Table 3. Antibiotic test of the isolates (zone of inhibition in mm) (CLSI guideline, 2016)

Source	Isolate No.	Bacterial isolate	Vancomycin (30µg)	Cotrimoxazol (30µg)	Azithromycin (15µg)	Gentamicin (10µg)	Amoxycillin (10 µg)	Cephradine (30 µg)	Ceftriaxone (30 µg)	Cefuroxime (30 µg)	Cefoxitin (30 µg)	Tetracycline (30 µg)
Local restaurants	1.	*Alcaligenes fecalis*	25(S)	30(S)	(R)	26(S)	23(S)	15(S)	27(I)	(R)	(R)	28(S)
	2.	*Staphylococcus aureus*	25(S)	18(S)	20(S)	(R)	20(S)	(R)	20(R)	(R)	(R)	15(I)
	3.	*Pseudomonas aeruginosa*	25(S)	24(S)	(R)	25(S)	15(R)	(R)	23(R)	(R)	(R)	30(S)
	4.	*Staphylococcus* spp.	28(S)	25(S)	30(S)	25(S)	32(S)	24(S)	30(S)	(R)	32(S)	35(S)
	5.	*Enterobacter aerogenes*	18(S)	25(S)	28(S)	26(S)	28(S)	24(S)	20(R)	(R)	26(S)	28(S)
	6.	*Proteus mirabilis*	27(S)	(R)	20(S)	20(S)	(R)	(R)	15(R)	(R)	(R)	(R)
	7.	*Salmonella choleraesuis*	12(R)	18(S)	23(S)	20(S)	12(R)	(R)	13(R)	(R)	(R)	24(S)
	8.	*Pseudomonas aeruginosa*	(R)	(R)	(R)	27(S)	(R)	(R)	(R)	(R)	(R)	14(R)
Fast Food Shops	9.	*E.coli*	12(R)	25(S)	(R)	20(S)	10(R)	12(S)	20(R)	16(I)	23(S)	24(S)
	10.	*E.coli*	15(I)	18(S)	(R)	20(S)	25(S)	22(S)	18(R)	20(S)	25(S)	25(S)
	11.	*Salmonella spp*	12(R)	20(S)	17(R)	15(S)	10(R)	10(R)	23(R)	(R)	17(I)	22(S)
	12.	*Proteus mirabilis*	30(S)	30(S)	25(S)	25(S)	28(S)	20(S)	24(I)	18(S)	26(S)	25(S)
	13.	*E.coli*	(R)	12(R)	18(S)	14(I)	15(R)	(R)	12(R)	(R)	(R)	26(S)
	14.	*Proteus mirabilis*	(R)	14(R)	17	18(S)	14(R)	(R)	18(R)	(R)	(R)	25(S)
	15.	*Klebsiella pneumoniae*	(R)	18(S)	8(R)	20(S)	14(R)	12(S)	18(R)	(R)	10(I)	13(R)
	16.	*Klebsiella pneumoniae*	(R)	29(S)	35(S)	41(S)	14(R)	9(R)	30(S)	(R)	(R)	26(S)
Canteen (Academic institution)	17.	*Corynebacterium Xerosis*	13(R)	11(R)	11(R)	19(S)	6 (R)	18(S)	10(R)	(R)	13(I)	24(S)
	18.	*E.coli*	33(S)	(R)	28(S)	23(S)	(R)	(R)	(R)	23(S)	35(S)	38(S)
	19.	*Enterobacter aerogenes*	15(I)	18(S)	(R)	20(S)	11(R)	23(S)	24(I)	(R)	24(S)	12(R)
	20.	*Klebsiella pneumonia*	15(I)	17(S)	20(S)	19(S)	7(R)	(R)	14(R)	(R)	(R)	30(S)
	21.	*Klebsiella pneumoniae*	(R)	29(S)	11(R)	30(S)	11(R)	(R)	28(S)	(R)	(R)	19(S)
	22.	*Klebsiella oxytoca*	(R)	28(S)	13(R)	19(S)	(R)	16(S)	28(S)	(R)	16(I)	22(S)
	23.	*Klebsiella oxytoca*	(R)	25(S)	17(R)	15(S)	(R)	14(S)	27(I)	6 (R)	16(I)	19(S)
	24.	*Enterobacter aerogenes*	(R)	20(S)	11(R)	17(S)	18 (I)	8(R)	20(R)	(R)	11(I)	22(S)
	25.	*Klebsiella pneumoniae*	15(I)	25(S)	15(R)	20(S)	29(S)	24(S)	25(I)	(R)	13(I)	27(S)
	26.	*E.coli*	15(I)	29(S)	(R)	20(S)	14(R)	14(S)	16(R)	13(R)	29(S)	12(R)
Canteen (Hospitals)	27.	*Klebsiella pneumoniae*	(R)	22(S)	9(R)	15(S)	(R)	11(R)	28(S)	(R)	(R)	13(R)
	28.	*Staphylococcus spp.*	(R)	21(S)	9(R)	16(S)	18 (I)	(R)	27(I)	(R)	(R)	19(S)
	29.	*Klebsiella pneumoniae*	(R)	22(S)	8(R)	16(S)	(R)	11(R)	29(S)	7(R)	(R)	19(S)
	30.	*Staphylococcus spp.*	(R)	14(R)	(R)	12(R)	(R)	9(R)	11(R)	(R)	(R)	11(R)
	31.	*Klebsiella pneumoniae*	(R)	(R)	9(R)	17(S)	12 (I)	(R)	12(R)	(R)	(R)	27(S)
	32.	*Klebsiella pneumoniae*	(R)	(R)	13(R)	11(R)	6(R)	(R)	14(R)	(R)	(R)	19(S)
	33.	*Proteus mirabilis*	(R)	24(S)	24(S)	20(S)	17 (I)	(R)	12(R)	(R)	(R)	26(S)
	34.	*Proteus mirabilis*	(R)	(R)	22(S)	17(S)	11(R)	(R)	14(R)	(R)	(R)	24(S)

