Feasibility of an antibiotic order form. First experience in the department of internal medicine of a university hospital

• Willem L. Blok, Inge C. Gyssens, Yechiel A. Hekster, Peter P. Koopmans and Jos W.M. van der Meer

Introduction

Inadequate control of antimicrobial drug use may lead to excessive expenditure for antimicrobial drugs and improper prescribing. It may also result in the emergence of multiresistant bacteria that threaten both the patient receiving the antimicrobial drug and other patients in the hospital [1 2]. Education and guidelines or restrictions on the availability of antimicrobial drugs may improve the quality of prescribing [3].

Durbin et al. were the first to introduce an antibiotic order form. The order form was designed to encourage the physician to review basic clinical and laboratory information and to categorize antimicrobial drug use as prophylactic, empirical (culture results not available), and therapeutic [4]. Use of the order form was mandatory, i.e. antibiotics were delivered to the patient only if the form was completed. Furthermore, antibiotics were automatically discontinued by the pharmacy after a predetermined number of days depending on the indication. Over the past ten years, further experience with the form was reported from several US hospitals [5-12]. An antibiotic order form may improve the quality of prescriptions by increasing the awareness of the physician of the desired antimicrobial spectrum, i.e. which microorganism is suspected in a given patient, the desired duration of treatment, the potential need to adjust dosage, and potential allergy of the patient to the drug [7 9 13 14]. By filling in the antibiotic order form, the prescribers provide themselves the data for drug utilization surveillance. In return, the antibiotic order form facilitates prescribing by providing information on the formulary drugs and preferred dosing regimens at the time of prescription. However, the introduction of uniform prescription guidelines and yet another form to fill in may be met with opposition from prescribers. Therefore, we investigated physician's acceptance of and compliance with an antibiotic order form. In addition, an attempt is made to evaluate the quality of antimicrobial drug prescriptions with the help of the antibiotic order forms.

Methods

Setting

The order form was introduced in the departments of general internal medicine, gastroenterology, nephrology, and endocrinology of the 948-bed University Hospital Nijmegen, in the course of an intensified education program on the use of antimicrobial drugs. Total number of beds in these wards was 100. Most of the prescriptions were written by nine residents, who were supervised by six internists. Data are presented in the first seven months following the introduction of the antibiotic order form in September 1992.

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Abstract
Inadequate control of antimicrobial drug use may lead to excessive expenditure for antimicrobial drugs and improper prescribing. It may also result in the emergence of multiresistant bacteria. An antibiotic order form may improve the quality of prescriptions by increasing the awareness of the physician of the antimicrobial spectrum needed (i.e. which microorganism is expected in a given patient), the desired duration of treatment, the potential need to adjust dosage, and the potential allergy of the patient to the drug. Furthermore, such an antibiotic order form facilitates prospective evaluation of both the quantity and the quality of prescribing practice. However, the introduction of yet another form to fill in may be met with opposition from prescribers. We have developed an easy-to-use antibiotic order form that incorporated the conventional medication order that was already in use in our hospital. Compliance (percentage of antimicrobial drug prescriptions for which an order form was used) was on average 58% in the first two weeks after introduction, and remained thereafter between 60% and 90%, varying between the different wards. Data retrieved from the antibiotic order forms could be used for surveillance. We conclude that this antibiotic order form was feasible in a large department of internal medicine of a university hospital. Future usefulness will depend on compliance and on personnel support for data processing and intervention.

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Drug supply and antibiotic order form

