Determination of the Antibiotic Resistance Profile of Student Cell Phones

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INTRODUCTION

The problem of antibiotic resistance has reached such significant levels that the World Health Organization (WHO) selected this topic for the World Health Day initiative in 2011 (3). Resistance of bacterial infections to one or multiple antibiotics is further compounded by the lack of new antibiotics and antimicrobials currently under development by pharmaceutical companies (1).

One method to slow antibiotic resistance is education of future healthcare practitioners and the general public. General biology and microbiology courses are perhaps the best means of teaching these concepts and reach many undergraduate students. Within lecture sections, discussion on control of microbial growth can be dovetailed with discussion on appropriate antibiotic use. Sampling of common use items (e.g., student cell phones) for bacterial presence, identification, and antibiotic resistance profiling helps students to recognize the need for routine cleaning of personal items and encourages thoughtful use of currently available medications. The data generated from this project can be saved and added to each semester, thus providing a data set that reflects a local trend of antibiotic resistance.

This exercise is a multilab period project and can be used to teach or reinforce several methods from general microbiology including aseptic technique, isolation streak, serial dilution, spread plating, Kirby Bauer testing, unknown identification (biochemical dichotomous key or identification system [e.g., Biolog (Biolog, Hayward, CA)]), and media production.

PROCEDURE

Materials

Day 1 (optional): Media making supplies—powdered media [nutrient broth, nutrient agar, Mueller Hinton II agar], balance, weigh boats/papers, weigh spatulas, calculators, glassware, deionized water, volumetric flasks, aluminum foil, and an autoclave (to be used by the instructor).

Day 2: Student cell phones, cotton balls, 70% (over-the-counter) isopropanol, sterile swabs, sterile DI water (for moistening swab to collect sample), 2.0 ml nutrient broth tube (to grow microbes on swab), and a wax pencil or glass marking pen (to label samples).

Day 3: Dilution blanks, pipettes, pipette aides, catheter trays containing disinfectant, nutrient agars for spread plating, glass beads (for spread plating), and samples from Day 2.

Day 4: Three to five nutrient agars (subcultures of spread plates) and three to five nutrient agar slants (stock cultures of well isolated colonies from Day 3 spread plates).

Day 5: Several nutrient agar slants (to make stock cultures), biochemical tests (e.g., Gram stain reagents, fermentation broths, etc.) or Biolog test materials, and three to five nutrient broths per student.

Day 6: Biochemical tests or Biolog test materials, sterile swabs, sterile blank paper disks, antibiotic disks, forceps, small beakers containing ethanol (for flame sterilization of forceps), and Mueller Hinton II agar plates.

Day 7: Biochemical tests or Biolog materials, rulers (to measure zones of inhibition), antibiotic chart (determining sensitivity based on zone diameter).

Safety issues

All materials that have come in contact with microbes should be disposed of following proper procedures (e.g., autoclaving and/or disinfection in chemical disinfectant). The ASM advocates that students must successfully demonstrate the ability to explain and practice safe laboratory techniques. For more information, read the laboratory safety section of the ASM Curriculum Recommendations: Introductory Course in Microbiology and the Guidelines for Biosafety in Teaching Laboratories, available at www.asm.org.

Activity

Students will aseptically sample their cell phone by running a moistened, sterile swab over the faceplate and/ or keypad of the cell phone. Students should sample areas on their phone that are most frequently touched. Swabs should be placed in 2.0 ml of sterile nutrient broth and incubated overnight at 35°C. Once cell phones have been sampled, cell phone surfaces should be wiped with a cotton ball moistened with 70% isopropanol and returned to the student. After samples have become turbid, the swab...
should be removed and disposed of in a biohazardous waste container and samples should be serially diluted and plated. If broths are turbid, dilutions 10⁻⁵ through 10⁻⁹ should be plated to provide the 30–300 CFU/ml range. Dilution plates should be grown overnight at 35°C. Three to five individual colonies may be streaked to nutrient agar slants if they are well isolated, or subcultures of mixed colonies may be made on nutrient plates.

Once pure colonies have been obtained, stocks should be made by culturing onto nutrient agar slants. Biochemical identification may be by dichotomous key—we use Johnson and Case, 2001 (2)—or identification system (e.g., Biolog). Biolog provides more stringent testing but costs may be prohibitive. The Kirby-Bauer method (2) should be used to generate an antibiotic resistance profile for each isolate. The number of antibiotics to be tested is up to the instructor; we routinely test 12 to 19 drugs, which include a negative control (sterile blank paper disk) and several traditionally used (e.g., penicillin, streptomycin) and other antibiotics (e.g., oxacillin [methicillin], piperacillin, vancomycin). Using antibiotics that are in current use by local physicians is ideal. Students should report their findings to the class and those findings may be used as a class discussion for the current state of antibiotic resistance.

Other Potential Activities

1. To conserve time and materials, the Kirby Bauer method may be used to determine the antibiotic resistance profile of the mixed cell phone sample. While the data would not be as meaningful, general trends could still be determined.
2. Other commonly touched surfaces (e.g., credit/debit/identification cards or iPads/laptops/iPods) may be tested for antibiotic resistances. Nonmetal surfaces would work best as metal has intrinsic antimicrobial properties.

CONCLUSION

Antibiotic resistance is a contemporary problem that may result in the loss of antibiotics within the next two generations (1). As such, biology and microbiology students have a vested interest in understanding how antibiotic resistant bacteria are transmitted from person to person through common-use items, how to decrease this transferal, and when antibiotic treatment is appropriate. While the techniques described in this activity are not used in traditional biology labs, students are capable of lecture discussion and brainstorming.

This activity will provide hands-on experience in identifying microbes isolated from the student’s cell phone and determining those organisms’ antibiotic resistance profile. The activity would make an ideal capstone activity for a general microbiology course or a lab activity for an advanced microbiology course where several techniques are applied to culture, isolate, identify, and test unknown organisms.

Class discussion may center on possible mechanisms to treat or slow the spread of antibiotic resistance, alternative sources for antimicrobials, healthcare without effective antibiotics, or effective education measures that could be implemented. Another potential side project for pre-health students is to launch a health education campaign designed to target their local college population on proper antibiotic usage.

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REFERENCES