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Antibiotic usage and antimicrobial resistance in indonesia

Hadi, U.

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Chapter VI

Determinants of carriage of resistant *Escherichia coli* in the Indonesian population inside and outside hospital

D.Offra Duerink[1], Endang Sri Lestari[2],Usman Hadi[3], Nico J. Nagelkerke[4], Juliette A.Severin[5], Henri A.Verbrugh[5], Monique Keuter[6] ,Inge C Gyssens[5], Peterhans van den Broek[1] ,
On behalf of the study group"Antimicrobial resistance in Indonesia: Prevalence and Prevention" (AMRIN)

1 Department of Infectious Diseases, Leiden University Medical Center, Leiden, The Netherlands
[2]Department of Clinical Microbiology, Dr. Kariadi Hospital-School of Medicine, Diponegoro University, Semarang, Indonesia
[3] Department of Internal Medicine
Airlangga University School of Medicine. Dr. Soetomo Teaching Hospital Surabaya, Indonesia
[4]Department of Community Medicine, United Arab Emirates University, Al Ain, United Arab Emirates
[5]Department of Medical Microbiology and Infectious Diseases, University Medical Centre Rotterdam, The Netherlands
[6]Department of Internal Medicine, Nijmegen University Centre for Infectious Diseases International Health (NUCI-IH), Radboud University Medical Centre, Nijmegen, The Netherlands

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Synopsis

Objectives

Antibiotic resistance is a worldwide healthcare problem exacerbated by antibiotic use and transmission of resistant bacteria. Not much is known about resistance in commensal flora and about determinants for resistance in Indonesia. This study analyzed recent antibiotic use as well as demographic, socioeconomic, disease-related and healthcare-related determinants of rectal carriage of resistant *Escherichia coli* (*E. coli)* in the community and in hospitals in Indonesia.

Methods

Carriers of susceptible *E. coli* were compared with carriers of *E. coli* with resistance to any of the tested antibiotics. Logistic regression analysis was performed to determine which variables were associated with carriage of resistant *E. coli*. Individuals in the community with varying levels of contact with healthcare institutions and hospitalized patients were analyzed as separate populations.

Results and conclusion

Of 3275 individuals (community 2494, hospital 781), 54% carried resistant *E.coli*. Recent antibiotic use was the most important determinant of resistance in both populations (community: odds ratio (OR) 1.8, 95% confidence interval (95%CI) 1.5-2.3, hospital: OR 2.5, 95%CI 1.6-3.9). In the community, hospitalization (OR 2.4, 95%CI 2.0-3.0), diarrhoeal symptoms (OR 1.9, 95%CI 1.3-2.7) and age under 16 (adults: OR 0.4, 95%CI 0.3-0.5) were associated with carriage of resistant *E. coli.* For hospitalized patients, having no health insurance was associated with less resistance (OR 0.6, 95%CI 0.4-0.9) and differences were observed between hospitals (Semarang: OR 2.2, 95%CI 1.5-3.3) and departments (Paediatrics: OR 4.3, 95%CI 1.7-10.7). Further research is needed to investigate whether transmission is responsible for these differences.

Introduction

Antibiotic resistance is a worldwide healthcare problem that threatens the progress in healthcare in developing countries.[1, 2] Limited published data are available on antibiotic resistance in *Escherichia coli (E. coli)* in the Far East and these primarily concern clinical isolates.[3-14] Resistance data from Indonesia are mostly limited to pathogens of diarrhoeal disease.[10, 12, 13, 15-19] The use of antibiotics is the most important determinant for emergence of resistant microorganisms.[20, 21] Little is known about other determinants for carriage of resistant bacteria, such as demographic[22] and socioeconomic[23, 24] factors.

The study group 'Antimicrobial Resistance in Indonesia: Prevalence and Prevention' (AMRIN) investigated rectal carriage of resistant bacteria among inhabitants of the island of Java. Rectal swabs of individuals in the community and the hospital were cultured for the presence of *E. coli*, a commensal intestinal bacterium frequently used as an indicator of antibiotic resistance in populations.[25] Antibiotic susceptibility testing of the *E. coli* isolates was conducted for six antibiotics commonly used in Indonesia: ampicillin, ciprofloxacin, cefotaxime, gentamicin, chloramphenicol, and trimethoprim/sulfamethoxazole.