*R=Resistant, S= Sensitive/Susceptible, I= Intermediate

Corynebacterium xerosis and *Klebsiella oxytoca* was found only in sample 01, 03 and 02, 03 respectively from academic canteens. *Staphylococcus aureus*, *Pseudomonas aerugenosa* and *Alcaligenes fecalis* were the most predominant bacteria found in most of the samples. *Salmonella cholerasuis* (sample 5 from fast food shop) and *Salmonella* spp. (sample 04 from local restaurant) was found to be present on one sample each. *Escherichia coli* was mostly found to be present in local restaurants and canteens from academic sector. *Klebsiella pneumonia* was prevalent in hospital canteens (sample 01,03,04), local restaurants (sample 04,05), academic canteens (sample 01,02,03).

Isolate 7 & 8 was resistant to vancomycin and isolate 6 and 8 was resistant to cotrimoxazole. All of these isolates were collected from tabletops of local restaurants (Table 3). Isolate 8 was resistant to all antibiotics except gentamicin. Cefuroxime showed 100% resistance and all isolates except isolate 4 were resistant to ceftriaxone.

Vancomycin, amoxicillin, ceftriaxone, cefuroxim were the least effective to inhibit the isolates collected from fast food shops from Dhaka city (Table 3). All isolates except isolate 13 showed sensitivity against gentamicin and isolate 15 showed resistance towards tetracycline. Most of the other isolates showed greater degree of susceptibility towards cotrimoxazole and tetracycline.

Vancomycin and azithromycine were effective against isolate 18 only from the canteens of academic institutions. Gentamicin is 100% effective against all the isolates from the same sectors. Isolate 19 & 26 were resistant for tetracycline and isolate 18 & 19 were susceptible for cefoxitin (Table 3).

Isolates collected from the hospital canteens showed to be completely resistant towards vancomycin, cefradine, cefuroxime and cefoxitin. Amoxicillin showed both intermediate and resistance result for all the same isolates from hospital canteen. Sensitivity was found for cotrimoxazole and gentamicin (isolate 27,2,29,33), azithromycin (isolate 34,3), ceftriaxone (isolate 27,29), tetracycline (isolate 2,29,31,32,33,34) (Table 3).

