

Article title: Organizational culture affecting quality of care: guideline adherence in perioperative antibiotic use

Brief title: Culture and antibiotics use

Word count for the abstract: 226 words

Word count for the text: 3,459 words

Abstract

Objective: The objective of this work was to elucidate aspects of organizational culture associated with hospital performance in perioperative antibiotic prophylaxis using quantitative data in a multi-center and multi-dimensional study.

Design: Cross-sectional retrospective study using a survey data and administrative data.

Setting/ Participants: 4,856 respondents from 83 acute hospitals in Japan in the organizational culture study, and 23,172 patients for the quality indicator analysis.

Main Outcome Measure: Multilevel models of various cultural dimensions were used to analyze the association between hospital organizational culture and guideline adherence. The dependent variable was adherence or non-adherence to Japanese and CDC guidelines at the patient level and main independent variable was hospital groups categorized according to organizational culture score. Other control variables included

hospital characteristics such as ownership, bed capacity, region, and urbanization level of location.

Results: The multilevel analysis showed that hospitals with a high score in organizational culture were more likely to adhere to the Japanese and CDC guidelines when compared with lower-scoring hospitals. In particular, the hospital group with high scores in the “collaboration” and “professional growth” dimensions had three times the odds for Japanese guideline adherence in comparison with low-scoring hospitals.

Conclusions: Our study revealed that various aspects of organizational culture were associated with adherence to guidelines for perioperative antibiotic use. Hospital managers aiming to improve quality of care may benefit from improving hospital organizational culture.

Key words

Antibiotic use, Multilevel model, Quality indicators, Quality culture, Health-care associated infections

Introduction

In recent years, many hospitals in Japan have begun to use quality indicators to monitor and improve quality in health care.¹ Quality indicators can be categorized according to the Donabedian structure-process-outcome paradigm,² and many process indicators have been developed to evaluate adherence to care guidelines or recommended procedures. Of these, indicators that evaluate antibiotic use are particularly important for investigating the overall quality of care in hospitals, as they concern a shared inter-disciplinary theme among the various hospital departments.

Surgical site infections (SSIs) have been reported to account for 30% of hospital-acquired infections in the United States, resulting in additional costs of approximately 16 billion dollars due to protracted lengths of stay and increased readmission rates.³ As a result, the *Guideline for the Prevention of Surgical Site Infection, 1999* was published with the objective of systematically controlling SSIs.⁴ In addition to hand hygiene and management of infected surgical personnel, the guideline established standards of perioperative prophylactic antibiotic use for surgeries. In 2013, an updated version of the Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery was published.⁵

There is a lack of standardization in the use of perioperative antibiotics in

Japan, with frequent over-utilization in both quantity and medication duration.^{6,7} Perioperative antibiotic prophylaxes extending over 24 hours from the day of surgery have been shown to be no more effective in the prevention of SSIs when compared with antibiotic prophylaxes that conclude within 24 hours.⁸ Furthermore, the prolonged use of antibiotics can have adverse effects, including direct effects (such as increased drug costs) and indirect effects (such as side effects, drug allergies, and the cultivation of drug-resistant bacteria).⁹ The appropriate control of perioperative antibiotic prophylaxis is therefore an important health care issue from the perspectives of providers, payers, and policymakers.

It has been previously suggested that organizational culture is one of the factors influencing quality of care, health care provider appraisals, and patient satisfaction.¹⁰⁻²⁰ The often-quoted definition of organizational culture is “the invisible force behind the tangibles and observables in any organization, a social energy that moves people to act. Culture is to an organization what personality is to the individual – a hidden, yet unifying theme that provides meaning direction, and mobilization.”²¹

In a review article published in 2003, Scott et al. reported that organizational culture may affect health care performance, but that this relationship lacks conclusive evidence.¹⁰ After 2003, several studies addressed the relationship between

organizational culture and health care performance, including the relationships between team work and patient satisfaction,¹² organizational culture and organizational commitment,¹³ organizational culture and climate and attitude toward evidence-based practice,¹⁴ organizational justice and turnover intention,¹⁵ and others.¹⁶⁻¹⁹ A report documenting the organizational culture in NHS acute care hospitals and their ratings addressed hospital culture as a whole.²⁰ These previous studies suggest a relationship between organizational culture and quality of care, but the majority of these analyses utilized a qualitative approach and were conducted on a relatively small number of sample hospitals. Furthermore, the majority of the studies were conducted in the United States and Europe. Although organizational culture is likely to be heavily influenced by national or social factors, there has yet to be a study of its relationship with the quality of care in Japan. Additionally, there is a need to conduct a quantitative analysis of this relationship using a larger sample size in order to provide more conclusive evidence.

