Practice Variation in the Treatment of Rheumatoid Arthritis Among German Rheumatologists

ANGELA ZINK, JOACHIM LISTING, SABINE ZIEMER, HENNING ZEIDLER and the German Collaborative Arthritis Centres

ABSTRACT. ***Objective.*** To describe practice variation in the treatment of rheumatoid arthritis (RA) among German rheumatologists with regard to drug and non-drug therapy.

Methods. We used data of 7,326 patients with RA registered in a national German rheumatological database in 1998. In the database, every patient with an inflammatory rheumatic disease seen at one of the German Collaborative Arthritis Centres is registered once a year with a standard clinical data form and a patient questionnaire. We compared health care provided by 29 rheumatological outpatient units. For drug and non-drug treatment unit prescription rates, ranges and outliers were calculated. Logistic regression analysis was used for case mix adjustment and for the identification of practice patterns.

Results. We observed variation concerning the frequency of use of single disease modifying antirheumatic drugs (DMARD). The median of the prescription rates in the 29 units for methotrexate (MTX) was 55% in 1998 (1st quartile: 51%, 3rd quartile: 63%); sulfasalazine had a median of 15% (quartiles: 10%/19%), antimalarials a median of 8% (quartiles: 5%/21%). Combination DMARD therapy was used in 11% (quartiles: 6%/18%). Prescriptions of low dose steroids (≤ 7.5 mg) had a median of 45% (quartiles: 35%/55%), and nonsteroidal antiinflammatory drugs (NSAID) had a median prescription rate of 58% (quartiles: 50%/70%). High variation was also found concerning active physiotherapy (median: 41%; quartiles 34%/55%) and passive physical measures (median 14%, quartiles 9%/37%). Differences in case mix (age, sex, rheumatoid factor, disease duration, severity, disability) only explained a small proportion of the total variation. When the units were grouped according to the frequency of prescription of DMARD combination therapy, treatment patterns could be identified. Units with higher rates of DMARD combination therapy used more drugs for the prevention and treatment of osteoporosis, more active physiotherapy but fewer NSAID and fewer passive physical therapies.

Conclusion. Variation in drug and non-drug treatment indicates significant differences in health care provision. Trends in the drug management of RA are adopted differentially by the members of the rheumatology community. The large variability in non-drug therapies may, apart from differences in availability, suggest a lack of agreement on therapeutic effectiveness. (J Rheumatol 2001;28:2201–8)

Key Indexing Terms:
RHEUMATOID ARTHRITIS   PRACTICE VARIATION
DATA BASE   DMARD   NON-DRUG THERAPY

For more than 2 decades the problem of variation in health care between regions, individual physicians, or groups of patients has been discussed in various medical specialties. Regional variation that could not sufficiently be explained by patient case mix was found in the management and mortality of different medical conditions[1-7]. Evidence was obtained that the differences observed on the process level were associated with different outcomes of care[8,9].

A large body of knowledge on adequate care of patients with rheumatic diseases has been obtained through clinical trials as well as observational practice data[10]. For rheumatoid arthritis (RA), clinical guidelines have been developed for the management and monitoring of drug therapy[11,12]. Guidelines can obviously not guide the behavior in the treatment of every single patient but they do provide important information for defining adequate care and assessing current care in specific groups of patients. However, because patients differ in their medical needs, help-seeking behavior

and priorities, and since physicians' training varies, and physicians have different ideas on treatment, there will always be, indeed must be, a certain amount of variation in the provision of care.

Concern has been raised not only about the large discrepancy in health care provided by rheumatologists and non-rheumatologists in the diagnosis and treatment of rheumatic diseases[13-18] but also about variation within the subspeciality[19,20]. Pincus and co-workers, investigating 7 rheumatologic practices, showed that there was wide variation in the use of disease modifying antirheumatic drugs (DMARD) and nonsteroidal antiinflammatory drugs (NSAID)[21,22].