The aim of the present study was to investigate whether recent antibiotic use as well as demographic, socioeconomic, healthcare-related and disease-related variables are risk factors for carriage of resistant *E. coli*. We hypothesized that recent antibiotic use would be associated with carriage of resistant *E. coli,* and that due to transmission of resistant bacteria differences would be found between nursing wards, departments and hospitals.

Materials and methods

Two government hospitals, the Dr. Soetomo hospital in Surabaya, East Java, and the Dr. Kariadi hospital in Semarang, Central Java, Indonesia, as well as three primary health centres (PHC, two in Surabaya and one in Semarang) were selected for this study. The hospital in Surabaya has approximately 60,000 and that in Semarang 26,000 admissions per year. The Medical Ethics Committees of the hospitals approved of the study protocol (ethical clearance No.5/Panke.KKE/2001 (Surabaya) and 11/EC/FK/RSDK/2001 (Semarang)). Patients upon admission to hospital (group A), healthy family members accompanying them (group B), people visiting a primary health centre for consultation or vaccination (group C) and patients upon discharge after hospitalization for five days or more (group D) were enrolled after giving informed consent. The aim was to include 4000 individuals; 500 individuals per group per city, whereby each department was equally represented.

For the purpose of analysis, individuals who had not been hospitalized (groups A, B and C) were combined into a community population, while patients upon discharge from hospital (group D) formed the hospital population.

Group A patients were included within the first 24 hours of admission. Persons in group B were included on admission of group A patients at a rate of one contact per patient. Patients in group C were included on specific study days twice weekly in Surabaya and once weekly in Semarang. Individuals were excluded from the study if they had been transferred from another hospital, if they were not accompanied by a family member (group A), or if they had been admitted to a hospital during the previous three months (groups A, B and C).

Demographic and socioeconomic data and, for community patients, data on health complaints and consumption of antibiotics in the month preceding the study were collected by semi-structured interviews, performed by pairs of trained Indonesian and Dutch data collectors (researchers, residents, medical students). For group A, diagnosis on admission, and for group D, data on antibiotic consumption during hospitalization and diagnosis on discharge were collected from medical records. Subjects for whom susceptibility testing and data on antibiotic consumption were available were included in the analyses (Figure 1).

Variables

Recent antibiotic use was defined in accordance with the nomenclature and subcategory definitions of the WHO ATC Classification code, subgroup antibacterials for systemic use.[26] We analyzed any antibiotic use, i.e. whether or not a patient took any antibiotic in the preceding month or during hospitalization; use of an antibiotic from a specific ATC class, combined or not combined with an antibiotic from a different class; and single antibiotic use, i.e. use of an antibiotic from a specific ATC class not combined with an antibiotic from a different class. Combined use was defined as either simultaneous or successive use of antibiotics from different ATC classes.

Origin (Surabaya or Semarang), sex, age (newborn to sixteen years of age versus over sixteen years of age in accordance with the age limit for the Departments of Paediatrics, and children of less than two years old versus people of more than two years of age in accordance with approximate pre- and post weaning periods), ethnicity and living area (urban or rural) were the selected demographic variables. Health insurance, income (below or above poverty line[27]), education (primary school not completed versus primary school education and higher), employment and crowding (one through eight versus nine or more individuals sharing a household) were the chosen socioeconomic variables.

Group, Department (Internal Medicine, Surgery, Obstetrics & Gynaecology or Paediatrics), nursing ward (sub-department), nursing class (I, II or III, with class I being the most expensive class) and length of stay in hospital (five through eight versus nine days or more) were studied as healthcare-related variables. Only the last ward of admission was recorded; transfers were not recorded. For community patients clinical signs and symptoms in the month preceding the study (fever, diarrhoea, respiratory symptoms, other symptoms or no symptoms) were the disease-related variables and for patients upon admission and discharge whether or not an infection was diagnosed.

