of new policies and procedures. Our laboratory has recently implemented bioMérieux's Advanced Reporting Tool (bioART®) for the VITEK® 2 system as a means to help execute these changes. This is a marked improvement on the less desirable methods previously mentioned. In this day and age of doing more with less and being LEAN, bioART® allows us to customize our susceptibility reporting rules and our technologists are less burdened with researching our policies and procedures for each isolate.

bioART® rules can be easily built as required so there is true real-time quality assurance. Rules can be customized to suppress antibiotics from susceptibility reports based on any number of conditions including: final interpretation, MIC value, bacterial phenotype, and even a specific organism or group of organisms. Non-formulary antibiotics can also be suppressed so that they are not included in the Advanced Expert System™ (AES) analysis. Even the whole susceptibility report can be held up for review.

Any report, whether it is released or held for review, can have customized site-specific comments added to the VITEK® 2 printed report. These comments can be written to alert technologists to the action they must take. For example, adding an interpretative comment to the susceptibility report or to perform ancillary tests for that particular isolate. The comments allow us to eliminate the use of extraneous notes and guarantee that each situation will be handled appropriately and in the same way.

## Here are a few examples of bioART® rules used in our laboratory:

**1.** Reminder to set up an ancillary test (colistin Etest®) for any Pseudomonas aeruginosa isolate that tests intermediate or resistant to a carbapenem (imipenem) per a request from our Infectious Disease department.
***If*** organism is *Pseudomonas aeruginosa*
***And*** Antibiotic is Imipenem, Interpretation I, R
***Then*** Add comment: Set colistin Etest®.

**In this scenario, the susceptibility is not held for review.**

**2.** Reminder to set up an ancillary test (vancomycin Etest) for any Methicillin Resistant *Staphylococcus aureus* with a vancomycin MIC ≥ 2mcg/mL. This rule is based on recent guidelines from the Infectious Diseases Society of America (IDSA).

***If*** organism is *Staphylococcus aureus*
***And*** Test Cefoxitin Screen is POS
***And*** Antibiotic is Vancomycin, MIC ≥ 2
***Then*** Suppress from reporting Vancomycin
***And*** Add comment: Set vancomycin Etest®.

**In this scenario the *Staphylococcus aureus* susceptibility results will not be held up for the technologist's review and will autofile.**

**3.** This rule will remind the technologist of an action to take (add a comment to the susceptibility report) when reporting a *Staphylococcus* isolate that does not express an inducible clindamycin resistance.

***If*** Organism is *Staphylococcus*
***And*** Antibiotic is Clindamycin, MIC ≤ 0.5
***And*** Antibiotic is Erythromycin, MIC ≥ 1
***And*** Test Inducible Clindamycin Resistance is NEG
***And*** Add comment: Add comment to clindamycin result: This isolate does not demonstrate inducible Clindamycin resistance *in vitro.*

**The organism *Staphylococccus* in this rule is a group of organisms consisting of all *Staphylococccus species.***

**4.** Sometimes several actions need to be taken such as stopping a report for technologist's review, a reminder for setting up ancillary tests, and suppressing antibiotics from the report. In addition, several bioART® rules may need to be written so all scenarios are covered. The bioART® function does not allow an either/or situation when selecting antibiotics so a rule needs to be written for each one. For *Enterobacteriaceae* isolates with an elevated carbapenem MIC, a rule is written for each carbapenem (ertapenem, imipenem, meropenem) to stop the report for the technologist's review and to set up ancillary tests such as the Modified Hodge Test and a Metallo Beta-Lactamase Etest.®

***If*** Organism is *Enterobacteriaceae*
***And*** Antibiotic is Ertapenem, MIC ≥ 1
***Then*** Stop for review
***And*** Add comment: Set Modified Hodge Test and Metallo Beta Lactamase Etest if ceftriaxone, ceftazidime, or cefotaxime is I or R. Do not report penicillin/penicillin inhibitors, cephalosporins, carbapenems or monobactams.

***If*** Organism is *Enterobacteriaceae*
***And*** Antibiotic is Imipenem, MIC ≥ 2
***Then*** Stop for review
***And*** Add comment: Set Modified Hodge Test and Metallo Beta Lactamase Etest if ceftriaxone, ceftazidime, or cefotaxime is I or R. Do not report penicillin/penicillin inhibitors, cephalosporins, carbapenems or monobactams.