Prospective observational studies of health-care delivery under non-trial conditions, which include sufficient numbers of patients for each of the participating units, yield important information about real treatment practice. Therefore, observational studies of large data sets reflecting daily practice, even though they have various methodological difficulties, play an important role in health services research and in quality assessment[23]. They raise awareness of over- or under-utilization of health services and regional variation in practice. Variation of practice may point out where not enough evidence of therapeutic efficacy of specific interventions is available to direct physician treatment behaviors and recommendations.

We used a large, uniform database, the German National Database[24-26], with a large number of participating rheumatologists in order to obtain first results on practice variation in German rheumatology. The size of the database enabled us to control for several confounding factors including case mix of the patients.

MATERIALS AND METHODS

The National Database of the German Collaborative Arthritis Centres was implemented in 1993 to observe processes and outcomes of care provided by rheumatologists participating in the 24 arthritis centers. The arthritis centers are not single institutions, but collaborations of rheumatologists in different health care settings (hospitals, private practices) in defined regions in all parts of Germany. The database is described in more detail elsewhere[25]. In 1998, a total of 71 single institutions within the 24 arthritis centers enrolled their outpatients, among them 22 university hospitals, 19 rheumatic disease units at general hospitals or specialized acute care rheumatologic hospitals, 5 rheumatologic rehabilitation hospitals with outpatient facilities (formerly: spa clinics) and 25 rheumatologists in individual fee-for-service practices.

Funding was provided by the Federal Ministry of Health for the implementation of the arthritis centers (full-time co-ordinators) and the monitoring of the data base (assistants in each of the arthritis centers). Participation in the data base was obligatory in order to receive funds. Since 1999, the database has been funded by the Federal Ministry of Research.

Data base design. Each outpatient with an inflammatory rheumatic disease is recorded once a year with a standardized, uniform clinical data sheet and a self-administered patient questionnaire. Each year the same items are recorded, and an identification number allows compilation of data for single patients from various years. The co-ordinators and assistants in the centers are provided with computer programs to check for completeness

and plausibility of the data. After completing and correcting the data (if necessary, by going back to the clinical records), the data are sent to the German Rheumatism Research Center for final checks and centralized analysis.

The physician clinical documentation comprises the onset of symptoms, diagnoses, measures of disease activity (erythrocyte sedimentation rate, C-reactive protein, 28 joint count, and physician global assessment of activity) and severity (physician global assessment of severity), and drug as well as surgical treatment. Drug treatment is recorded in 2 ways: as current therapy (on the day of registration in 1998) and therapy ever within the past 12 months. DMARD are recorded as single substances but without dosages, steroids as ≤ 7.5 mg and > 7.5 mg, and NSAID as a group. Drugs given with the aim of preventing and treating osteoporosis are also recorded as a group only. The diagnosis of RA is made according to the physician's clinical judgment but is only registered as definite if the American College of Rheumatology (ACR) criteria are met[27]. The patients give information about pain, disability (as measured by the self-administered Hanover Functional Status Questionnaire, which is similar to the HAQ and highly correlated with it[28]), non-drug and inpatient treatments during the past 12 months, social situation, and demography.

Patient selection. For the year 1998, data for 25,653 individual outpatients with inflammatory rheumatic disease, among them 12,992 patients with RA, were available. Of those, 11,374 were registered as having a definite disease. In order to be able to ascribe a certain treatment to a defined unit, analyses were restricted to cases who had been seen in the unit for at least the previous 6 months. The total number of cases available for the analyses was thus 9,174. Comparisons among single institutions require a minimum number of cases in each of them. We therefore analyzed the data from the 29 largest rheumatologic units that had been treating at least 100 of these cases each. The total number of cases fulfilling the above mentioned criteria in these institutions was 7,326. The patients in the selected institutions did not differ significantly from the total 9,174 cases in the database with respect to age, sex, disease duration, severity of the disease and mean disability score.

The selected units comprised 7 university outpatient clinics, 11 outpatient clinics of rheumatology hospitals (among them 4 acute care hospitals in rheumatology, 4 departments of rheumatology at general hospitals, and 3 rehabilitation hospitals with outpatient facilities) and 11 rheumatologists in individual practices.