Selection of strains and susceptibility testing

Rectal samples were taken with sterile cotton-tipped swabs, which were transported to the laboratory in Amies transport medium (Copan, Brescia, Italy) in closed boxes at ambient temperature. They were cultured within 24 hours on CHROMagar Orientation (Becton

Dickinson, Heidelberg, Germany) for the isolation of *E. coli*.[28] From each culture, two colonies representing the dominantly growing bacterium were further analyzed. Pink colonies were assumed to be *E. coli* and used for susceptibility testing without additional determination. From the original 3995 isolates, almost 400 were confirmed by Vitek 2 (bioMérieux, Marcy-l'Etoile, France).[11] Previously published validation of identification of *E. coli* by CHROMagar yielded a positive predictive value of 0.93, which is comparable to our results.[28]

Susceptibility testing was performed by the Clinical and Laboratory Standards Institute (CLSI; formerly the NCCLS) based disk diffusion method on Mueller-Hinton agar using disks containing ampicillin (10 μg), chloramphenicol (30 μg), gentamicin (10 μg), cefotaxime (30 μg), ciprofloxacin (5 μg) and trimethoprim/sulfamethoxazole(1.25/23.75 μg).[29] The performance of the susceptibility testing was monitored twice weekly by the quality control strain *E. coli* ATCC 25922. Isolates that were susceptible or intermediately susceptible according to the CLSI criteria were categorized as susceptible. For the purpose of analysis, a maximum of one *E. coli* isolate per enrolled individual, namely the first *E. coli* isolate in the study database, was included in the analysis.

Analysis

Individuals carrying resistant strains were compared with individuals carrying bacteria susceptible to all tested antibiotics. Resistance as an outcome variable for each of the different antibiotics was explored in two different ways:

1. Resistance of *E. coli* to any of the tested antibiotics, irrespective of whether this was resistance to the specific antibiotic considered, or whether the resistance to the antibiotic of interest was part of a pattern of resistance to multiple antibiotics, was taken as the outcome (dependent) variable, and possible determinants for this variable identified.
2. Carriage of *E. coli* resistant to the specific antibiotic of interest was taken as the outcome variable, and determinants for this outcome variable identified. This approach was only pursued when at least 100 isolates with the relevant resistance pattern were available.

To identify determinants for any of these outcome variables, logistic regression analysis with backward selection of variables (statistical package SPSS, version 12.0, SPSS Inc., Chicago, Illinois, USA) was used.

In view of the large number of interrelated candidate determinants, some of which were sparse (i.e. most individuals had the same value for this variable), each of the analyses was performed using a two step procedure. First, candidate variables were selected by performing logistic regression on four partially overlapping sets of covariables (Web-only Appendix 1):

(a) any antibiotic use, combined with all demographic, socioeconomic, disease-related and healthcare-related determinants,
(b) demographic determinants,
(c) socioeconomic determinants,
(d) disease-related and healthcare-related determinants (without nursing wards).

Then, a 'final' logistic regression analysis was performed with all variables that were significantly associated with antibiotic resistance in any of these four analyses. The variables that were significantly associated with resistance in this final analysis were presumed to be independently associated (in the sense that the association was not caused by confounding) with resistance. This approach of selecting candidate variables was preferred over the usual strategy of picking variables univariately significantly associated with the outcome variable, as in our experience that strategy sometimes misses variables that are only significantly associated with the outcome variable in conjunction with other variables. Use of antibiotics from specific antibiotic classes and single use of specific antibiotic classes were analyzed as separate sets of variables. When logistic regression could not be performed because of sparse data, variables with very small dispersion were excluded from the analyses.

Possible clustering of susceptibility patterns between groups A and B was investigated by comparing whether included pairs of individuals had similar susceptibility patterns (Table 2) and calculating Pearson's correlation coefficient.