The objective of our study was to elucidate the aspects of organizational culture associated with hospital performance in perioperative antibiotic prophylaxis using quantitative data in a multi-center and multi-dimensional study.

Methods

Organizational culture

To evaluate organizational culture, we conducted a questionnaire survey to employees of 92 hospitals that had agreed to participate in the study between December 2010 and February 2011. All participant hospitals were members of the Quality Indicator/Improvement Project (QIP), an initiative designed to monitor and improve clinical performances in acute care hospitals in Japan through the analysis of administrative claims data. QIP member hospitals voluntarily provide data for analysis, and research findings are periodically reported in feedback to these hospitals.

The survey was developed and validated by Kobuse et al.²² Briefly, that study assessed construct validity, internal consistency, criterion validity, and discriminative power of the questionnaire using exploratory factor analysis, multitrait scaling analysis, Cronbach's alpha coefficient, and regression analysis of staff-perceived achievement of safety; the findings indicated excellent validity and reliability of the questionnaire. This survey was based on a theoretical framework composed of the following eight cultural dimensions: "collaboration", "information sharing", "morale", "professional growth", "common values", "resource allocation prioritization", "responsibility and authority", and "improvement orientation". The questionnaire comprised 25 items, which employed

a Likert-type rating scale divided into five levels; the results of the questionnaire were converted into a dimensional score ranging from 0 to 100 at the respondent and hospital levels. In addition, we concurrently performed a job satisfaction survey composed of seven items, and the score was similarly converted into an additional dimension of organizational culture designated “job satisfaction”. Examples of the questionnaire items are presented in Table 1. Seventy-five copies of the questionnaire were sent to each of the participant hospitals and allocated accordingly: 10 for management staff, 30 for physicians, 20 for nurses, 10 for paramedical staff, and 5 for administrative staff. The numbers of questionnaires provided to each occupation subgroup were determined to reflect the general personnel composition of Japanese hospitals while taking into account the different degrees of influence on quality improvement and guideline adherence. As physicians would generally have a stronger influence on decision making for quality improvement, we intentionally increased the number of questionnaires for physicians (taking into account the predicted lower response rates in physicians) to provide a similar number of responses in both physicians and nurses. The respondents were not given any incentives to complete the survey, and all participation was voluntary. In-hospital distribution of the questionnaires to each occupation subgroup was conducted by a hospital employee, and responses were returned by post using

pre-addressed, postage-paid envelopes that we provided.

Quality indicators for perioperative antibiotic prophylaxis

Quality indicators were calculated using Diagnosis Procedure Combination (DPC) administrative data that were collected from QIP participant hospitals. The DPC system is a hospital reimbursement system that uses diagnosis-related group-like patient classification, and all claims data are produced in a standardized format by hospitals reimbursed under this system.

The target quality indicators selected for analysis were the “average duration of perioperative antibiotic prophylaxis by surgical contamination class” and the “proportion of adherence to guidelines for perioperative antibiotic prophylaxis”.

Because of data limitations, the duration of perioperative antibiotic prophylaxis was calculated in days. The indicators were aggregated from the following 11 surgery types:

a) Chronic Subdural Hematoma, b) Artificial Hip Joint Replacement, c) Mastectomy, d) Thyroid Surgery, e) Gastrectomy, f) Laparoscopic Cholecystectomy, g) Prostate Cancer, h) Hysterectomy, i) Uterine Cancer, j) Ovarian Cystoma, and k) Ovarian Cancer. These surgeries were divided into clean surgeries (a–d) and clean-contaminated surgeries (e–k), and the indicators were calculated for both groups. These classifications were similar to

the classifications of surgeries in the perioperative antibiotic use guidelines.^{4, 22} In the proportion of adherence to guidelines for perioperative antibiotic prophylaxis, the overall rate was calculated by adding all numerators and denominators among the different surgeries for each hospital.