4. Discussion

A significant number of people suffer from food poisoning and other diseases starting upon the consumption of contaminated food. Many pathogenic bacteria can get into the food chain by various means. Direct entry of microbes from the food handling surface or the tabletops from the area where people generally eat on is one of the major sites from where the microbes find their way into the food. So the tabletops in all food serving areas like canteens, restaurants and other food serving shops must be properly maintained to avoid the accumulation of high number of such bacteria. Poor personal hygiene of the workers or the food handler, unsanitized towels for cleaning, cross contamination from other contaminated equipments, contaminated eating utensils kept on the table all contribute to the buildup of pathogenic microbes on the tabletops (10, 40- 44). Tabletops made of wood are more prone to accumulation of nutrients spilled from the food items on the table and is often difficult to clean. Avoidance of vigorous cleaning with proper disinfectants might increase the accumulation of biofilm formation resulting in continuous spread of infection. The spreading is not only aided by hands but also with the clothes used for cleaning the tabletops as well (45-46).

In current study we found *Esherichia coli, Klebsiella pneumonia, Klebsiella oxytoca, Corynebacterium xerosis, Staphylococcus aures, Salmonella* spp., *Proteus mirabilis, Enterobacter aerogenes, Pseudomonas aeruginosa* and *Alcaligenes fecalis*. They all can cause disease in human. *Staphyloccus aureus* can produce enterotoxin and cause food borne intoxication. Other staphylococcal food borne disease can cause abdominal cramp, nausea, vomiting and sometimes diarrhea (47,48). Though *Klebisella pneumoniae* is not generally recognized as foodborne pathogen, but in a study it was showed to be capable to cause nosocomial infection being foodborne (49,50). *Klebsiella oxytoca* can cause gastroenteritis (51). *Proteus mirabilis* can come from poultry origin and can being a foodborne pathogen it can cause disease in human. It can produce urease which aids in the development of urinary tract infection (52). *Pseudomonas aeruginosa* can increase cellular permeability and eventually cause cell death (53). *Corynebacterium xerosis* can cause septicemia, pleuropneumonia and arthritis in immune-compromised person (54). *Escherichia coli* is the most common pathogen causing severe gastro-enteric disease worldwide (55).

Drug resistance has become a very common and alarming scenario which has made the treatment and complete eradication of the pathogenic bacteria very difficult. Resistance properties are shared among the bacterial population and several factors aid in such dissemination of resistant traits like adaptation with the antibiotic, misuse of antibiotics, international travelling/migration. Furthermore, bacteria can resist

the effects of antibiotics by adapting new mechanisms like efflux pump to move out the antibiotics from the cell, changes in their metabolic pathways, changes in receptors, acquisition of resistant gene containing plasmid etc. (56-61).

In this study, most resistant pathogenic isolates were found from the hospital; canteens. As the hospital environment is a source of pathogenic bacteria due to the over activity from the patients. The health care workers and the patients often use the hospital canteens. The workers in the canteen serve food not only in the canteen but also to the words and cabins for the patients. Thus they bring the pathogenic microbes and disseminate throughout all the areas of the hospital including the canteen area. If proper hand washing, use of appropriate sanitizing and disinfecting solutions is not strictly maintained, the incidence disseminating the foodborne infection will not be eliminated. Second most drug resistant pathogens were found from canteens of the academic institutions. A huge number of students come in the canteens. Many general people also come here for cheaper rate of the food in such canteens. As the environment is overcrowded and vigorous washing of tabletops is not possible and as a result many pathogenic microbes are disseminated and with the organic substances attached on the tabletops aid in the proliferation and biofilm formation of the adjacent microbes. Fast food shops and local restaurant showed better results than hospital canteen and canteen of academic institutions. As fast food shops generally can maintain hygienic condition as they are not overcrowded and most people visiting fast food shops or restaurant are generally in good health. Proper hygienic condition should be strictly maintained to overcome the incidents of foodborne disease.

5. Conclusion

Foodborne illness is very common especially in overcrowded and developing countries where large number of people lack the proper knowledge of sanitation. Foodborne diseases are caused by pathogenic bacteria transmitted by food. These bacteria can get into the food from different sources. One such source is contaminated tabletops from where the bacteria can ready come in close contact with food directly or by means of our hands which carry bacteria from tabletop into the food while touching the food directly with bare hands. Moreover, the bacteria on the surfaces also come from different sources like contaminated food, unsanitized hands from the workers, contaminated water, tabletop washing clothes etc. Strict regulation for the proper personal hygiene maintenance in food processing and serving area, use of appropriate disinfectants to clean the tabletops and washing clothes, regular changing of the washing clothes, overall maintenance of cleanliness in food handling environment, punishment for not following the sanitation program in the food serving areas should be compulsory.