Results

Between July and October 2001 in Surabaya and January and May 2002 in Semarang, 3995 subjects were included. In 3275 individuals, culture and susceptibility data on *E. coli* and antibiotic use data were complete. In 720 patients, data were not suitable for analysis: 180 because there was no growth on the agar plate, 385 because no pink colonies were present in the culture, and 155 because of missing susceptibility data (Figure 1). No growth was observed significantly more frequently in Semarang (8%) than in Surabaya (1%, $p<0.001$). In Surabaya, no significant differences were observed between the groups, while in Semarang, the proportion with no growth varied from 5% in group B to 13% in group D ($p<0.001$). The proportion of pink colonies did not differ significantly between Surabaya and Semarang, or between the groups in Surabaya, but varied between 80% in group D and 92% in group B ($p<0.001$) in Semarang. Missing or incomplete susceptibility data occurred more frequently in Surabaya (8%) than in Semarang (1%, $p<0.001$). In Semarang, no significant differences were observed between the groups, while in Surabaya, the proportion with missing susceptibility data varied from 1% in group B to 11% in group C ($p<0.001$).

No significant differences in demographic, socioeconomic, disease-related and healthcare-related variables were observed between the community and hospital populations, with the exception of age (Table 1). Additional information regarding population characteristics can be found in web-only Appendix 2 for the community and in Appendix 3 for the hospital.

Antimicrobial resistance

Of the 3275 *E. coli* strains, 1552 (47%) were susceptible to all tested antibiotics, 585 (18%) to a single antibiotic and 1138 (35%) to two or more antibiotics (Table 2). In 69 strains (not shown in Table 2), resistance patterns were observed that occurred less than 8 times.

In the community, ampicillin resistance was observed most frequently (851 isolates, 34%), followed by trimethoprim/sulfamethoxazole resistance in 716 isolates (29%) and chloramphenicol resistance in 369 isolates (15%). Resistance to ciprofloxacin, gentamicin, and cefotaxime occurred less than 100 times. Single ampicillin resistance

was observed in 236 isolates (9%) and single trimethoprim/sulfamethoxazole resistance in 162 isolates (6%), while single chloramphenicol, gentamicin and ciprofloxacin resistance were observed less than 100 times. Single cefotaxime resistance was not present in any of the isolates.
In hospitalized patients, ampicillin resistance was also observed most frequently (570 isolates, 73%), followed by trimethoprim/sulfamethoxazole resistance in 434 isolates (56%), chloramphenicol resistance in 334 isolates (43%), ciprofloxacin resistance in 173 isolates (22%) and gentamicin resistance in 141 isolates (18%). Cefotaxime resistance was observed less than 100 times. In hospitalized patients, single resistance was observed for less than 100 subjects for all tested antibiotics and single cefotaxime resistance was not present in any of the isolates.

Antibiotic use

The results on antibiotic use are summarized in Table 3. In the community (2494 individuals), 367 antibiotic courses were prescribed in the month preceding the study, while for 781 hospitalized individuals, 1084 antibiotic courses were prescribed. Penicillins ranked first and accounted for 71% of antibiotic use in the community and 40% in hospitals. In the community tetracyclines (10%), sulphonamides (7%) and amphenicols (7%) were the other frequently used antibiotics. In the community 93% of antibiotic use concerned the use of a single antibiotic. In the 2125 individuals in the community who received no antibiotic treatment, the carriage rate of multiple resistances (resistance to more than one antibiotic) was 24%, in the 347 patients receiving one antibiotic 38% and in the 22 patients receiving more than one antibiotic 46%.
In hospitalized patients cephalosporins (22%) and quinolones (10%) ranked second and third, respectively. Single antibiotic use was observed in 33% of cases. In the 127 hospitalized patients who received no antibiotic treatment, the carriage rate of multiple resistances was 33%, in the 159 patients receiving one antibiotic 64% and in the 495 patients receiving more than one antibiotic 71%.

Determinants of resistance in the community (groups A, B and C)

Analysis of determinants for resistance in the community was performed with resistance to any of the tested antibiotics, single ampicillin resistance and single trimethoprim/sulfamethoxazole resistance, because more than 100 cases were available for these resistance groups.