The study sample used for the calculation of the indicators consisted of inpatients that had been discharged from QIP participant hospitals between April 2010 and March 2011 and had undergone any of the target surgeries described above. The duration of antibiotic use was calculated in days, beginning from the day of surgery to the day that antibiotic administration was discontinued. Cases that had been administered antibiotics before the day of surgery or whose dosage duration exceeded the hospital average plus 3 days were excluded because these cases were suspected as having an infection. As any subsequent antibiotic use in infected patients would no longer be for the purpose of prophylaxis, these cases were excluded from analysis. Cases from hospitals with fewer than 10 target cases during the study period were also excluded from analysis.

In this study, the indicators were developed using both the CDC guidelines and Japanese domestic guidelines.^{4,23} The Japanese guidelines were established and published by the Japanese Association for Infectious Diseases and the Japanese Society

of Chemotherapy in 2005. In the Japanese guidelines, the recommended standard dosage durations for perioperative antibiotic prophylaxis are two days for clean surgeries and four days for clean-contaminated surgeries. In the CDC guidelines, however, the recommended standard is one day for either type of surgery. Therefore, the standards of the Japanese guidelines are easier to achieve than the CDC guidelines.

Statistical analysis

Hospitals were included in statistical analysis if data from both the organizational culture survey and at least one quality indicator were available.

First, we performed Spearman's rank correlation analysis between each dimension of organizational culture and the quality indicator of average duration of perioperative antibiotic prophylaxis in order to verify a continuous relationship between the two. Next, we constructed multilevel logistic models²⁴ to analyze the association of each dimension of organizational culture with adherence to Japanese guidelines or CDC guidelines for perioperative antibiotic prophylaxis. The multilevel models included cases from all surgery types irrespective of surgical wound contamination class. We selected the multilevel model approach because it can account for the correlations among respondents from the same hospital, thereby making it suitable for multicenter

patient-level data.²⁴

Multilevel analyses were performed for each of the nine dimensions of organizational culture as the main independent variable. Models were developed for the following dependent variables: 1) adherence to Japanese guidelines at the patient level, and 2) adherence to CDC guidelines at the patient level. The independent variables included patient-level error term at the first level and hospital characteristics at the second level. For variables related to hospital characteristics, hospital categories based on the organizational culture score were used as the main independent variable. Hospitals were divided into three groups according to the tertiles of their scores of organizational culture for each dimension. These groups were designated high, medium, and low scores. Control variables, which hospitals are generally unable to regulate, included the following hospital-level variables: ownership (municipal, public, or private), bed capacity (≥ 300 beds or < 300 beds), region (one of six geographic regions), and urbanization level of location (major city or non-major city). ; patient-level variables included age and sex.

In addition to the main multilevel model analysis described above, we developed two additional model configurations for the purpose of validation. Additional Model 1 was a univariable model and included only the main independent variable.

Additional Model 2 included hospital- and patient-level control variables in addition to the main independent variable. In theory, patient characteristics would not be expected to substantially influence perioperative antibiotic prophylaxis and the duration of medication. However, patient characteristics in reality may have influence on the duration of prophylaxis, and we therefore employed the model. All statistical analyses were conducted using SAS 9.3 (SAS Institute Inc. NC USA). Statistical significance was set at $P \leq 0.05$.

Results

Of the 93 hospitals that participated in the organizational culture survey, 83 had responses for at least one quality indicator. The organizational culture survey included 4,856 respondents from 83 hospitals, with a response rate of 78.0%. The analysis for the quality indicators included 23,172 cases admitted to the same 83 hospitals.

Hospital characteristics of the study sample are presented in Table 2. Private hospitals were the most common ownership type at 35 hospitals, followed by 29 public hospitals and 19 municipal hospitals. The hospitals were situated throughout Japan, and 62 (74.7%) were located in a non-major city area.

Table 3 shows the characteristics of the organizational culture survey

respondents and the patients analyzed in the quality indicator analysis. The most numerous respondents in the organizational culture survey were nurses (1,570 respondents, 32.5%), followed by physicians (1,521 respondents, 31.5%). The sample sizes according to surgical contamination class were 6,848 (29.6%) in clean surgeries and 16,324 (70.4%) in clean-contaminated surgeries. Laparoscopic cholecystectomy was the most frequent surgical type, and thyroid surgery was the least. The overall proportion of adherence to the Japanese guidelines was 84.9%, whereas adherence to the CDC guidelines was substantially lower at 35.4%.