Data analyses. Box plots were used to describe the variability of treatment. The percentage of patients treated was calculated for every unit and every kind of treatment. The boxes in the figures show the median, 25th and 75th percentile, and range of the 29 unit values except for outliers. Outliers are units that differ more than 1.5 times the interquartile range from the boxes.

In addition to the crude prescription rates shown in Figures 1 to 3, direct standardized rates were calculated by using disease duration, rheumatoid factor and disability for case mix adjustment. These data are not shown because they are very similar to the crude rates.

Furthermore, in order to characterize the DMARD treatment regimes of the participating units the frequency of combination therapy was used. The rationale for this was that there is a trend towards increasing use of combinations in DMARD therapy in Germany (from 6% in 1995 to 17% in 1999). The hypothesis was that a more recent therapeutic approach would be best reflected in the use of this treatment strategy. Logistic regression was applied to decide whether, after adjustment for co-variables, the percentage of patients treated with combination therapy in a single unit was significantly higher or lower than the mean frequency over all patients and units. For case mix adjustment, age, sex, disease duration (4 groups), rheumatoid factor, severity of the disease and disability (3 groups) were used as co-variables in the multivariate logistic regression analysis. We received 3 groups of units with this method: Group I with a significantly lower rate of combination therapies (group mean: 5%, SD of rates 2.5); Group II with an average rate (11%, SD 3.3); and Group III with a significantly higher rate of combination therapies (21%, SD 8.1). Treatment patterns were compared between the 3 groups by odds ratios adjusted for
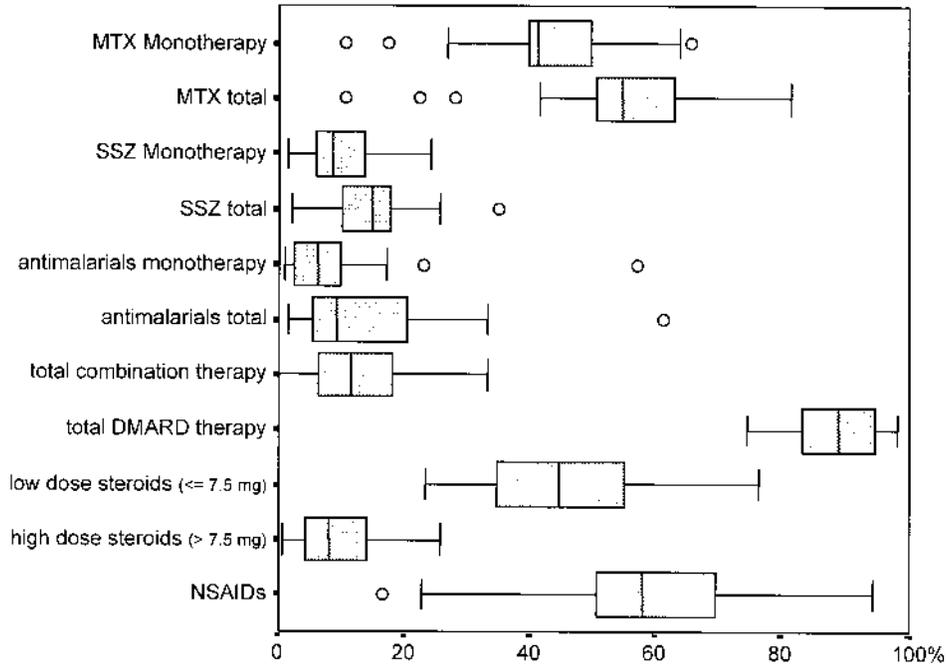
Figure 1. Variation in DMARD therapy among 29 rheumatologic units in Germany, 1998 (lines in the boxes: median of units; edges of boxes: lower and upper quartiles; error bars: range excluding outliers; small circles: outliers).
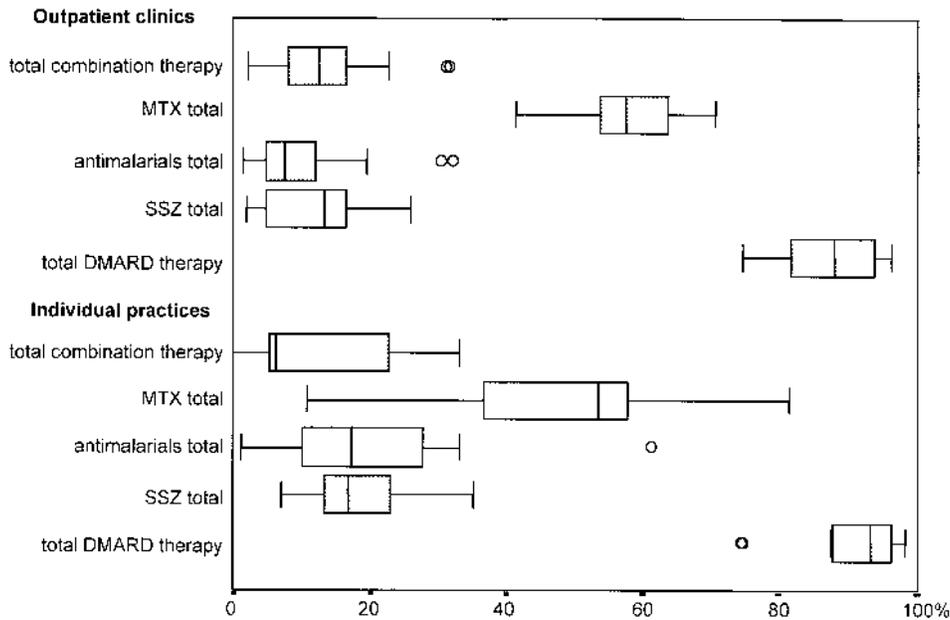
Figure 2. Variation in DMARD therapy among 29 rheumatologic units in Germany, 1998; comparison of 18 hospital outpatient clinics and 11 individual practices (lines in the boxes: median of units; edges of boxes: lower and upper quartiles; error bars: range excluding outliers; small circles: outliers).