***If*** Organism is *Enterobacteriaceae*
***And*** Antibiotic is Meropenem, MIC ≥ 2
***Then*** Stop for review
***And*** Add comment: Set Modified Hodge Test and Metallo Beta Lactamase Etest if ceftriaxone, ceftazidime, or cefotaxime is I or R. Do not report penicillin/penicillin inhibitors, cephalosporins, carbapenems or monobactams.

**These rules remind the technologist to suppress the appropriate antibiotics and set up the ancillary tests if the aforementioned criteria is met, and while still allowing us to report any antibiotics not affected by the Modified Hodge Test or Metallo Beta-Lactamase Etest until they can be verified.**

As stated earlier, our laboratory reports patient results into two LIS systems in which one has a real-time quality assurance program. Being part of a large laboratory system does have its downside when requesting immediate revisions which take time to be built, test and implement. bioART® rules can be built and tested by us at our convenience. If any tweaking needs to be done – there is no waiting or requisitions to fill out. In addition, some susceptibility changes may be temporary and the bioART system allows us to disable a rule at any time.

Since implementing the VITEK® 2 bioART® rules in our laboratory it has removed most of the burden from technologists to memorize the ever changing scenarios of susceptibility reporting and therefore removing chances of error, our reports are more consistent, and allows us to preserve accuracy in our susceptibility reporting.

# bioART®

**A**dvanced **R**eporting **T**ool for VITEK® 2 Systems

VITEK® 2

# *Klebsiella oxytoca* and Antibiotic-Associated Hemorrhagic Colitis

William M. Janda, Ph.D., D(ABMM)
Professor of Pathology, Microbiology, and Immunology
Director, Clinical Microbiology Laboratory
*University of Illinois Medical Center*
*Chicago, Illinois*

At the present time, the genus *Klebsiella* includes includes six species: *K. pneumoniae, K. oxytoca, K. granulomatis, K. variicola, K. singaporensis,* and *K. alba.*[2,11,16,18,21] Three of these species – *K. pneumoniae, K. oxytoca,* and *K. granulomatis* – are associated with infections in humans. *K. pneumoniae* is further divided into three subspecies: *K. pneumoniae subsp. pneumoniae, K. pneumoniae* subsp. *ozaenae* and *K. pneumoniae subsp. rhinoscleromatis. K. pneumoniae* subsp. *pneumoniae* is a well-recognized cause of pneumonia, urinary tract infections, liver abscesses, and bacteremia.[16,17] *K. pneumoniae* subsp. *ozaenae* is associated with ozena, an infection characterized by chronic atrophic rhinitis, pneumonia, otitis media, urinary tract infections, and bacteremia. *K. pneumoniae* subsp. *rhinoscleromatis* is the cause of rhinoscleroma, a granulomatous respiratory tract infection involving the nasal passages. *K. granulomatis,* formerly known as *Calymmatobacterium granulomatis,* is a fastidious gram-negative bactererium that causes donovaniasis, a genital ulcer disease seen primarily in South and Central America, Asia, and Africa. *K. oxytoca,* like *K. pneumoniae* subsp. *pneumoniae,* is associated with nosocomial infections of the urinary and respiratory tracts, in particular. Like *K. pneumoniae* subsp. *pneumoniae, K. oxytoca* constitutively produces ß-lactamases that confer resistance to amino- and carboxypenicillins, and may also become multiply-resistant with the acquisition of genes encoding extended-spectrum ß-lactamase enzymes (ESBLs).[5] *K. variicola, K. singaporensis,* and *K. alba* are newly described species that have been isolated from plants, soil, and, rarely, clinical samples.[11,16,18,21] In 2001, former members of the genus *Klebsiella* – *K. planticola, K. ornithinolytica,* and *K. terrigena* – were transferred to the new genus *Raoultella* as *R. planticola, R. ornithinolytica,* and *R. terrigena.*[6]

Over the 20 to 25 years, *K. oxytoca* has emerged as the etiologic agent of an acute hemorrhagic colitis syndrome that is temporally related to the receipt of penicillin agents and is associated with the production of a specific cytotoxin. Several case reports and studies in the English, French and Japanese scientific literature suggest that the prevalence of antibiotic-associated hemorrhagic colitis (AAHC) due to *K. oxytoca* is increasing. Therefore, it is important that laboratorians become familiar with this new clinical syndrome, the types of patients in which this condition may develop, and the detection and reporting of *K. oxytoca* when it is present in diarrheal stool specimens. This review describes AAHC caused by K. oxytoca, the mode of action of the *K. oxytoca* toxin responsible for the syndrome, and the recognition and reporting of this agent in stool specimens from patients.