Table 4 shows the description and correlations of organizational culture dimensions and duration of antibiotic prophylaxis. The mean organizational culture score of each dimension ranged from 51.2 to 76.8. In the quality indicator analysis, the overall average duration of perioperative antibiotic prophylaxis was 2.4 days in clean surgeries and 2.6 days in clean-contaminated surgeries. In the Spearman's rank correlation analysis, "collaboration", "professional growth" and "job satisfaction" showed statistically significant negative correlations with durations of antibiotic prophylaxis in both clean and clean-contaminated surgeries. Antibiotic prophylaxis in clean-contaminated surgeries had considerably more significant associations with organizational culture dimensions; all dimensions except for "responsibility and

authority” and “improvement orientation” demonstrated statistically significant associations.

In multilevel modeling analyses for adherence to the Japanese guidelines, all organizational culture dimensions excluding “job satisfaction” showed significant associations with guideline adherence. These results are presented in Table 5. The analysis showed that in all three models, hospitals with high organizational culture dimensional scores were associated with better adherence to the guidelines than hospitals with lower scores. This suggests that patients admitted to hospitals with a high score in organizational culture were more likely to be administered perioperative antibiotics appropriately than hospitals with lower scores. In particular, the hospital group with high scores in the “collaboration” and “professional growth” dimensions had three times the odds for guideline adherence in comparison with low-scoring hospitals. In contrast, the “job satisfaction” dimension did not show significant associations with organizational culture scores. There were small changes in the values of some of the coefficients between the main multilevel model and the additional models, but no notable differences were observed.

In analyses for the proportion of adherence to the CDC guidelines, all organizational culture dimensions excluding “professional growth” showed statistically

significant associations with guideline adherence. Similar to the model for adherence to the Japanese guidelines, hospitals with high organizational cultural dimensional scores showed higher proportions of adherence than low-scoring hospitals. “Common values”, “resource allocation”, and “responsibility and authority” showed higher odds ratios in comparison with the Japanese guidelines model. In addition, “job satisfaction” showed significantly higher odds for hospitals with high organizational culture dimensional scores for adherence to the CDC guidelines.

Discussion

In this study, we examined the relationships between various dimensions of hospital organizational culture and quality indicators on perioperative antibiotic prophylaxis. Our findings show that hospitals with high organizational culture scores were associated with higher adherence to both the CDC and Japanese guidelines for most organizational culture dimensions. To our knowledge, this is the first study to provide strong evidence toward the relationship between organizational culture and health care performance based on a multi-center and multi-dimensional study.

We hypothesize that the following three factors may influence the relationship between organizational culture and guideline adherence: characteristics of guidelines,

the direct relationship between organizational culture and care, and the indirect relationship between organizational culture and care.

First, adherence to guidelines regarding the use of prophylactic antibiotics may be susceptible to influence from organizational culture. A feature of these guidelines is that they concern a cross-departmental issue, and do not directly nor immediately affect the well-being of the patients. Clinicians may therefore take a shorter-term view of the issue rather than consider the ramifications of long-term antibiotic use.⁹ The culture of a working environment can help members deal with uncertainty by defining important issues,²⁵ which may be the case in prophylactic antibiotic use.

Second, organizational culture may affect prophylactic antibiotic use directly. The results of our analysis do not show a causal relationship between organizational culture and guideline adherence, but instead indicate a correlative relationship between the two. It is, however, difficult to assume that adherence to guidelines would result in better organizational culture, and the direction of causation was therefore thought to run from organization culture to improved guideline adherence. A strong culture of “collaboration” and “information sharing” can lead to surgeons being able to obtain ample information on SSIs and associated guidelines from infectious disease specialists or pharmacists. Professional groups sharing a higher common understanding of norms

have been shown to be associated with improved work-unit effectiveness than groups with less agreement about norms.²⁶ Additionally, a healthy organizational culture may encourage peer review of various medical decisions.