the co-variables given above. The 95% confidence intervals of these odds ratios were also computed. In order to compare the patient characteristics of the 3 groups, Kruskal-Wallis-test and Chi-square test were applied. In these comparisons, only p values below 0.001 were considered as significant. Data analysis was performed using the program SPSS (Statistical Package for the Social Sciences[29].

RESULTS

Practice variation in drug and non-drug therapy. The rheumatologists in the 29 selected units prescribed DMARD to 88% of their patients with RA. At the date of registration, a total of 55% of the patients were treated with methotrexate

Figure 3. Variation in non-drug therapy among 29 rheumatologic units in Germany, 1998 (lines in the boxes: median of units; edges of boxes: lower and upper quartiles; error bars: range excluding outliers; small circles: outliers).
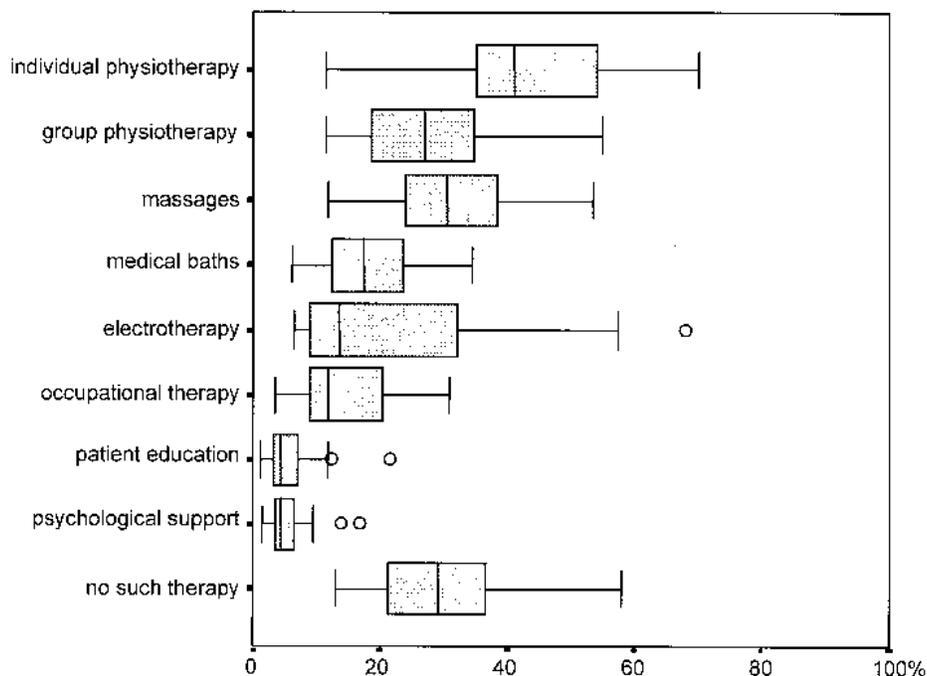
(MTX), 14% as part of a combination therapy. Antimalarials were used for 16% of the patients, sulfasalazine (SSZ) for 13%, and parenteral gold for 5%.