In the University Hospital Nijmegen, the pharmacy delivered formulary drugs for inpatients to the wards on a twice-weekly basis. Computerized drug consumption data were available per ward level, but not for individual patients. Formulary drugs were kept in ward stocks, that were managed by nurses. Non formulary drugs had to be ordered on individual prescriptions and were directly controlled by the pharmacy. Formulary drugs for individual patients were prescribed on medication orders consisting of a strip of paper and duplicate sticker that was pasted on the patient's Kardex® medication card. The strips were kept in the patient's nursing record, and the stickered Kardex® cards were sent to the pharmacy after discharge of the patient. So far, Kardex® cards were the only resource for antimicrobial drug surveillance individual patient level. In this drug delivery system, a conventional antibiotic order form could not be used, because the nurses, not the pharmacy technicians, were dispensing the majority of the drugs out of a stock. Therefore, an adapted antibiotic order form was developed (Figure 1). Although it was not only introduced for antibacterial drugs, but also for antiviral and antifungal drugs, we preferred to keep its original name 'antibiotic order form'. The lower part of the antibiotic order form was similar to the original medication order strip. After filling in the order on the sheet, the duplicate sticker could be pasted on the Kardex® card. The text on the order form stickers was printed in blue instead of black ink, and therefore the sticker could easily be identified when checking the cards. The order forms were gathered by the ward clerk and processed for surveillance by an investigator (WB). Prescribers were asked to categorize all their prescriptions of antimicrobial drugs as prophylaxis, empirical therapy, or directed therapy. For empirical prescriptions, they were asked to state the suspected causative microorganism; for directed therapy, they were asked for the isolated pathogen. Empirical therapy had to be streamlined to directed therapy after 72 hours, and documented by another form.

Further items to be filled in included patient data, date of prescription, site of infection, weight, serum creatinine, and a history of allergy. A limited number of formulary antimicrobial drugs and dosage regimens were printed on the form and could be ticked off. The prescriber was asked to state his/her reasons to deviate from the preprinted antimicrobial drugs and/or dosing regimens. The use of the form was voluntary, i.e. delivery of the antimicrobial drugs to the patients was not dependent on completion of the form.

Compliance

Compliance (percentage of prescriptions for which an order form was used) was measured by checking the Kardex® cards as described above. Pharmacy technicians identified the patients to whom antimicrobial drugs were prescribed on their twice weekly visits to the wards. They scored the total number of antimicrobial drug prescriptions and these figures were compared with the antibiotic order forms received. When order forms were missing, no further action was undertaken. Newsletters provided the physicians with feedback of their actual compliance.

Quantity of use

The number of prescriptions is an incomplete estimate of the quantity of antimicrobial drug use, as duration of treatment may vary. Therefore, an estimate of the prevalence of antimicrobial drug use was made. Twice a week, pharmacy technicians scored the number of patients that actually received antimicrobial therapy. The score of one month was related to the number of bed-days of that month. Thus, the estimate of the prevalence presented is the twice-weekly-scored number of patients receiving an antimicrobial drug/100 bed days over a month. Prescriptions on the forms were quantified according to the patient's age. The distribution of the types of antimicrobial drugs prescribed on the forms was calculated.

Quality of use

Data extracted from the antibiotic order forms were used to quantify the sites of infection, the microorganisms suspected or isolated, and the reasons to deviate from the antimicrobial drugs or the dosages indicated on the form. Prescriptions that were categorized as empirical therapy were evaluated separately for adequacy of microbiological spectrum, i.e. if the isolated pathogen was susceptible to the drug. No attempt was made to evaluate microbiological efficacy, i.e. the actual cure rate of infections.

Results

Compliance

Acceptance of the antibiotic order form by physicians was high. Compliance rose from 58% in the first two weeks after introduction to 76% from week five to eleven. Thereafter, compliance remained between 60% and 90%, varying between the different wards. However, many forms were not filled in completely. Localization of infection was indicated on 84% forms, and on 73% of those forms, a suspected or isolated pathogen was indicated .

Quantity of use

Six hundred and fifty-eight forms with new therapeutic antibiotic prescriptions were collected over seven months. The number of patients on antimicrobial drugs/100 bed days as scored by the pharmacy technicians was 9.0, 9.8, 8.6, 9.8, 8.8, 10.6 and 12.8. The frequency distribution of the types of antimicrobial drugs prescribed is given in Figure 2. Penicillins were the most frequently prescribed drugs (41%), followed by cephalosporins (14%) and cotrimoxazole (11%).