Third, organizational culture may also indirectly affect prophylactic antibiotic use, and it is possible that the relationship between organizational culture and quality of care contains spurious correlations. Remesh et al. state that physicians may not always use antibiotics appropriately despite having adequate information about recommended usage.²⁷ In addition to organizational culture, quality of care may also be influenced by management-related elements such as executive management, organizational design, information management and technology, and incentive structures.²⁸ A strong organizational culture may therefore be induced by strong leadership, IT systems that promote organizational culture, or other factors that encourage higher quality of care. In a previous review article, factors affecting patient health care outcomes also included structural characteristics, information technology systems and decision support, service activity and planning, and workforce design.¹¹ Our findings that various dimensions of organizational culture demonstrate a positive association with higher adherence to guidelines supports this concept.

The organizational culture dimensions that showed a stronger association with

adherence to CDC guidelines than to the Japanese guidelines were “common values”, “resource allocation”, and “responsibility and authority”. These cultural dimensions are generally institutional-level characteristics, rather than individual- or team-level, and are possibly elements that are important for organizations seeking to set the highest standards of care. In addition, “job satisfaction” showed statistically positive associations with CDC guideline adherence, although it did not show any association with adherence to the Japanese guidelines. An analysis of Japanese hospitals in 2009 reported no significant association between quality of care and physician job satisfaction, and the authors of that study suggest that this may be because Japanese physicians place a high priority on fulfilling their job responsibilities regardless of personal dissatisfaction or stress due to working conditions.²⁹ Hospitals that choose to follow the more stringent CDC guidelines (which are not required in Japan) may be providing a better overall working environment, and this may explain our observed association between job satisfaction and the CDC guidelines. These hospitals may proactively apply information and technology for improving quality of care, such as the use of highly integrated electronic medical record systems. In addition, these hospitals may also tend to employ highly motivated physicians, have clearer missions, and utilize more efficient management systems. It is possible that these factors contribute to a

higher level of job satisfaction in CDC guideline-compliant hospitals.

However, there is no established method at present to reform or improve organizational culture.³⁰ Scott et al. have reported that factors leading to successful organizational culture change include structural, process and contextual dimensions.³¹ Additionally, the NHS has successfully implemented changes to health care organizational culture through policy changes,^{20,32} indicating that policy initiatives that affect the whole industry may also be important in improving hospital organizational culture.

Our study has several limitations. First, the actual occupational composition of the sample population may vary among the hospitals, as the distribution of the questionnaires was conducted by a staff member in each hospital. This may introduce a degree of selection bias in which the results are influenced by the hospital employees in charge of distribution. Also, the proportions of the sample do not directly reflect the general personnel composition of Japanese hospitals, but instead also take into account the different degrees of influence on decision making and compliance to guidelines. Therefore, these findings may not be representative of hospitals throughout Japan. Second, because the sample population comprised QIP hospitals that have voluntarily participated in a quality improvement project, there are limitations to the external

validity of the findings. Hence, our results may be more indicative of hospitals that work proactively to improve quality of care. Third, the quality indicators used in this study were process indicators, not outcome indicators. In an analysis of SSIs, infection incidence or length of stay may be preferable as indicators, but these outcomes could not be analyzed due to limitations of the data source. However, with further improvements to the administrative data infrastructure, such analyses may be possible in future research.

In conclusion, our study identified the associations of several hospital organizational culture dimensions with adherence to perioperative antibiotic prophylaxis guidelines using a multi-center and multi-dimensional study. The findings suggest that hospital performance in guideline adherence was influenced by various aspects of organizational culture. Moreover, the study indicated that organizational-level culture dimensions were important for achieving the more stringent goals of the CDC guidelines than those of the Japanese guidelines. Hospital managers aiming to improve quality of care may benefit from making improvements to hospital organizational culture.

Acknowledgments

This study was supported in part by a Health Sciences Research Grant from the Ministry of Health, Labour and Welfare of Japan, and a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science. The sponsors had no role in design or conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript.

References

1. Ministry of Health, Labour and Welfare (Japan). Implementation guideline for promotion project of evaluating quality of care and public disclosure (in Japanese). Available at: <http://www.mhlw.go.jp/topics/2010/05/dl/tp0514-1d.pdf> (Accessed July 16, 2013).
2. Donabedian A. Evaluating the quality of medical care. *Milbank Mem Fund Q*. 1966 Jul;44(3):Suppl:166-206.
3. Lissovoy G, Fraeman K, Hutchins V, et al. Surgical site infection: incidence and impact on hospital utilization and treatment costs. *Am J Infect Control*. Jun 2009;37:387-397.
4. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control*. Apr 1999;27:97-132; quiz 133-4; discussion 96.
5. Bratzler DW, Dellinger EP, Olsen KM, et al. American Society of Health-System Pharmacists. Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery. *Am J Health-Syst Pharm*. 2013 Feb; 70: 195-283.