Figure 1 shows the 25th to 75th percentile (in boxes), the median, the minimum and maximum values (error bars), and outliers. The median of all units for MTX as monotherapy was 41%; including combination therapies, the median for MTX was 55%. Compared to MTX, SSZ (median: 16%), antimalarials (median: 8%) and parenteral gold (median: 4%) were used much less frequently. Concerning antimalarials, there was a rather large variation with 50% of the units between 5% and 21%, and one outlier at 61%. There was also considerable variation concerning the frequency of use of combination therapies: 50% of the units used combinations in 6% to 18% of the cases with a median at 11%, but there were 2 units that did not use any combination therapy and 3 who did in more than 31% of all cases.

Low dose corticosteroids were used in 35 to 55% of all cases in half of the units (boxes) with a median of 45% (range 23% to 77%). High dose steroids (> 7.5 mg) were used in 4% to 14% by half of the units with a median of 8% (range 1% to 26%). The widest variation is found concerning the use of NSAID that were prescribed to 50% to 70% of the patients by half of the units with a median of 58% (range 22% to 94%).

After accounting for differences in patient case mix by logistic regression, these differences in prescription remained highly significant (p < 0.001). In a second approach, using direct standardization, the expected rates for each unit, which were obtained after standardization for the average case mix of all units, were compared with the crude rates. There was a good agreement between the 2 types of rates (data not shown). By comparing the variances of the crude rates with the variances of the directly standardized rates, we found that only a small proportion of the total variation (1% to 7% in the single drug and non-drug treatments) could be attributed to differences in case mix, with one exception: For high dose steroids a larger proportion of the variation (19%) could be ascribed to differences in the percentages of patients with a positive rheumatoid factor or severe disability. Some variation could be attributed to the type of the documenting unit. There was an obvious difference concerning the use of antimalarials between rheumatologists in individual practices (mean of patients: 27%) and hospital-based units (10% at rheumatology outpatient clinics of non-university and 6% of university hospitals). Rheumatologists in practices also used more injectable steroids (13% compared to 4% in non-university and 2% in university units). There was no significant difference in the use of MTX and SSZ, and only a small difference concerning DMARD combination therapy (15% in individual practices compared to 14% in non-university and 10% in university units).

Figure 2 shows the box plots with median values according to practice type. Outpatient clinics had a higher

median usage of combination therapy and MTX than individual practices (which is different from the above mentioned mean values), and a lower median for antimalarials and SSZ (which is in accordance with the mean values). Because the boxes overlap for each therapy, outpatient clinics and individual practices cannot be considered as distinct groups.