Any antibiotic use was associated with carriage of *E. coli* with resistance to any of the tested antibiotics (odds ratio (OR) 1.8, 95% confidence interval (95%CI) 1.5-2.3), single ampicillin resistance (OR 1.6, 95%CI 1.1-2.3) and single trimethoprim/sulfamethoxazole resistance (OR 1.8, 95%CI 1.2-2.8). Prior use of penicillins was associated with carriage of *E. coli* resistant to any of the tested antibiotics (OR 1.8, 95%CI 1.4-2.4) and single ampicillin resistance (OR 1.8, 95%CI 1.2-2.7). Prior use of amphenicols was associated with carriage of *E. coli* resistant to any of the tested antibiotics (OR 3.1, 95%CI 1.3-7.5). Prior use of sulphonamides was associated with carriage of *E. coli* resistant to any of the tested antibiotics (OR 5.5, 95%CI 2.1-14.8) and single trimethoprim/sulfamethoxazole resistance (OR 7.5, 95%CI 2.0-28.0).

Logistic regression analysis performed with only single antibiotic use did not change the findings significantly; in most cases the same antibiotics were associated with resistance when used as a single antibiotic drug or combined with other antibiotics (data not shown).

Socioeconomic variables were not associated with carriage of resistant *E. coli* in the community. Neither were demographic variables, except for age: adults were less likely to be carriers of *E. coli* with resistance to any of the tested antibiotics (OR 0.4, 95%CI 0.3-0.5) and single ampicillin resistance (OR 0.6, 95%CI 0.4-0.9) than children. The same analysis with children of less than two years old versus people of more than two years of age yielded similar results (data not shown). Admission to hospital (group A) was associated with carriage of *E. coli* resistant to any of the tested antibiotics (OR 2.4, 95%CI 2.0-3.0) and single ampicillin resistance (OR 2.7, 95%CI 1.9-4.0, group B = reference category). Susceptibility patterns of groups A and B did not correlate, although individuals from these groups were included as pairs (Pearson's correlation coefficient = 0.014). Diarrhoea was associated with carriage of *E. coli* resistant to any of the tested antibiotics (OR 1.9, 95%CI 1.3-2.7).

Determinants of resistance in hospitalized patients (group D)

Analysis of determinants for resistance in hospitalized patients was only performed with resistance to any of the tested antibiotics, because single resistance was observed for less than 100 subjects for all tested antibiotics.

The use of any antibiotic (OR 2.5, 95%CI 1.6-3.9), penicillins (OR 3.2, 95%CI 2.2-4.8), amphenicols (OR 3.9, 95%CI 1.2-12.8), quinolones (OR 6.8, 95%CI 3.0-15.1) and metronidazole (OR 2.9, 95%CI 1.1-7.6) were associated with carriage of *E. coli* with resistance to any of the tested antibiotics.

Logistic regression analysis with only single antibiotic use changed the findings significantly for carriage of *E. coli* with resistance to any of the tested antibiotics: any (single or combined) cephalosporin use was not associated with resistance, but single cephalosporin use was associated with less carriage of *E. coli* with resistance to any of the tested antibiotics (OR 0.2, 95%CI 0.1-0.5). Single use of other antibiotics was not associated with carriage of *E. coli* with resistance to any of the tested antibiotics (data not shown).

Having no health insurance was associated with less carriage of *E. coli* with resistance to any of the tested antibiotics (OR 0.6, 95%CI 0.4-0.9). Discharge from the hospital in Semarang was associated with carriage of *E. coli* with resistance to any of the tested antibiotics (OR 2.2, 95%CI 1.5-3.3). Discharge from the Department of Paediatrics (OR 4.3, 95%CI 1.7-10.7), rather than from Internal Medicine (reference category) was associated with carriage of *E. coli* with resistance to any of the tested antibiotics.

Significant differences were observed between several individual nursing wards, but for most wards the numbers of patients were too small to draw any conclusions from these data (data not shown).