6. Sumiyama Y. Perioperative infections (in Japanese). Japanese Journal of Chemotherapy. 2004;2:52.
7. Sekimoto M, Imanaka Y, Evans E, Ishizaki T, Hirose M, Hayashida K, Fukui T. Practice variation in perioperative antibiotic use in Japan. Int J Qual Health Care. 2004;16(5):367-373.
8. Kreter B, Woods M. Antibiotic prophylaxis for cardiothoracic operations. Meta-analysis of thirty years of clinical trials. J Thorac Cardiovasc Surg. Sep 1992;104:590-599.
9. Avorn J, Solomon DH. Cultural and economic factors that (mis)shape antibiotic use: the nonpharmacologic basis of therapeutics. Ann Intern Med. Jul 18 2000;133:128-135.
10. Scott T, Mannion R, Marshall M, et al. Does organisational culture influence health care performance? A review of the evidence. J Health Serv Res Policy. Apr 2003;8:105-117.
11. Brand CA, Barker AL, Morello RT, et al. A review of hospital characteristics associated with improved performance. Int J Qual Health Care. Oct 2012;24:483-494.
12. Meterko M, Mohr DC, Young GJ. Teamwork culture and patient satisfaction in

- hospitals. *Med Care*. May 2004;42:492-498.
13. Mannion R, Davies HT, Marshall MN. Cultural characteristics of "high" and "low" performing hospitals. *J Health Organ Manag* 2005;19:431-439.
 14. Sikorska-Simmons E. Predictors of organizational commitment among staff in assisted living. *Gerontologist*. Apr 2005;45:196-205.
 15. Heponiemi T, Manderbacka K, Vanska J, Elovainio M. Can organizational justice help the retention of general practitioners? *Health Policy* 2013 Apr;110(1):22-28.
 16. Aarons GA, Sawitzky AC. Organizational Culture and Climate and Mental Health Provider Attitudes Toward Evidence-Based Practice. *Psychol Serv*. Feb 2006;3:61-72.
 17. Wijngaarden JD, Dirks M, Huijsman R, et al. Hospital rates of thrombolysis for acute ischemic stroke: the influence of organizational culture. *Stroke*. Oct 2009;40:3390-3392.
 18. Curry LA, Spatz E, Cherlin E, et al. What distinguishes top-performing hospitals in acute myocardial infarction mortality rates? A qualitative study. *Ann Intern Med*. Mar 15 2011;154:384-390.
 19. Carney M. Influence of organizational culture on quality healthcare delivery. *Int J Health Care Qual Assur* 2011;24:523-539.

20. Jacobs R, Mannion R, Davies HT, Harrison S, Konteh F, Walshe K. The relationship between organizational culture and performance in acute hospitals. *Soc Sci Med* 2013 Jan;76(1):115-125.
21. Cameron KS, Quinn RE. Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework. Jossey-Bass. 1999
22. Kobuse H, Morishima T, Tanaka M, et al. Visualizing variations in organizational safety culture across an inter-hospital multifaceted workforce. *J Eval Clin Pract*. June 2014;20(3):273-280.
23. Japanese Journal of Chemotherapy, The Japanese Association for Infectious Diseases. Guideline for Antibiotic Use (in Japanese). Japan: Kyowa Kikaku; 2005.
24. Merlo J, Chaix B, Yang M, Lynch J, et al. A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. *J Epidemiol Community Health*. 2005 Jun;59(6):443-9.
25. Dodek P, Cahill NE, Heyland DK. The relationship between organizational culture and implementation of clinical practice guidelines: a narrative review. *JPEN J Parenter Enteral Nutr*. Nov-Dec 2010;34:669-674.