Variation in non-drug therapy is shown in Figure 3. During the previous 12 months, individual physiotherapy had been prescribed to 34% to 54% of the patients in half of the units with a median of 41%. The median for group physiotherapy was 27% (25th to 75th percentile: 19% to 37%). Passive measures like massages were prescribed to 31% (24% to 39%), medical baths to a median of 18% (13% to 25%), and electrotherapies (e.g., ultrasound, stimulation therapy, diadynamics etc.) to a median of 14% (7% to 37%) with an outlier at 68%. Occupational therapy (including application of splints and technical aids) was prescribed to 12% (25th to 75th percentile: 9% to 21%). Psychological support (including pain management) and patient education were rarely prescribed in outpatient care. The median for each of these therapies was 5%.

Identification of practice styles. We have seen that the above mentioned differences in practice patterns cannot be explained by differences in patient case mix or by the institutional context of the unit alone. We therefore investigated whether we could find correlations among single treatments that could be identified as different treatment patterns. The units were assigned to 3 groups according to the frequency of use of combination therapy. Patient characteristics of the 3 groups are shown in Table 1.

The patients in these groups were not different in respect to disease duration, percentage of women, functional status, percentage of persons still employed, and level of education.

Partly due to the large sample sizes, they were statistically different concerning age, percentage of patients with a positive rheumatoid factor, duration of treatment in the unit, and pain. Except for rheumatoid factor, these differences are rarely clinically relevant. The more obvious difference between the groups is the percentage of patients treated either in hospital outpatient clinics or private rheumatology practices: while this percentage was rather similar in the Groups I and III, a very small number of patients from private practices (16%) was found in Group II. The number of visits to a rheumatologist and to a general practitioner (GP) for the rheumatic condition was also different among the groups: Groups I and II had significantly more contact with a rheumatologist than Group III, whereas this was the other way round concerning contacts with a GP. In total, the number of contacts with a physician for the rheumatic condition per year was very similar between the groups.

Table 2 shows the treatment characteristics in these groups. The percentages refer to all patients in the respective group. Odds ratios are given for the comparison of Group I to II and of Group I to III. MTX was used with equal frequency as monotherapy, but due to its involvement in combinations, there was a difference of 17% between Groups I and III in total MTX therapy. Rheumatologists in Group II used more SSZ than those in Groups I and III, whereas antimalarials were used more often in Group I. There was a statistically significant, yet probably not clinically relevant, difference concerning the use of steroids above 7.5 mg/day with more use in Group II. In this group also low-dose steroids were used more often. Physicians in Group III prescribed significantly more drugs for the prevention and treatment of osteoporosis and fewer NSAID. Patients in Groups II and III had significantly more prescriptions of active physiotherapy compared to Group I, while

Table 1. Patient and treatment characteristics in 3 groups of rheumatological outpatient units (I = low, II = intermediate, III = high intensity of combination therapy). Values are means ± standard deviations and percentages, based on patients in each group.

	Group I n = 2,169	Group II n = 1,791	Group III n = 3,370	p value
Age (yrs)	56.9 ±12.4	56.5 ±12.4	57.9 ±12.3	s*
Women	75.7%	76.5%	77.1%	ns**
RF positive	61.3%	73.3%	63.1%	s
Years of education	11.1 ±2.6	11.2 ±2.8	11.0 ±2.7	ns
Employed	26.6%	27.6%	24.9%	ns
Disease duration (yrs)	10.1 ±9.2	10.7 ±9.0	10.2 ±8.9	ns
Duration of treatment in the units (yrs)	4.9 ±4.7	4.8 ±5.2	4.2 ±4.1	s
Functional status (FFbH; % of full function)	68.7 ±23.2	70.8 ±22.9	70.8 ±23.5	ns
Pain (rating scale 0 = no pain to 10)	4.7 ±2.6	4.4 ±2.6	4.4 ±2.8	s
No. of visits to a rheumatologist/year	6.7 ±5.0	7.1 ±5.4	3.8 ±4.1	s
No. of visits to a GP/year	14.4 ±14.3	13.8 ±15.6	16.9 ±17.3	s
Total no. of physician visits for RA	20.8 ±15.1	20.9 ±17.0	20.2 ±17.3	ns
Patients from private practices	52.9%	15.8%	41.7%	s

* significant at the level p < 0.001
** not significant at the level p < 0.001

Table 2. Comparison of treatment regimes between Groups I, II, and III: percent of patients in each group and case-mix adjusted odds ratios (OR) of Groups II or III compared to I (in parentheses: 95% confidence intervals).