The first reports of possible involvement of *K. oxytoca* in cases of hemorrhagic enterocolitis appeared from Japan in the mid-to-late 80's, with the observation of high fecal burdens of *K. oxytoca* in Japanese patients who developed hemorrhagic enterocolitis after receiving penicillin derivatives.[4] In 1989, Minami and colleagues identified certain *K. oxytoca* strains obtained from Japanese patients with hemorrhagic diarrhea that produced a low-molecular-weight "cytotoxin" related to *C. difficile* toxin A.[13] This cytotoxin induced rounding of cultured cell lines, including HEp-2, Vero, CHO-K1, and HeLa cells, and resulted in death of 70% to 80% of these cells within 48 hours. The amount of cytotoxin required to cause cell rounding and death of 50% of the cell culture monolayers was cell line-dependent and ranged from 0.6 µg/ml to 1.4 µg/ml. This cytotoxin was partially purified by gel filtration and reversed-phase high-performance liquid chromatography and further characterized as to molecular structure and mode of action. Using this cytotoxin preparation and HEp-2 cells, the toxin was demonstrated to cause inhibition of both DNA and RNA synthesis.[7,14] Additional characterization of the cytotoxin revealed that it is heat-labile (i.e., inactivated by heat treatment at 60° C for 30 minutes), stable to treatment with pronase or trypsin, and produced during the logarithmic growth phase, with maximum production during the early stationary phase. The cytotoxin appears to be chromosomally encoded and nuclear mass resonance (NMR) and FAB mass spectrometry indicate that it is a small molecule with a molecular weight of 217 daltons and the chemical formula $C_8H_{15}O_4N_3$.[14] Injection of purified cytotoxin into ligated ileal and colonic loops in rabbits caused mucosal hemorrhage and fluid accumulation, while similar preparations from non-toxigenic *K. oxytoca* strains did not cause any of these effects.[12] These results suggested that *K. oxytoca* strains that were able to produce this cytotoxin were responsible for the pathogenesis of AAHC.

In 2006, Hogenauer and colleagues studied 22 consecutive patients who had AAHC but were negative for *C. difficile.*[9] All underwent diagnostic colonoscopy and the diagnosis of AAHC was based on clinical history (use of antibiotics before onset of diarrhea) and endoscopic features associated with segmental hemorrhagic colitis. Stool specimens were cultured for all recognized enteric pathogens, including *C. difficile* and *C. difficile* toxins, and were examined for the presence of *K. oxytoca.* In order to determine the prevalence of intestinal *K. oxytoca,* stool specimens from 385 healthy subjects who had not taken antimicrobial agents within the prior four weeks were also examined for the presence of *K. oxytoca*. Among the 22 patients, 6 were diagnosed with AAHC and *K. oxytoca* was isolated from the stool of 5 of 6 patients. All stool specimens were negative for other enteric pathogens. These five patients were receiving penicillin derivatives as outpatients when cramping and bloody diarrhea developed suddenly after 3-7 days of antibiotic treatment. Two of the 5 patients who were *K. oxytoca*-positive had also been taking NSAIDS at the time of disease onset. All five patients had leukocytosis (mean of 16,500/mm$^3$) and elevated C-reactive protein. Colonoscopies performed on the five patients showed segmental hemorrhagic colitis localized predominantly in the right colon along with mucosal edema and hemorrhage and with rectal sparing in all cases. No pseudomembranes were observed. Among the stool specimens obtained from healthy subjects, *K. oxytoca* was found in only 6 (1.6%) of the 385 healthy subjects. *K. oxytoca* isolates from the five AAHC patients were analyzed for cytotoxin production along with two toxin-negative control *K. oxytoca* ATTC strains.[9] After overnight growth in broth, the organisms were removed by centrifugation/filtration and the supernatant (100 ul of a 1:1 dilution with PBS) was added to HEp-2 cell culture monolayers.
After incubation for 48 hours at 37oC, the monolayers were examined under a microscope. Cytotoxicity, as evidenced by cell rounding and death, was observed with all five *K. oxytoca* clinical isolates, while the two control *K. oxytoca* strains had no effects on the cultured cells.