26. Argote L. Agreement about norms and work-unit effectiveness: evidence from the field. *Basic and Applied Social Psychology* 1989;10:131-140.
27. Remesh A, Gayathri AM, Singh R, et al. The knowledge, attitude and the perception of prescribers on the rational use of antibiotics and the need for an antibiotic policy-a cross sectional survey in a tertiary care hospital. *J Clin Diagn Res.* Apr 2013;7:675-679.
28. Glickman SW, Baggett KA, Krubert CG, et al. Promoting quality: the health-care organization from a management perspective. *Int J Qual Health Care.* Dec 2007;19:341-348.
29. Utsugi-Ozaki M, Bito S, Matsumura S, et al. Physician Job Satisfaction and Quality of Care Among Hospital Employed Physicians in Japan. *J Gen Intern Med.* Mar 2009; 24(3): 387–392.
30. Parmelli E, Flodgren G, Beyer F, et al. The effectiveness of strategies to change organisational culture to improve healthcare performance: a systematic review. *Implement Sci.* Apr 3 2011;6:33-5908-6-33.
31. Scott T, Mannion R, Davies HT, et al. Implementing culture change in health care: theory and practice. *Int J Qual Health Care.* Apr 2003;15:111-118.

32. Mannion R, Harrison S, Jacobs R, et al. From cultural cohesion to rules and competition: the trajectory of senior management culture in English NHS hospitals, 2001-2008. *J R Soc Med.* Aug 2009;102:332-336.

Table 1 Cultural dimensions used in the questionnaire for organizational culture

Dimensions of organizational culture	Examples of questionnaire items
Collaboration	Staff members help one another to prevent errors.
Information sharing	Important information is immediately disseminated across all relevant departments/units.
Morale	All staff members work as one to diligently prevent errors.
Professional growth	You have developed your professional skills in your department.
Common values	You have a good understanding of the basic business vision or the operational direction of your hospital.
Resource allocation	Staff members are given enough time to provide care or services using
prioritization	reliable procedures.
Responsibility and authority	You are given the appropriate authority required to fulfill your responsibilities.
Improvement orientation	Safety measures are implemented and maintained by follow-up activities in your department.
Job satisfaction	You are satisfied with your workplace and do not intend to leave.

Table 2 Hospital characteristics		
	N	(%)
All	83	(100.0%)
Ownership		
Municipal	19	(22.9%)
Public	29	(34.9%)
Private	35	(42.2%)
Bed capacity		
<300	29	(34.9%)
≥300	54	(65.1%)
Region		
Hokkaido & Tohoku	6	(7.2%)
Kanto	15	(18.1%)
Chubu	14	(16.9%)
Kinki	24	(28.9%)
Chugoku & Shikoku	11	(13.3%)
Kyushu	13	(15.7%)
Urbanization level of location		
Non-major city	62	(74.7%)
Major city	21	(25.3%)

Table 3 Survey respondents and patient characteristics

Organizational culture survey		
		N (%)
All		4 856(100.0%)
Occupation	Management staff	534(11.0%)
	Physician	1 521(31.5%)
	Nurse	1 570(32.5%)
	Paramedical staff	762(15.8%)
	Administrative staff	447(9.2%)
	Not answered	22(0.5%)
Years of experience at current workplace	<3	1 309(27.0%)
	≥3 and <10	1 218(25.1%)
	≥10	2 322(47.8%)
	Not answered	7(0.1%)
Quality indicator analysis		
All		23 172(100.0%)
Sex	Male	6 021(26.0%)
	Female	17 151(74.0%)
Age in years, mean(SD)		58.4(17.6)-
Surgical type	Chronic Subdural Hematoma	648(2.8%)
	Artificial Hip Joint	2 437(10.5%)
	Mastectomy	3 264(14.1%)
	Thyroid Surgery	499(2.2%)
	Gastrectomy	3 159(13.6%)
	Laparoscopic Cholecystectomy	4 140(17.9%)
	Prostate Cancer	713(3.1%)
	Hysterectomy	3 129(13.5%)
	Uterine Cancer	2 484(10.7%)
	Ovarian Cystoma	2 188(9.4%)
	Ovarian Cancer	511(2.2%)
Japanese guidelines	Adherence	19 677(84.9%)
	Non-adherence	3 495(15.1%)
CDC guidelines	Adherence	8 213(35.4%)
	Non-adherence	14 959(64.6%)

Table 4 Description and correlations of organizational culture dimensions and duration of perioperative antibiotic prophylaxis