Conflict of interest

Authors declare to have no conflict of interest.

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References

1.Scott E. Food safety and foodborne disease in 21st century homes. Canadian J Infect Dis 2003; 14:277–280.

2.WillsWJ, Meah A, Dickinson AM, *et al*. I don't think I ever had food poisoning'. A practice-based approach to understanding foodborne disease that originates in the home. Appetite 2015; 85:118–125.

3.Edema MO, Osho AT, Diala CI. Evaluation of microbial hazards associated with the processing of suya (a grilled meat product). Sci Res & Essays 2008; 3: 621-626.

4.Food Safety Agency. 2009. Scores on the Doors. Retrieved December 2008 from http://www.food.gov.uk/multimedia/pdfs/board/fsa080306.pdf

5.Knight AJ, Worosz MR, Todd ECD. Serving Food Safety: Consumer perception of food safety at restaurants. Int J Contemp Hospital Manage 2007; 19: 476-484.

6.Moore G, Griffith C. A comparison of traditional and recently developed methods for monitoring surface hygiene within the food industry: an industry trial. Int J Environ Health Res 2002; 12: 317-329.

7.Lee J, Almanza BA, Nelson DC, *et al*. Using health inspection scores to assess risk in food service. J Environ Health 2009.71: 29-32.

8.Adams MR, Moss MO. Food Microbiol 2008. Cambridge, UK: The Royal Society of Chemistry.

9.Begani RK, Tombe B, Polong T. Effectiveness of Cleaning and Sanitation of Food Contact Surfaces in the PNG Fish Canning Industry. DWU Res J 2012; 16, 68- 80.

10.Blackburn C de W. Microbiological analysis and food safety management: GMP and HACCP systems. In: McMeekin TA, editor. Detecting pathogens in food. Cambridge: Woodhead Publishing Limited 2003. p. 3–17.

11.Beumer RR, Kusumaningrum H. Kitchen hygiene in daily life. Int Biodeter & Biodegrad 2003; 51: 299-302.

12.Bloomfield S, Exner M, Fara GM, *et al*. Perspectives, prevention of the spread of infection e the need for a family-centered approach to hygiene promotion. Euro - surveillance 2008; 13: 4-6. www.eurosurveillance.org

13.Yepiz-Gomez MS, Bright KR, Gerba CP. Identity and numbers of bacteria present on tabletops and in dishcloths used to wipe down tabletops in public restaurants and bars. Food Protect Trends 2006; 26: 786-792.

14.Chaidez C, Gerba CP. Bacteriological analysis of cellulose spongs and loofahs in domestic kitchens from a developing country. Dairy Food Environ Sanit 2000; 20: 834-837.

15.Lee MB, Greiga JD. A Review of Gastrointestinal Outbreaks in Schools: Effective Infection Control Interventions. J School Health 2010; 80: 588-598.

16.Sneed J, Strohbehn C, Gilmore SA, *et al*. Microbiological evaluation of foodservice contact surfaces in Iowa assisted-living facilities. J Americ Diet Associat 2004; 104: 1722-1724.

17.Wilks SA, Michels H, Keevil CW. The survival of Escherichia coli O157 on a range of metal surfaces. Int J Food Microbiol 2005; 105: 445-454.

18.Teixeira P, Silva S, Araújo F, *et al*. Bacterial Adhesion to food contacting surfaces. In: Mendez-Vilas A., editor. Communicating Current Research and Education Topics and Trends in Applied Microbiology. 2007; Vol. 1. (Microbiology).

19.Gorman R, Bloomfield S, Adley CC. A study of cross-contamination of food-borne pathogens in the domestic kitchen in the Republic of Ireland. Int J Food Microbiol 2002; 76: 143–150. doi: 10.1016/s0168-1605(02)00028-4.

20.Redmond EC, Griffith CJ. Assessment of consumer food safety education provided by local authorities in the UK. British Food J 2006; 108: 732–752.

21.CDC. Day care-related outbreaks of rhamnose-negative Shigella sonnei—six states, June 2001-March 2003. MMWR Morb. Mortal. Wkly. Rep. 2004; 53: 60–63.