Discussion

This study shows that antibiotic use is the most important albeit not the only determinant of carriage of resistant *E. coli*. In the non-hospitalized population, age under 17 and diarrhoea were independent determinants. Individuals screened upon admission to hospital carried resistant *E. coli* more often than patients who visited a PHC and healthy relatives who accompanied patients at admission to hospital. In hospitalized patients screened upon discharge, having health insurance was associated with carriage of resistant *E. coli,*as were several healthcare-related determinants: hospitalization in Semarang and admission to the Gynaecology & Obstetrics or Paediatric Departments.

In concordance with our hypothesis we observed that, for most antibiotic classes, most resistance was present in the group most exposed to antibiotics and least resistance in the group least exposed to antibiotics. In the community, direct associations were observed between the use of specific antibiotics and resistance to those antibiotics, namely between beta-lactam antibiotics and ampicillin resistance and sulphonamide use and trimethoprim/sulfamethoxazole resistance. Here, the majority of antibiotic therapy consisted of single therapy.

For hospitalized patients two-thirds of antibiotic treatments were combined therapies. The use of penicillins, amphenicols, quinolones and metronidazole was associated with resistance to any of the tested antibiotics. Epidemiologically one can assume that it represents a greater exposure to antibiotics, since most patients took more than one antibiotic. Indeed there was a high rate of multiple resistances. In the subset of hospitalized patients treated with a single antibiotic, single use of a cephalosporin was associated with less resistance to any of the tested antibiotics. It is unlikely that cephalosporins actually protect against resistance. In a hospital population, where 84% of the patients took antibiotics during admission, single beta-lactam use might reflect a relatively healthy population with a relatively low susceptibility to infections and exposed to relatively low quantities of antibiotics (e.g. as prophylaxis).

Several other determinants, although independent from antibiotic use in the analysis, can still be explained by a relatively high exposure to antibiotics. Health insurance increased the probability of carriage of resistant *E. coli*. This is most likely, at least partly, due to the different consumption pattern of antibiotics. Individuals with health insurance

consumed antibiotics more frequently, took longer antibiotic courses and different antibiotic classes, namely cephalosporins, macrolides and quinolones, than people without health insurance.

In the community more children than adults carried resistant *E. coli*. Several factors may have contributed to carriage of resistant *E. coli* in children.Young children generally tend to receive antibiotics more frequently than adults.[30] The AMRIN study confirmed that more children than adults received antibiotics. Apart from antibiotic use, children might acquire resistant bacteria more easily than adults, because of the greater exposure through unhygienic behaviour.

With regard to clinical signs and symptoms, we observed that individuals who reported diarrhoea had a higher probability of carriage of resistant *E. coli* than individuals with other or no complaints. We must interpret these data carefully, since diarrhoea often occurs during antibiotic use and patients may have incorrectly reported diarrhoea as a symptom instead of an adverse reaction to an antibiotic.

Our results indicate that the hospital, the department and the nursing ward to which a patient is admitted are determinants of carriage of resistant *E. coli* in hospitalized patients. In hospitals, transmission of resistant bacteria contributes to the problem of antibiotic resistance, probably much more so than in the community.[31, 32] Further investigations are needed to show whether transmission of resistant strains of *E. coli* explains the differences between the two hospitals, the departments and the wards.

There are several limitations to the study. Antibiotic use in the community was self-reported. We may have missed determinants for carriage of resistant *E. coli*, because, since quantitative analysis was not feasible with the amount of variables analyzed, we dichotomized the variables for the purpose of analysis. The design of the study is not useful for making statements about mechanisms causing resistance, although it is helpful for making recommendations for further research. Finally, care must be taken in generalization of our results to the general Javanese population, as the majority of participants was in contact with healthcare institutions, in varying levels. The community population consisted of several subgroups, with group B being most representative of the general Javanese population. The hospital population was approximately representative of urban Javanese government hospitals, with a tendency towards longer than average

hospital admissions. However, the design proved useful to show that the more intensively individuals are in contact with healthcare institutions, the more prone they are to carriage of resistant *E. coli*.