Quality of use

In 108 (16%) out of 658 forms the localization was left blank and they were excluded from the analysis. Localization of the infection and the mentioning of a (suspected) pathogen are analyzed in the remaining 550 forms (Table 1). Of the 403 forms that showed both localization of the infection and the (suspected) pathogen, 51% were categorized as empirical therapy and 49% as directed therapy. Fifty-three percent of all 550 prescriptions were made for the treatment of respiratory tract infections and urinary tract infections. Table 1 shows, as an example, 97 suspected pathogens and 37 isolated pathogens cited on 103 forms to treat respiratory tract infections.

sticker met patiëntgegevens

Academisch Ziekenhuis Nijmegen

St Radboud

Antibiotica formulier *mei 1992*

na invullen retour apotheek

datum: _____

arts: _____ afd: _____

Vul in van A tot E welk antibioticum u nu wilt voorschrijven:

A ☐ nieuw voorschrift ☐ verlenging ☐ verandering van dosis of route: ga naar D

B INDICATIE

DUUR (planning)

☐ PROFYLAXE ☐ chirurgische ingreep: _____ ☐ < 24 u

☐ andere: _____ _____ dgn

☐ empirische THERAPIE, vermoedelijke verwekker: _____ ☐ 3-5 d

☐ gerichte THERAPIE, aangetoonde verwekker: _____ _____ dgn

LOKALISATIE

☐ bloed ☐ urinewegen ☐ luchtwegen ☐ centraal zenuwstelsel

☐ maagdarmkanaal ☐ huid/weke delen ☐ bot/gewrichten ☐ andere: _____

C gewicht: _____ serumcreatinine: _____ allergie: ☐ nee ☐ ja, voor: _____

D

MIDDEL	aanbevolen bij normale nierfunctie **route dosis**	**frequentie**	**route dosis**	**frequentie**
feneticilline	PO ☐ 500mg ☐ 1g	☐ 4dd	penicilline G ☐ 4 MIE	
penicilline G			IV ☐ 0,5 MIE ☐ 1 MIE ☐ 2 MIE	☐ 4dd ☐ 6dd
amoxicilline	PO ☐ 500mg ☐ 1g	☐ 3dd	IV ☐ 1g ☐ 2g	☐ 4dd ☐ 6dd
amoxi/clav	PO ☐ 625mg ☐ 1,2g	☐ 3dd	IV ☐ 1,2g	☐ 4dd
flucloxacilline	PO ☐ 500mg ☐ 1g	☐ 4dd	IV ☐ 1g ☐ 2g	☐ 4dd ☐ 6dd
piperacilline			IV ☐ 2g ☐ 4g	☐ 3dd ☐ 4dd
cefazoline			IV ☐ 1g	☐ 3dd
cefuroxim			IV ☐ 750mg ☐ 1,5g	☐ 3dd
ceftazidim			IV ☐ 1g ☐ 2g	☐ 3dd
gentamicine			IV ☐ ____ mg	☐ 2dd
ciprofloxacine	PO ☐ 500mg ☐ 750mg	☐ 2dd	IV ☐ 200mg ☐	☐ 2dd
clindamycine	PO ☐ 150mg ☐ 300mg	☐ 4dd	IV ☐ 300mg ☐ 600mg	☐ 4dd
colistine	PO ☐ 100mg	☐ 4dd		
doxycycline *	PO ☐ 100mg	☐ 1dd	IV ☐ 100mg	☐ 1dd
erytromycine	PO ☐ 500mg ☐ 1g ☐ 250mg	☐ 4dd	IV ☐ 500mg ☐ 1g	☐ 4dd
metronidazol	PO ☐ 500mg	☐ 3dd	IV ☐ 500mg	☐ 3dd
nitrofurantoïne	PO ☐ 50mg	☐ 4dd		
trimethoprim	PO ☐ 300mg	☐ 1dd		
trimeth/sulfa	PO ☐ 960mg ☐ ____ mg ☐ 3dd	☐ 2dd	IV ☐ 960mg ☐ ____ mg	☐ 3dd ☐ 2dd
vancomycine	PO ☐ 125mg	☐ 4dd	IV ☐ 500mg	☐ 4dd
aciclovir	PO ☐ 200mg ☐ 800mg	☐ 5dd	IV ☐ 250mg ☐ 500mg ☐ 750mg	☐ 3dd
ganciclovir			IV ☐ ____ mg	☐ 2dd
amfotericine B	PO ☐ 10mg ☐ 100mg	☐ 4dd	IV ☐ ____ mg * *	☐ 1dd
flucytosine	PO ☐ ____ mg	☐ 4dd	IV ☐ ____ mg	☐ 4dd
ketoconazol	PO ☐ 200mg	☐ 1dd		
fluconazol *	PO ☐ 100mg ☐ ____ mg ☐ 3dd	☐ 1dd	IV ☐ 200mg ☐ ____ mg	☐ 1dd
miconazol gel	PO ☐ 5ml	☐ 4dd		