In the same report, Hogenauer and colleagues established an animal model for AAHC using Sprague-Dawley rats.[9] The animals were split into 6 groups and received all various combinations of a cytotoxic *K. oxytoca* strain orally with and without amoxicillin/clavulanate and with and without indomethicin (a non-steroidal anti-inflammatory drug). Animals that received the organism along with amoxillin-clavulanate and indomethicin became colonized with *K. oxytoca* and developed right-sided hemorrhagic colitis. Among the control animals that did not receive antibiotic, colonization of the gut with *K. oxytoca* did not occur and the animals did not develop disease. Examination of

tissue from the colon of infected animals revealed histopathology similar to that seen in humans with *K. oxytoca* AAHC. Culture of the infected colonic tissue from the animals yielded the same *K. oxytoca* isolate that was orally administered to the affected animals. The results of this animal model essentially fulfilled the tenets of Koch's postulates, establishing cytotoxin-producing *K. oxytoca* strains as the causative agent of AAHC.

Several other reports in the literature have since confirmed the association of *K. oxytoca* with AAHC. The first case report of *K. oxytoca* AAHC in North America described a 79-year-old-male from San Diego who presented with a new onset of diarrhea, abdominal pain, and hematochezia.[3] Based on an abdominal CT examination, the patient underwent emergency sigmoidal colonoscopy because of concern for impending colonic performation. In a case report from Japan, Philbrick et al described a 63 year old man who developed *K. oxytoca* AAHC after taking amoxicillin for sinusitis prophylaxis following a dental implant procedure five days earlier.[15] Sweetser and colleagues described a case of *K. oxytoca* AAHC in a 67-year old female who underwent a sigmoid resection with primary anastomosis procedure for recurrent diverticulitis.[20] The patient presented 3 days after the surgery with explosive, voluminous diarrhea containing red and white blood cells. Imaging of the colon revealed mucosal enhancement suggesting infectious or inflammatory colitis, and the flexible sigmoidocopy showed a granular and edematous colonic mucosa with yellow and white pseudomembrane formation, which had not been previously reported for *K. oxytoca*-associated AAHC. In 2010, Shinjoh, Iwata, and Takahashi reported the first two pediatric cases of *K. oxytoca*-associated AAHC.[19] The patients were a 14 year-old female and an 11-year-old female who was receiving amoxicillin for treatment of tonsillitis due to group A ß-hemolytic streptococci. A third pediatric case involved a 15-year-old male who presented with an acute *E. coli* urinary tract infection with upper urinary tract involvement.[8] Three days after treatment with amoxicillin-clavulanate, the boy developed acute abdominal pain with bloody diarrhea. Ultrasound revealed thickening and hyperemia of the terminal ileum, caecum, and ascending colon and diarrheal stool specimens yielded *K. oxytoca* as the only agent in the stool; this isolate was demonstrated to produce the cytotoxin by tissue culture assay.

Isolates of *K. oxytoca* from cases of AAHC have been studied and compared with other strains of the same species and with other members of the genus *Klebsiella*. In the report by Hogenaur and colleagues, all five cytotoxin-producing isolates were resistant to ampicillin/amoxicillin due to the constitutive ß-lactamase produced by *K. oxytoca* strains.[9] One of the five isolates was also resistant to clarithromycin, and one isolate was resistant to cefotaxime due to production of an ESBL. Other studies have shown that individual AAHC patients may simultaneously carry multiple, genotypically distinct toxigenic and non-toxigenic *K. oxytoca* strains. In a study by Joainig and colleagues, stool isolates of *K. oxytoca* were obtained from 13 AAHC patients, 14 patients with non-hemorrhagic gastroenteritis, and 13 asymptomatic carriers.[10] These strains were compared with *K. oxytoca* strains isolated from the urinary tract (10 isolates), the respiratory tract (16 isolates), blood cultures (13 isolates), and wounds (16 isolates). Nine (60%) of the 15 isolates recovered from the stool of AAHC patients were cytotoxin-positive, as were 8 (57%) of 14 stool isolates from patients with acute/chronic colitis, and 6 (46%) of 13 stool isolates from asymptomatic carriers. While 2 (15%) of 13 isolates from blood cultures and 6 (36%) of 16 isolates from cutaneous infections were cytotoxigenic, none of the respiratory tract and urinary tract isolates of *K. oxytoca* produced cytotoxin. Toxigenic and nontoxigenic *K. oxytoca* strains may therefore be present in both symptomatic and asymptomatic individuals, but patients with AAHC have significantly more toxigenic strains in the stool than asymptomatic persons. In one study, AAHC patients harbored 4 X $10^6$ cfu of toxigenic *K.oxytoca* per ml of stool, while asymptomatic patients harbored <$10^1$ cfu of toxigenic *K. oxytoca* per ml of stool.[22] Other studies have also shown that patients with AAHC without *C. difficile* but with *K. oxytoca* in the stool had significantly higher rates of cytopathic K. oxytoca strains than a control group of healthy carriers of *K. oxytoca*.[1] Cytotoxin production appears to be specific for *K. oxytoca* and is not seen in *K. pneumoniae* or in other *Klebsiella* species that have been examined.[10]