	Group I	Group II	Group III	Total	OR Group II	OR Group III
n	2169	1791	3370	7330	compared to group I	
DMARD combinations	4.9	11.3	21.0	13.9	2.7 (2.1;3.5)	6.4 (5.0;8.1)
MTX total	45.8	52.7	62.6	55.2	1.4 (1.3;1.7)	2.4 (2.1;2.7)
MTX monotherapy	41.3	43.7	43.5	42.9	1.2 (1.0;1.3)	1.2 (1.0;1.3)
Sulfasalazine total	12.5	16.7	10.7	12.7	1.4 (1.2;1.7)	0.9 (0.7;1.1)
Antimalarials total	19.4	12.3	15.9	16.1	0.5 (0.4;0.6)	0.8 (0.6;0.9)
Any DMARD	87.3	89.5	88.6	88.4	1.1 (0.9;1.4)	1.3 (1.0;1.5)
Corticosteroids ≤ 7.5 mg	38.7	49.1	46.3	44.8	1.7 (1.5;2.0)	1.5 (1.4;1.8)
Corticosteroids > 7.5 mg	7.5	10.9	7.8	8.5	1.8 (1.4;2.3)	1.2 (1.0;1.6)
NSAID	69.0	68.2	47.8	58.9	0.9 (0.8;1.1)	0.4 (0.3;0.5)
Osteoporosis therapy	18.7	26.9	35.7	28.7	2.0 (1.7;2.4)	3.0 (2.6;3.5)
Active physiotherapy	41.3	59.7	60.5	54.1	2.0 (1.7;2.3)	2.0 (1.8;2.3)
Passive physiotherapy	40.7	49.8	35.2	40.7	1.4 (1.2;1.6)	0.7 (0.6;0.8)

passive measures were less frequently prescribed in Group III.

In summary, Group III, due to classification, was characterized by the highest frequency in the use of combination therapy (which also lead to the highest frequency of MTX prescription), by the highest proportion of patients receiving osteoporosis medication, and by less frequent use of NSAID and passive physical therapies. Group II had the highest proportion of patients receiving corticosteroids and was comparable to Group III concerning active physiotherapy.

DISCUSSION

There are few data on the comparison of case mix and therapeutic behavior in the treatment of RA among rheumatologic outpatient units. The participation of nearly all large rheumatologic outpatient clinics in Germany and a considerable number of individual practices enabled us to describe the variation in health care in German rheumatology.

We have shown significant variation among German rheumatologists in their provision of health care to patients with RA. Case mix adjustment for demographic and clinical variables only slightly reduced the observed variation.

Studies on practice variation in DMARD therapy mostly stem from time periods where MTX in general was much less frequently used than today. In Edmonton, large variation was found among rheumatologists concerning parenteral gold, antimalarials, and SSZ but MTX was then (in the early 1990s) only rarely used[30,31]. According to a recent survey among members of the Canadian Rheumatology Association and the ACR[32], MTX was the drug of first choice in aggressive RA for most of the Canadian (69%) and US rheumatologists (79%). In cases unresponsive to MTX, 38% would use combination and 24% triple therapy. In mild RA, the vast majority (more than 90%) would prefer single DMARD therapy that is in accordance with treatment behavior of German rheumatologists in the majority of cases. However, compared to other reports[19], DMARD combination therapy in Germany is still comparatively rarely used, even though its application is increasing.

In the UCSF longitudinal RA panel in 1990, Criswell and Redfearn[33] found a high variation in the use of prednisone among 63 rheumatologists (1st quartile: 27%, 3rd quartile: 72%). Our study showed little practice variation regarding high dose (> 7.5 mg) steroid therapy but variation for low dose therapies was almost as high as in the Californian data.