** met oplaaddosis* ** * proefdosis, oplaadschema*

E **ANDER MIDDEL** reden voor andere keuze: _____

begindat.	geneesmiddel en sterkte	or.	im.	rect.	iv.	dosis	tijd
stopdat.							
	____ x per dag _____						
kamer	naam / par.arts						

begindat.	geneesmiddel en sterkte	or.	im.	rect.	iv.	dosis	tijd
stopdat.							
	____ x per dag _____						
kamer	naam / par.arts						

Fill in from A to E which antibiotic you want to prescribe: dr: _____ ward: _____

A new prescription extension change in dose or route: go to D

B INDICATION DURATION

PROPHYLAXIS type of operation _____ <24 h

other: _____ days

empirical THERAPY, suspected microorganism: _____ 3-5 days

directed THERAPY, isolated microorganism _____ days

LOCALIZATION

blood urinary tract respiratory tract central nervous system

GI tract skin/soft tissue bone/joint other

C weight _____ serum creatinine ____ allergy; none yes, _____

D DRUG in case of normal renal function

* after a loading dose ** after a test dose, loading schedule

E OTHER DRUG reason for other choice _____

Figure 1

Antibiotic order form with conventional medication order strip

Table 1 *Localization of infections and categorization of 550 new antibiotic order forms*

Site of infection	*Forms* n (%)	*Suspected*[a] *pathogen* n (%)	*Isolated*[b] *pathogen* n (%)	*No pathogen mentioned* n (%)
Respiratory tract	158 (29)	70 (35)	33 (16)	55 (37)
Urinary tract	133 (24)	38 (19)	69 (35)	26 (18)
Blood	85 (15)	23 (11)	43 (22)	19 (13)
Skin / soft tissue	57 (10)	29 (24)	22 (11)	6 (4)
Abdominal	63 (12)	22 (11)	18 (9)	23 (16)
Bone and joint	7 (1)	5 (3)	0 (0)	2 (1)
Central nervous system	6 (1)	1 (0)	5 (3)	0 (0)
Other site	41 (8)	15 (7)	10 (5)	16 (11)
Total	550 (100)	203 (100)	200(100)	147 (100)

[a] Categorized as empirical therapy, [b] Categorized as directed therapy

The prescribers deviated from the proposed antimicrobial drugs in 6% only. Overall, alternative drugs and/or alternative dosing regimens were prescribed in 22%. In the department of nephrology, dosing adaptations amounted to 38%, mostly due to renal function impairment.

A subgroup of 68 consecutive empirical prescriptions was analyzed in detail. Isolated microorganisms were susceptible to the empirically chosen drug in 23/31 (74%). The probability that the isolated pathogen was susceptible to the empirically started drug was higher when the prescribing physican cited a suspected pathogen on the form: Odds ratio 3.1 (95% confidence interval: 0.6-16.6). However, according to Fisher's exact test, the difference was not significant (P=0.23).