In summary, *K. oxytoca* AAHC may develop suddenly after receipt of penicillins or penicillin derivatives (e.g., amoxicillin) . Some patients may also have a history of recent use of NSAIDS. The diarrhea is characterized by presence of blood and mucous, the absence of *C. difficile* and the presence of hematochezia. The antimicrobial agent apparently selects for *K. oxytoca,* which are resistant to broad-spectrum penicillin derivatives, resulting in overgrowth of the organism in the gut and the elaboration of cytotoxin by some strains. Colonoscopy usually shows segmental (i.e. left-sided, right-sided or pancolonic) hemorrhagic colitis involving the transverse/ascending colon with rectal sparing. On histopathology, bowel abnormalities include acute inflammation with eythema, edema, ulcerations, and purpura, with a diffusely hyperemic mucosa, submucosal hemorrhage, and fibrinopurulent damage. Patients will have a marked leukocytosis, and an elevated C-reactive protein. This condition is usually self-limited, with spontaneous resolution of symptoms occurring within a few days after cessation of the offending antibiotic. *K. oxytoca* AAHC should be suspected if the patient is *C. difficile*-negative, has been on antimicrobial therapy, and has symptoms that include diarrhea with hematochezia. *K. oxytoca* can be isolated from the stool, biopsy specimens collected during colonoscopy, or intra-luminal fluid from patients. Colonic biopsy specimens and diarrheal stool may yield the organims in pure culture. Consequently, heavy growth or a preponderance of *K. oxytoca* in these specimen types from patients with consistent illness should be reported to the physician. *K. oxytoca* may also be a rare cause of severe infectious colitis in patients without a history of antibiotic use.[3] Because of the role of toxigenic *K. oxytoca* in the pathogenesis of AAHC, laboratories may want to consider adding a comment to the final laboratory report if *K. oxytoca* is found in the stool in significant numbers: "Toxigenic strains of *Klebsiella oxytoca* have been associated with antibiotic-associated hemorrhagic colitis (AAHC). Patients usually respond to withdrawal of antimicrobial agents."

See page 8 for references

live

LISTEN. INSPIRE. VALUE. EMPOWER.

At our recent internal employee Summit, we introduced a brand-new initiative called **LIVE**, dedicated to the way we **L**isten, **I**nspire, **V**alue, and **E**mpower others–especially, you, our valued customers. **LIVE** is an expression of bioMérieux's core values, and an acknowledgement of the importance of integrating our personal and professional lives in a way that achieves balance.

**LIVE** is a holistic approach to business and life, with each of its four elements intricately connected to one another. Of particular importance in our relationships with our customers, is the element of ***Listening.*** bioMérieux is committed to its partnership with you, as we build the laboratory of the future–a lab that allows all stakeholders to work more effectively in providing accurate, actionable information to help physicians care for their patients. Your input is crucial to this process, and we're ***Listening.***

In the coming months, we will be rolling out a variety of new communications that will bring the campaign to life in exciting ways. We look forward to hearing your feedback and working with you to achieve our mutual goals.