22.CDC. Outbreaks of multidrug-resistant *Shigella sonnei* gastroenteritis associated with day care centers—Kansas, Kentucky, and Missouri, 2005. MMWR Morb. Mortal. Wkly. Rep. 2006; 55:1068–1071.

23.Van Houdt R, Michiels CW. Biofilm formation and the food industry, a focus on the bacterial outer surface. J Appl Microbiol 2010; 109: 1117–1131.

24.De Cesare A, Sheldon BW, Smith KS, *et al*. Survival and persistence of *Campylobacter* and *Salmonella* species under various organic loads on food contact surfaces. J Food Protect 2003; 66**:** 1587-1594.

25.Wang Y, Zhang S, Yu J, *et al*. An outbreak of *Proteus mirabilis* food poisoning associated with eating stewed pork balls in brown sauce, Beijing. Food Control 2010; 21: 302–305.

26.Herzog K. 2011. Poorhand-washingledto green county *E. coli* outbreak. Retrieved from http://www.jsonline.com/features/health/poor-handwashing-led-to-green-county-ecoli-outbreak-132279498.html

27.Todd EC, Greig JD, Bartleson CA. Outbreaks where food workers have been implicated in the spread of food borne disease. Part 4: infective doses and pathogen carriage. J Food Protect 2008; 71: 2339-2373.

28.Pellegrino R, Crandall PG, Seo HS. Hand washing and disgust response to handling different food stimuli between two different cultures. Food Res Int 2015; 76: 301-308.

29.Howells AD, Roberts KR, Shanklin CW, *et al*. Restaurant employees' perceptions of barriers to three food safety practices. J Americ Diet Associat 2008; 108: 1345-1349. PMid: 18656574.

30.World Health Organization. 2015, http://www.who.int/mediacentre/news/releases/2015/food-safety/en/

31.Afroz H, Ahmed T, Uddin MA. Microbiological analysis and antibacterial activity of pear samples. Stamford J Microbiol 2015; 5: 1-4.

32.Ahmed T, Urmi NJ, Munna MS, *et al*. Assessment of microbiological proliferation and *in vitro* demonstration of the antimicrobial activity of the commonly available salad vegetables within Dhaka Metropolis, Bangladesh. Americ J Agri & Forestry 2014; 2: 55-60.

33.Malek M, Akhter J, Ahmed T, *et al*. Isolation and quantification of microorganisms from some common milk products within Dhaka city, Bangladesh. Stamford J Microbiol 2015; 5: 13-17.

34. Piangka N, Ahmed T, Acharjee M. Microbiological analysis for drug resistant pathogenic microorganisms with determination of the antibacterial properties found in *Fragaria x ananassa* (strawberry) samples. Stamford J Microbiol 2016; 6:16-19.

35. Rahman F, Noor R. Prevalence of pathogenic bacteria in common salad vegetables of Dhaka Metropolis. Bangladesh J Botany 2012; 41:159–162.

36. Acharjee M, Jahan F, Rahman F, *et al*. Bacterial proliferation in municipal water supplied in Mirpur locality of Dhaka city, Bangladesh. Clean- Soil, Air, Water. 2013; 434-441.

37. Cappuccino JG, Sherman N. Microbiology - A Laboratory Manual. The Benjamin/Cummings Publishing Co., Inc., Menlo Park, California 1996.

38. Noor R, Saha SR, Rahman F, *et al*. Frequency of opportunistic and other intestinal parasitic infections among the HIV infected patients in Bangladesh. Tzu Chi Med J 2012; 24: 191-195.

39. Ferraro MJ, Craig WA, Dudley MN. Performance standards for antimicrobial Susceptibility testing. 2001. Eleventh edit. Pennsylvania, USA: NCCLS.

40. Kusumaningrum HD, Riboldi G, Hazeleger WC, *et al*. Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. Int J Food Microbiol 2003; 85: 227–236.

41. Mattick K, Durham K, Domingue G, *et al*. The survival of foodborne pathogens during domestic washing-up and subsequent transfer onto washing-up sponges, kitchen surfaces and food. Int J Food Microbiol 2003; 85: 213–226.