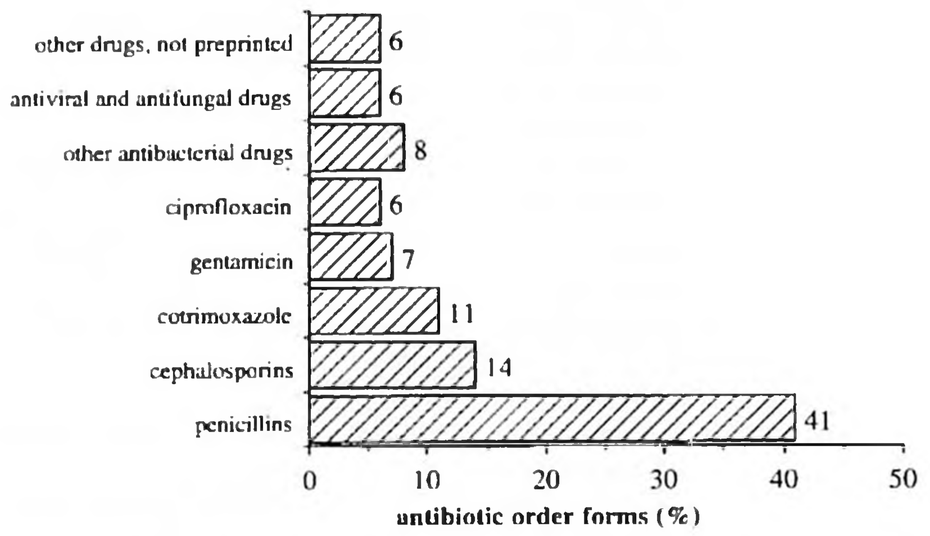

Figure 2
Frequency distribution of antimicrobial drug types prescribed on 658 new order forms.

Table 2 *Pathogens (n=134) as mentioned on 103 antibiotic order forms for respiratory tract infections*

Pathogen	*Suspected* n (%)	*Isolated* n (%)
Pneumococci	24 (25)	6 (16)
Hemophilus influenzae	22 (23)	5 (14)
Gram-negative bacteria	13 (13)	3 (8)
Gram-positive bacteria	7 (7)	2 (5)
Anaerobic bacteria	5 (5)	-
Legionella	4 (4)	1 (3)
Klebsiella	3 (3)	-
Proteus	-	1 (3)
Meningococci	-	1 (3)
Aspergillus	3 (3)	-
Streptococci	4 (4)	1[a] (3)
Staphylococci	3 (3)	5† (14)
Pneumocystis carinii	2 (2)	5 (14)
Moraxella catharrhalis	2 (2)	2 (5)
Mycobacterium tuberculosis	-	2 (5)
Miscellaneous	5†† (5)	3# (8)
Total	97 (100)	37(100)

[a] Group A, † *Staphylococcus aureus* 3x, †† *Chlamydia psittaci* 2x, *Mycoplasma pneumoniae* 2x, Herpes simplex, # Citrobacter, *E. coli*, Herpes simplex

Discussion

Over the first half year after the introduction of the order form, surveillance of limited parameters of antimicrobial drug use could be done. According to the opinion of many prescribing physicians, incorporation of the conventional medication order in the antibiotic order form facilitated its use. As delivery of antimicrobial drug therapy to the patient was not dependent upon the completion of the antibiotic order form, compliance was limited. Higher compliance rates may be achieved when the use of the form is mandatory [15]. Nevertheless, with an overall compliance of 76%, we consider the data extracted from the forms as representative for the half year studied.

The scores of the pharmacy technicians, used as an estimate of the prevalence of antimicrobial drug use, allowed for monthly comparisons. There was no decrease in consumption over the first seven months. Comparison with consumption data before the introduction of the form is more difficult. In a one-month review performed two years earlier in the same department, antimicrobial drug consumption was accurately quantified with the data on the Kardex® medication cards. The incidence rate was 4.2 thera-

peutic courses/100 bed days (unpublished data). The decrease in consumption following the use of the form described in US hospitals, was probably achieved by the automatic stop of drug delivery by the pharmacy after 72 hours for empirical therapy or after the planned duration of directed therapy had expired [7]. In our setting, the planned duration filled in on the forms had no consequences for the actual delivery of the drugs to the patient.