In conclusion, antibiotic use was the most important determinant for carriage of resistant *E. coli* in our study. Most antibiotic classes were associated with carriage of resistant *E. coli*. An aberrant antibiotic consumption pattern of people with health insurance may explain the role of health insurance. Children, regardless of more frequent antibiotic use, were at greater risk of carriage of resistant *E. coli* than adults, perhaps because of the greater exposure to (resistant) microorganisms. Differences between and within hospitals were point to transmission of resistant bacteria within hospitals.

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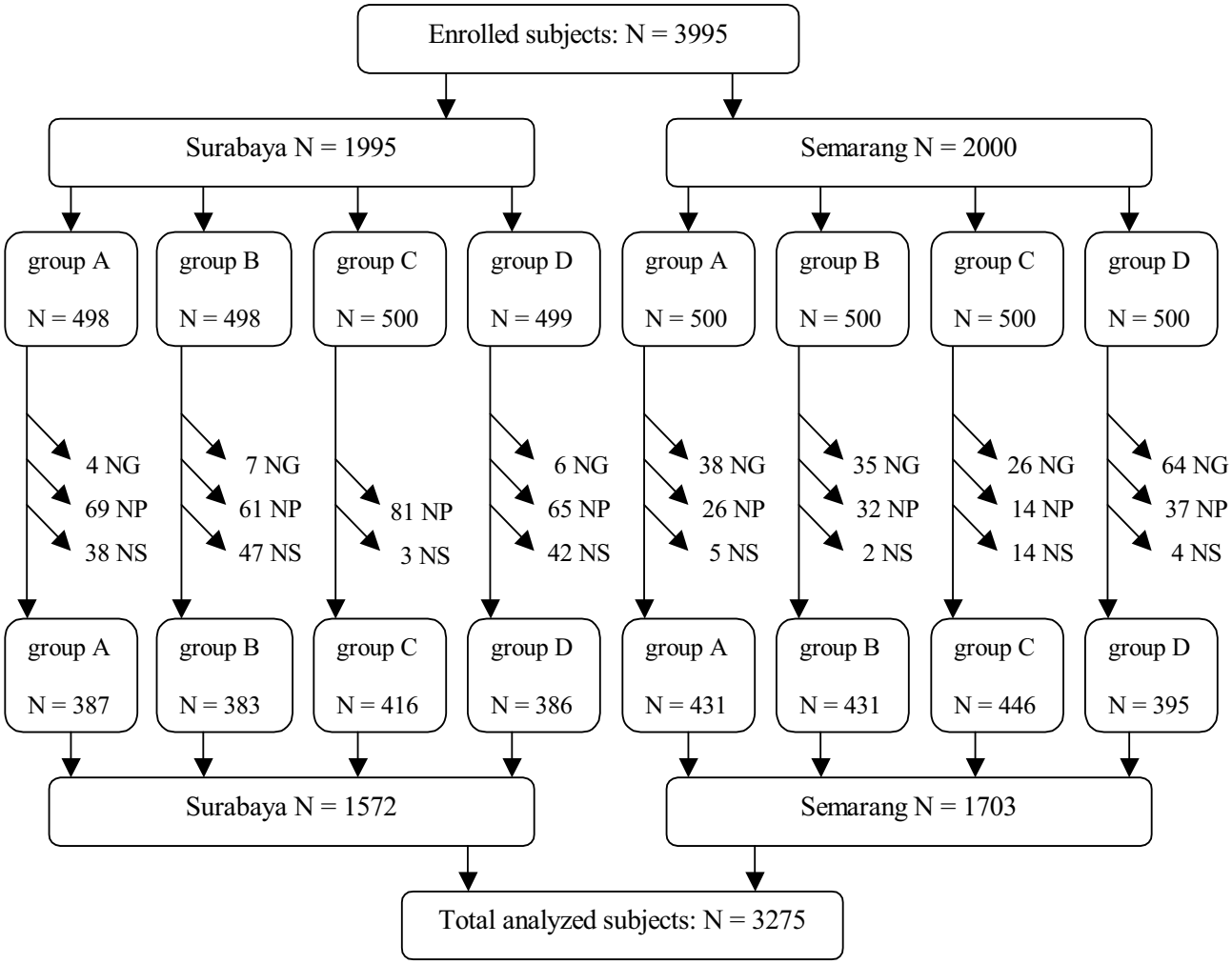
Figure 1: Flow chart with numbers of enrolled and analyzed subjects