42. Food and Drug Administration. FDA report on the occurrence of foodborne illness risk factors in selected institutional foodservice, restaurant, and retail food store facility types [homepage on the Internet]. c2004 [cited 2012 July03].Availablefrom:http://www.fda.gov/Food/FoodSafety/RetailFoodProtection/FoodborneIllnessandRiskFactorReduction/RetailFoodRiskFactorstudies/ucm089696.htm

43. Brannon LA, York VK, Roberts KR, *et al*. Appreciation of food safety practices based on level of experience. J Food Serv Bus Res 2009; 12: 134–154.

44. Gorman R, Bloomfield S, Adley CC. A study of cross-contamination of foodborne pathogens in the domestic kitchen in the Republic of Ireland. Int J Food Microbiol 2002; 76:143–150.

45. Rossi EM, Scapin D, Tondo EC. Survival and transfer of microorganisms from kitchen sponges to surfaces of stainless steel and polyethylene. J Infect in Develop Count 2013; 7: 229–234.

46. Teixeira P, Silva S, Araújo F, *et al*. Bacterial Adhesion to food contacting surfaces. In: Mendez-Vilas A., editor. Communicating Current Research and Education Topics and Trends in Applied Microbiology 2007. Vol. 1. (Microbiology).

47. Balaban N, Rasooly A. Staphylococcal enterotoxins. Int J Food Microbiol 2000; 61: 1–10.

48. le Loir Y, Baron F, Gautier M. *Staphylococcus aureus* and food poisoning. Genetics & Molecul Res 2003; 2: 63–76.

49.Calbo E, Freixas N, Xercavins M, *et al*. Foodborne nosocomial outbreak of SHV1 and CTX-M-15-producing *Klebsiella pneumoniae*: epidemiology and control. Clin Infect Dis 2011; 52: 743–749.

50.Wu H, Liu BG, Liu JH, *et al*. Phenotypic and molecular characterization of CTX-M-14 extended-spectrum β-lactamase and plasmid-mediated act-like AmpC β-lactamase produced by *Klebsiella pneumoniae* isolates from chickens in Henan Province, China. Genetic Molecul Res 2012; 11: 3357–3364.

51.Ghosh M, Wahi S, Kumar M, *et al*. Prevalence of enterotoxigenic *Staphylococcus aureus* and *Shigella* spp. in some raw street vended Indian foods. Int J Environ Health Res 2007; 17: 151–156.

52.Gonzalez G, Bronze MS, Boydet DR. 2014. http://emedicine.medscape.com/article/ 226434-overview#showall,diakses 23/11/14.

53.Mengmeng Su, Fang Liu, Zhang Luo, *et al*. The antibacterial activity and Mechanism of chlorogenic acid against foodborne pathogen *Pseudomonas aeruginosa*. Foodborne Pathogens & Dis 2019; 16: 823-830.

54.Lortholary O, Buu-Hoï A, Fagon JY, *et al*. Mediastinitis Due to Multiply Resistant *Corynebacterium xerosis*, *Clinical Infectious Diseases* 1993; 16: Page 172, https://doi.org/10.1093/clinids/16.1.172

55.Yang SC, Lin CH, Aljuffali IA, *et al*. Current pathogenic *Escherichia coli* foodborne outbreak cases and therapy development. Arch Microbiol 2017; 199: 811-825.

56.World Health Organization. *Tackling Antibiotic Resistance from a Food Safety Perspective in Europe.* WHO; Geneva, Switzerland: 2011. www.euro.who.int/__data/assets/pdf_file/0005/136454/e94889.pdf

57.World Health Organization. World Health Organization Estimates of the Global Burden of Foodborne Diseases. WHO; Geneva, Switzerland: 2015. http://apps.who.int/iris/bitstream/10665/199350/1/9789241565165_eng.pdf

58.Mendelson M, Røttingen JA, Gopinathan U, *et al*. Maximizing access to achieve appropriate human antimicrobial use in low-income and middle-income countries. Lancet 2015; 387:188–198.

59.Laxminarayan R, Matsoso P, Pant S, *et al*. Access to effective antimicrobials: a worldwide challenge. Lancet 2015; 387: 168–175.

60.Dar OA, Hasan R, Schlundt J, *et al*. Exploring the evidence base for national and regional policy interventions to combat resistance. Lancet 2015; 387: 285–295.

61.Årdal C, Outterson K, Hoffman SJ, *et al*. International cooperation to improve access to and sustain effectiveness of antimicrobials. Lancet 2015; 387: 296–307.