This relatively high compliance with the form on voluntary basis may have served the purpose of enhancing quality of prescription. The prescribers used almost exclusively the proposed drugs on the form (94%). Moreover, half of the other prescriptions were for tuberculostatic drugs, that had been omitted from the form. In addition, the order form reminded the prescriber to think of a suspected microorganism. It is thought that there is a relationship between the quality of prescribing antimicrobial drugs and the knowledge of a (suspected) pathogen [16]. The degree of appropriateness of empirical therapy of 74% compared favorably with the figures of the previous case review before the implementation of the order form. At that time, 67% of the isolated pathogens were susceptible to the drug chosen. A suspected microorganism was spontaneously mentioned in the medical record in 20 % of empirical courses (unpublished observations). Again, data before and after the introduction of the form are not entirely comparable, as, without a form, prescribers were not asked for the (suspected) pathogen. Analyzing the prescribing practices after the introduction of the antibiotic order form by the in-depth method used in the review before the introduction, may provide a better evaluation of the effectiveness of the form.

We conclude that surveillance of antimicrobial drug use by an order form was feasible in this large department of internal medicine. Future usefulness of the form will depend on the level of compliance and the availability of personnel and support for data processing and intervention.

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References

1. Mouton RP, Glerum JH, Van Loenen AC. Relationship between antibiotic consumption and frequence of antibiotic resistance of four pathogens – a seven year study. J Antimicrob Chemother 1976;2:9-19.
2. Goossens H, Van Laethem Y, Levy J, et al. Predicting gentamicin resistance from annual usage in hospital. Lancet 1986;ii:804-805.
3. Quintiliani R. Strategies for the cost-effective use of antibiotics. In: Gorbach SL, Bartlett JG, Blacklow NR (eds.) Infectious Diseases. Philadelphia: W.B. Saunders Company, 1992: 348-352.
4. Durbin WAJ, Lapidas B, Goldmann DA. Improved antibiotic usage following introduction of a novel prescription system. JAMA 1981;246:1796-1800.
5. Kowalsky SF, Echols RM, Peck F Jr. Preprinted order sheet to enhance antibiotic prescribing and surveillance. Am J Hosp Pharm 1982;39:1528-1529.
6. Schaffner W, Ray WA, Federspiel CF, Miller WO. Improving antibiotic prescribing in office practice: a controlled trial of three educational methods. JAMA 1983;250:1728-1732.
7. Echols RM, Kowalsky SF. The use of an antibiotic order form for antibiotic utilization review: influence on physicians' prescribing patterns. J Inf Dis 1984;150(dec):803-807.
8. Scarafile PD, Campbell BD, Kilroy JE, Methewson HO. Computer-assisted concurrent antibiotic review in a community hospital. Am J Hosp Pharm 1985;42:313-315.
9. Avorn J, Soumerai SB, Taylor W, Wessels MR, Janousek J, Weiner M. Reduction of incorrect antibiotic dosing through a structured educational order form. Arch Intern Med 1988;148:1720-1724.
10. Russell WA. Implementation of an antibiotic order form. Fl J Hosp Pharm 1988;8:337-349.
11. Todd MW, Keith TD, Foster MT Jr. Development and implementation of acomprehensive criteria-based drug-use review program. Am J Hosp Pharm 1987;44:529-535.
12. Lipsy RJ, Smith GH, Maloney ME. Design, implementation, and use of a new antimicrobial order form: a descriptive report. Ann Pharmacother 1993;27:856-861.
13. Hess DA, Mahoney CD, Johnson PN, Corrao WM, Fisher AE. Integration of clinical and administrative strategies to reduce expenditures for antimicrobial agents. Am J Hosp Pharm 1990;47:585-591.
14. Coleman RW, Rodondi LC, Kaubisch S, Granzella NB, O'Hanley PD. Cost-effectiveness of prospective and continuous parenteral antibiotic control: experience at the Palo Alto Veterans Affairs Medical Center from 1987 to 1989. Am J Med 1991;90:439-444.
15. Jeffrey LP, Mahoney CD. A comprehensive system for antimicrobial monitoring and review using a mandatory antimicrobial ordering sheet. Hosp Pharm 1987;22:877-883.
16. Moss F, McNicol MW, McSwiggan DA, Miller DL. Survey of antibiotic prescribing in a district general hospital. I. Pattern of use. Lancet 1981;ii:349-352.