Reasons for exclusion of enrolled subjects from analysis:

NG = no growth on agar plate

NP = no pink colonies on agar plate

NS = no complete susceptibility data

Table 1: Demographic characteristics of community and hospital populations

	community N=2494		hospital N=781		significant difference
Surabaya	1186	(48)	386	(49)	NS
group A (admission)	818	(33)	-		-
group B (relatives)	814	(33)	-		-
group C (PHC)	862	(35)	-		-
group D (discharge)	-		781	(100)	-
Internal Medicine	197*	(24)	192	(25)	NS
Surgery	203*	(25)	204	(26)	NS
Obstetrics & Gynaecology	217*	(27)	209	(27)	NS
Paediatrics	201*	(25)	176	(23)	NS
age above 16	2032	(82)	558	(71)	p<0.001
female sex	1548	(62)	460	(59)	NS
Javanese ethnicity	2377	(95)	733	(94)	NS
urban provenance	1615	(65)	497	(64)	NS
health insurance	641	(26)	219	(28)	NS
low income	1084	(57)	360	(46)	NS
Primary school completed	1971	(79)	586	(75)	NS
employment	1575	(63)	447	(83)	NS
crowding > 8 persons per household	315	(13)	73	(9)	NS
Nursing class III	679*	(83)	615	(79)	NS
length of stay >8 days	-		394	(50)	-
clinical signs of infection	1805	(72)	-		-
infection diagnosis in hospital	206*	(32)	204	(26)	NS

Absolute numbers are shown, with percentages between brackets. ‘NS’ represents no significant differences were observed between the populations. * Only calculated for group A; percentages are proportions of patients in group A.

Table 2: Resistance patterns

number of isolates (%)		ampicillin	chloramphenicol	gentamicin	cefotaxime	ciprofloxacin	trimethoprim/ sulfamethoxazole
1552	(47.4)	S	S	S	S	S	S
361	(11.0)	R	R	S	S	S	R
321	(9.8)	R	S	S	S	S	S
316	(9.6)	R	S	S	S	S	R
185	(5.6)	S	S	S	S	S	R
94	(2.9)	R	R	S	S	S	S
59	(1.8)	R	R	S	S	R	R
41	(1.3)	S	R	S	S	S	S
37	(1.1)	R	S	S	S	R	R
28	(0.9)	R	R	R	S	R	R
22	(0.7)	R	R	R	S	S	R
21	(0.6)	R	R	R	R	R	R
20	(0.6)	R	R	R	R	S	R
19	(0.6)	S	S	S	S	R	S
19	(0.6)	S	S	R	S	S	S
17	(0.5)	R	S	S	S	R	S
17	(0.5)	R	S	R	S	R	R
16	(0.5)	S	R	S	S	S	R
13	(0.4)	R	S	R	R	R	R
11	(0.3)	R	S	S	R	S	R
10	(0.3)	R	S	R	S	S	S
10	(0.3)	R	S	R	R	S	R
9	(0.3)	S	S	S	S	R	R
8	(0.2)	R	S	R	R	R	S

The number of times a given resistance pattern was found is shown in the first column, with the prevalence between brackets. Resistance is represented by an R, susceptibility by an S.

Table 3: Total and single antibiotic use in community and hospital populations

	community		hospital	
	total use (N)	single use (%)	total use (N)	single use (%)
tetracycline	37	86	5	20
penicillins	261	97	440	51
amphenicols	24	75	52	15
cephalosporins	0	0	239	30
carbapenems	0	0	3	0
sulphonamides	26	88	39	15
macrolides	10	60	26	15
aminoglycosides	2	100	92	2
quinolones	3	100	114	34
metronidazole	4	100	69	0
Others	0	0	5	0
Total	367	93	1084	33

Total use (N) is the number of antibiotic prescriptions; single use (%) is single antibiotic use as percentage of total number of prescriptions.