# Exciting New Media From bioMérieux

bioMérieux will soon be introducing the newest addition to our chromID™ line of chromogenic media. chromID™ *C. difficile* is a selective and differential chromogenic media for the detection and identification of *Clostridium difficile* in stools of symptomatic patients. This media contributes to the diagnosis and epidemiological monitoring of *C. difficile*, which is a causative agent of pseudomembranous colitis and is the number one etiological agent in nosocomial or antibiotic-associated diarrhea.[1] A study by the *Association for Professionals in Infection Control & Epidemiology* indicated that 13 of every 1,000 patients were either infected or colonized with *C. difficile*.[2] The financial burden of *C. difficile* has been estimated to run from $2,871 to $4846 per case for primary infection and from $13,655 to $18,067 per case for recurrent infections.[3] Control of this pathogen within institutions has been difficult due to the ability of the organism to form spores and spread to other patients. Although controversial, there have been calls for culturing to help contain this pathogen.[4]

chromID™ *C. difficile* media is rapid and easy to use and does not require technical expertise to identify positive cultures. *C. difficile* colonies produce easy to read dark grey or black colonies upon the media, in only 24 hours versus 48 to 72 hours with conventional media. The media shows superior recovery over conventional media. A study of 474 isolates comparing percent recovery showed chromID™ *C. difficile* recovery of 99% versus 55% with other culture media.[5]

This media will help laboratories isolate organisms for further testing and will assist infection preventionists in controlling this pathogen. By rapidly identifying colonized patients, appropriate infection prevention measures can be implemented which may prevent transmission of the organism. Hospitals should examine their current *C. difficile* prevention measures and determine whether or not to include proactive surveillance cultures.

## REFERENCES


1. **Bartlett JG., Gerding D.** - Clinical Recognition and Diagnosis of Clostridium *difficile* Infection - Clin Infect Dis. - 2008;vol. 46, p.S12-S18.

2. **APIC Website**: 2010 Clostridium *difficile* Pace of Progress Survey , Results of an Online Poll of Infection Preventionists, May 2010 http://www.apic.org/AM/Template.cfm?Section=Featured News_and Events&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=15496

3. **Ghantoji, S**, et al. Economic healthcare costs of Clostridium *difficile* infection: a systematic review. J Hosp Infect. 2010 Apr; 74(4):309-18. Epub 2010 Feb 12.

4. **Delmee, M**, et al. Laboratory diagnosis of Clostridium *difficile*-associated diarrhea: a plea for culture. Journal of Medical Microbiology (2005), 54, 187-191.

5. Refer to chromID™ *C. difficile* agar (CDIF) Instructions for Use.


## EVENTS CALENDAR

**National** | **Regional** | **bioFood**

| | Date | Event & Location |
|---|---|---|
| MARCH | 21-24 | **American College of Healthcare Executives (ACHE)** Chicago, IL |
| | 23-27 | **SCACM** Cleaveland, OH |
| | 28-30 | **SAFMLS** New Orleans, LA |
| APRIL | 1-4 | **SHEA** Dallas, TX |
| | 8 | **SEACM VA Spring Meeting - DCLS** Richmond, VA |
| | 12 | **SEACM Spring Meeting** Greer, SC |
| | 14 | **SEACM GA Meeting** Decatur, GA |
| | 11-15 | **PDA** San Antonio, TX |
| | 19-21 | **Food Safety Summit** Washington DC |
| | 20-21 | **Illinois Society of Microbiology** Naperville, IL |
| | 25 | **Clinical Lab Collaborative** Meeting Duluth, MN |
| | 28-30 | **ASCLS Washington Spring Seminar** Vancouver, WA |
| MAY | 3-4 | **American Association of Critical Care Nurses/Teaching Institute** Chicago, IL |
| | 3-4 | **ASCLS-CNE** Providence, RI |
| | 5 | **CLMA Think Lab** Baltimore, MD |
| | 8-11 | **Clinical Virology Symposium** Daytona Beach, FL |
| | 9-12 | **Amerinet Member Conference** Orlando, FL |
| | 10-13 | **Society for Hospital Medicine** (SHM) Grapevine, TX |
| | 14-19 | **American Urology Association** Washington, DC |
| | 21-24 | **American Society of Microbiology (ASM)** New Orleans, LA |

**Complete this form and fax it to 919-479-3615 or email a copy to info.biomerieux@biomerieux.com**

asm2011

We are pleased to announce that bioMérieux will be attending this year's ASM General Meeting in New Orleans, from Saturday, May 21, to Monday, May 23 – and we hope that you will join us for this important industry event.