	Spearman's rank correlation coefficients												
	Mean	25th Percentile	50th Percentile (Median)	75th Percentile	Collaboration	Information sharing	Morale	Professional growth	Common values	Resource allocation prioritization	Responsibility and authority	Improvement orientation	Job satisfaction
Organizational culture													
Collaboration	74.4	72.0	74.5	76.9	1								
Information sharing	73.2	70.2	72.7	76.4	.757**	1							
Morale	76.8	74.4	77.0	79.8	.790**	.833**	1						
Professional growth	71.6	68.7	72.0	75.1	.716**	.567**	.576**	1					
Common values	66.7	64.0	66.3	69.6	.676**	.622**	.681**	.624**	1				
Resource allocation prioritization	51.2	47.9	51.5	54.7	.476**	.492**	.485**	.486**	.487**	1			
Responsibility and authority	65.9	63.0	65.8	68.6	.741**	.652**	.743**	.628**	.735**	.525**	1		
Improvement orientation	67.0	63.8	66.4	70.2	.715**	.796**	.837**	.643**	.764**	.515**	.744**	1	
Job satisfaction	58.5	56.5	58.5	60.4	.478**	.430**	.527**	.425**	.489**	.687**	.637**	.533**	1
Average duration of perioperative antibiotic prophylaxis (days)													
Clean surgery	2.4	1.9	2.2	2.8	-.253*	-.164	-.168	-.325**	-.216	-.149	-.172	-.207	-.228*
Clean-contaminated surgery	2.6	2.0	2.5	3.1	-.352**	-.291**	-.315**	-.279*	-.234*	-.234*	-.207	-.206	-.112

** $P < 0.01$, * $P < 0.05$

Table 5 Multilevel analysis results[†]: odds ratios for adherence to guidelines according to organizational culture scores

Adherence to Japanese Guideline										
Organizational culture dimension	Hospital groups by dimensional score	Exp(B)								
		Model of collaboration	Model of information sharing	Model of morale	Model of professional growth	Model of common values	Model of resource allocation prioritization	Model of responsibility and authority	Model of improvement orientation	Model of job satisfaction
Collaboration	Top	3.603***								
	Middle	1.683*								
	Bottom	<i>Ref</i>								
Information sharing	Top		2.440**							
	Middle		1.802*							
	Bottom		<i>Ref</i>							
Morale	Top			2.674***						
	Middle			1.796*						
	Bottom			<i>Ref</i>						
Professional growth	Top				3.025***					
	Middle				0.934					
	Bottom				<i>Ref</i>					
Common values	Top					2.398**				
	Middle					0.966				
	Bottom					<i>Ref</i>				
Resource allocation prioritization	Top						2.358**			
	Middle						1.055			
	Bottom						<i>Ref</i>			
Responsibility and authority	Top							2.429**		
	Middle							1.414		
	Bottom							<i>Ref</i>		
Improvement orientation.	Top								2.477**	
	Middle								1.906*	
	Bottom								<i>Ref</i>	
Job satisfaction	Top									1.293
	Middle									1.094
	Bottom									<i>Ref</i>

Adherence to CDC Guideline (continued)										
Organizational culture dimension	Hospital groups by dimensional score	Exp(B)								
		Model of collaboration	Model of information sharing	Model of morale	Model of professional growth	Model of common values	Model of resource allocation prioritization	Model of responsibility and authority	Model of improvement orientation	Model of job satisfaction
Collaboration	Top	2.859***								
	Middle	1.750								
	Bottom	<i>Ref</i>								
Information sharing	Top		2.392*							
	Middle		1.938*							
	Bottom		<i>Ref</i>							
Morale	Top			2.458**						
	Middle			1.234						
	Bottom			<i>Ref</i>						
Professional growth	Top				1.980					
	Middle				0.969					
	Bottom				<i>Ref</i>					
Common values	Top					3.327***				
	Middle					1.155				
	Bottom					<i>Ref</i>				
Resource allocation prioritization	Top						2.770**			
	Middle						1.376			
	Bottom						<i>Ref</i>			
Responsibility and authority	Top							3.024**		
	Middle							1.101		
	Bottom							<i>Ref</i>		
Improvement orientation.	Top								2.404*	
	Middle								1.665	
	Bottom								<i>Ref</i>	
Job satisfaction	Top									2.415**
	Middle									1.599
	Bottom									<i>Ref</i>

†: Adjusted for hospital variables (owner, capacity, region, and urbanization level of location)

Ref: Reference category

*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$