Visit us at **Booth #543** and take advantage of these exciting educational **KNOWLEDGE FORUMS.**
Presentations take place every 45 minutes from well-known microbiology thought leaders, on topics including:

- **MALDI-TOF Technologies in Microbiology Lab** - ***Wayne Wang, MD,*** *Medical Director, Grady Memorial Hospital*
- **Resistance Mechanisms** - ***Paul Schreckenberger, Ph.D,*** *Director of Clinical Microbiology, Loyola University Medical Center*
- **Case Study: Lean Lab Design** - ***Elaine Hinds MS, MT(ASCP), CLS(NCA),*** *Microbiology Manager, Sunrise Medical Labs*
- **Automation: Vision and Making the Case** - ***Linda Bruno, MT, ASCP,*** *Assoc. Administrative Director, Univ. of IL, Chicago*
- **Lean Blood Culture Workflow (Examine your Process - Collection to Patient Care)** - ***Maryanne Cuillo, MT (ASCP),*** *Assistant Manager Microbiology, Florida Hospital*
- **Sepsis: Know from Day 1**

First Name: _____ Last Name: _____

Title: _____ Hospital: _____

Phone: _____ Fax:_____

Email: _____

Address: _____

City: _____ State: _____ Zip: _____

☐ **YES, I am attending ASM**

☐ **No, I will not be attending ASM but want my local rep to contact me regarding the following:**
-Mass Spectrometry
-Microbiology Informatics
-LEAN Lab Workflow Assessment
-Managing Sepsis
-Molecular Diagnostics

bioMérieux Connection NEWSLETTER

100 Rodolphe Street,
Durham, North Carolina 27712

www.biomerieux.com

**ADDRESS SERVICE REQUESTED**

*References from article: Klebsiella oxytoca and Antibiotic-Associated Hemorrhagic Colitis - pages 4, 5*

## REFERENCES

1. **Beaugerie, L., M. Metz, F. Barbut, G. Bellaiche, Y. Bouhnik, L. Raskine, J.C. Nicolas, F.P. Chatelet, N. Lehn, J.C. Petit, and the Infectious Colitis Study Group.** 2003. Klebsiella oxytoca as an agent of antibiotic-associated hemorrhagic colitis. Clin. Gastroenterol. Hepatol. 1:370-376.

2. **Carter, J.S., F.J. Bowden, I. Bastian, G.M. Myers, K.S. Sriprakash, and D.J. Kemp.** 1999. Phylogenetic evidence for reclassification of Calymmatobacterium granulomatis as Klebsiella granulomatis comb. nov. Int. J. Syst. Evol. Microbiol. 49:1695-1700.

3. **Chen, J., E.R. Cachey, and G.C. Hunt.** 2004. Klebsiella oxytoca: a rare cause of severe infectious colitis: first North American case report. Gastrointest. Endoscopy 60:142-145.

4. **Chida, T., R. Nakaya, M. Tsuji, N. Simuzu, G. Matsuda, T. Seo, H. Sagara, and Y. Matsubara.** 1986. Intestinal microflora of patients with antibiotic-associated hemorrhagic colitis associated with Klebsiella oxytoca and Clostridium difficile enterotoxin [Japanese]. Kansenshogaku Zasshi 60:608-615.

5. **Decre, D., B. Burghoffer, V. Gautier, J.-C. Petit, and G. Arlet.** 2004. Outbreak of multi-resistant Klebsiella oxytoca involving strains with extended-spectrum ß-lactamases and strains with extended-spectrum activity of the chromosomal ß-lactamase. J. Antimicrob. Chemother. 54:881-888.

6. **Drancourt, M., C. Bollet, A. Carta, and P. Rousselier.** 2001. Phylogenetic analyses of Klebsiella species delineate Klebsiella and Raoultella gen. nov., with description of Raoultella ornithinolytica comb. nov., Raoultella terrigena comb. nov. and Raoultella planticola comb. nov. Int. J. Syst. Evol. Microbiol. 51:925-932.

7. **Higaki, M., T. Chida, H. Takano, and R. Nakaya.** 1990. Cytotoxic component(s) of Klebsiella oxytoca on HEp-2 cells. Microbiol. Immunol. 34:147-151.

8. **Hoffmann, K.M., A. Deutschmann, C. Weitzer, M. Joainig, E. Zechner, C. Hogenauer, and A.C. Hauer.** 2010. Antibiotic-associated hemorrhagic colitis caused by cytotoxin-producing Klebsiella oxytoca. Pediatrics 125:e960-e963.

9. **Hogenaur, C., C. Langner, E. Beubler, I.T. Lippe, R. Schicho, G. Gorkiewicz, R. Krause, N. Gerstgrasser, G.J. Krejs, and T.A. Hinterleitner.** 2006. Klebsiella oxytoca as a causative organism of antibiotic-associated hemorrhagic colitis. N. Engl. J. Med. 355:2418-2426.

10. **Joainig, M.M., G. Gorkiewicz, E. Leitner, P. Weberhofer, I. Zollner-Schwetz, I. Lippe, G. Feierl, R. Krause, T. Hinterleitner, E.L. Zechner, and C. Hogenauer.** 2010. Cytotoxic effects of Klebsiella oxytoca strains isolated from patients with antibiotic-associated hemorrhagic colitis or other diseases caused by infections and from healthy subjects. J. Clin. Microbiol. 48:817-824.

11. **Li, X., D. Zhang, F. Chen, J. Ma, Y. Dong, and L. Zhang.** 2004. Klebsiella singaporensis sp. nov., a novel isomaltulose-producing bacterium. Int. J. Syst. Evol. Microbiol. 54:2131-2136.

12. **Minami, J., S.-I. Katayama, O. Matsushita, H. Sakamoto, and A. Okabe.** 1994. Enterotoxic activity of Klebsiella oxytoca cytotoxin in rabbit intestinal loops. Infect. Immun. 62:172-177.

13. **Minami, J., A. Okabe, J. Shiode, and H. Hayashi.** 1989. Production of a unique cytotoxin by Klebsiella oxytoca. Microb. Pathog. 7:203-211.

14. **Minami, J., S. Saito, T. Yoshida, T. Uemura, and A. Okabe.** 1992. Biological activities and chemical composition of a cytotoxin of Klebsiella oxytoca. J. Gen. Microbiol. 138:1921-1927.

15. **Philbrick, A.M., and M.E. Ernst.** 2007. Amoxicillin-associated hemorrhagic colitis in the presence of Klebsiella oxytoca. Pharmacotherapy 27:1603-1607.

16. **Podshun, R., and U. Ullman.** 1998. Klebsiella spp. as nosocomial pathogens; epidemiology, taxonomy, typing methods and pathogenicity factors. Clin. Microbiol. Rev. 11:589-603.

17. **Pope, J.V., D.L. Teich, P. Clardy, and D.C. McGillicuddy.** 2008. Klebsiella pneumoniae liver abscess: an emerging problem in North America. J. Emerg. Med. Doi:10.1016/j.jemermed.2008.04.041.

18. **Rosenblueth, M., L. Martinez, J. Silva, and E. Martinez-Romero.** 2004. Klebsiella variicola, a novel species with clinical and plant-associated isolates. Syst. Appl. Microbiol. 27:27-35.

19. **Shinjoh, M., S. Iwata, and T. Takahashi.** 2010. Klebsiella oxytoca-positive, penicillin-associated hemorrhagic colitis in children. Pediatr. Int. 52:132-133.

20. **Sweetser, S., K.W. Schroeder, and D.S. Pardi.** 2009. Pseudomembranous colitis secondary to Klebsiella oxytoca. Am. J. Gastroenterol. 104:2366-2368

21. **Xu, J., W. Li, X. Chen, and Y. Zhou.** 2010. Klebsiella alba sp. nov., a novel pesticide-tolerant bacterium from a heavily polluted environment. J. Gen. Appl. Microbiol. 56:241-247.

22. **Zollner-Schwetz, I.. C. Hogenauer, M. Joainig, P. Weberhofer, G. Gorkiewicz, T. Valentin, T.A. Hinterleitner, and R. Krause.** 2008. Role of Klebsiella oxytoca in antibiotic-associated diarrhea. Clin. Infect. Dis. 47:e74-e78.



*bioMérieux Connection* is published by bioMérieux, Inc., 100 Rodolphe Street, Durham, NC 27712. Please send address corrections and mailing list additions to biomerieux.connection@na.biomerieux.com. For customer service, call toll free 800-682-2666. Please visit our web site at www.biomerieux-usa.com. Please share your comments and suggestions with us through your local account manager or by emailing us at the address above. As always, we thank you for being a bioMérieux customer.