Our study is the first to show practice variation concerning the prescription of active and passive physiotherapy in daily rheumatology practice. The most obvious variation is seen in the use of electrotherapies. These forms of therapy are used for non-drug pain relief and as a preparation for active physiotherapy[34]. Frequency of use seems to depend on the rheumatologist's education and experience with this therapy as there are large differences between units in the Western (old German states) and Eastern parts (new German states) of the country (data not shown). East Germany had a long tradition and experience in the application of these therapies, and they are still much more often used in the new compared to the old German states. The variation in non-drug therapies corresponds with findings of Rush and Shore[35] in their survey of 100 rheumatologists and 100 rehabilitation specialists: 53 % of the physicians in this study felt that active exercise was helpful in acute arthritis and 47% did not. The majority considered microwave, laser, and magnetotherapy not helpful. However, the authors state that this could be due to the unavailability of these therapies.

We tried to identify treatment patterns and grouped the outpatient units according to their frequency of use of DMARD combination therapy. During the past few years, there has been a steadily increasing use of this treatment strategy in Germany. We found that the group with the most intensive use of combination therapy also used more low

dose corticosteroids, osteoporosis treatment and active physiotherapy whereas rheumatologists in that group used fewer NSAID, high dose steroids, and passive physiotherapeutic measures. The intermediate group concerning combination therapy differed significantly from the group with the lowest rate with respect to corticosteroid use, osteoporosis medication, and active physiotherapy. A lower rate of NSAID prescription seems to reflect a more recent treatment pattern. In the US, a decrease in the use of NSAID from 86% to 76% was found between 1981 and 1996[36]. In our database, between 1995 and 1999 (most recent available data) there was a decrease in the use of NSAID for RA from 69% to 58%. The usage of MTX has increased from 47% to 56%. The proportion of patients with active physiotherapy during a one-year period has increased from 34% to 41%, and passive measures decreased from 30% to 23%: This supports the assumption that the group with the highest portion of DMARD combination therapy stands for a more modern treatment philosophy.

The differences between the units can neither be sufficiently explained by sociodemographic characteristics of the patients (educational level or type of insurance) nor by the institutional level (hospital or office-based rheumatologist) as the highest number of hospital-based rheumatologists was in the intermediate group. The finding that the group with the highest average number of contacts with a rheumatologist (Group I) was also the group with the lowest therapy intensity seems contradictory. The explanation is that there exists 2 different kinds of rheumatologists in private practices in Germany: those who can act like a general practitioner and treat the patients for all their different conditions, and those who only work as rheumatology consultants. The latter group can be expected to have fewer contacts with the patients per year. In Group III, 30% of the patients came from consultant rheumatologists in private practices whereas there were no such patients in Group I. Therefore, the number of contacts with a rheumatologist alone is not a good indicator of the intensity of rheumatologic treatment.

Henke and Epstein, in their survey of 66 US rheumatologists, found a consistency of practice styles across different management activities and concluded that practice style may be a general characteristic of a physician rather than being specific for individual procedures[20]. Criswell and Henke found influences in the professional experience, payment method, practice setting and training location and concluded that most of the variation was explained by rheumatologist characteristics as opposed to patient case mix[37].

Variation in our data may in part be the result of different financial restrictions. Not all hospital outpatient clinics are entitled to prescribe complementary therapies and are therefore dependent on the family physician's cooperation. Rheumatologists in individual practices are restricted in their budgets, especially for physiotherapy. Patient education and occupational therapy are rarely available in outpatient settings. These restrictions differ throughout Germany as health services and payment are organized on a regional level.

In the future, the database will continue to be an important source of information on therapeutic behavior and its changes, e.g., through the introduction of new drugs like COX-II inhibitors, leflunomide, and TNF-α inhibitors but also because of growing budgetary problems. Furthermore, it will reflect whether the discussion within German rheumatology concerning different practice styles will lead to a reduction in the variability of practice.

APPENDIX 1

Participating German Collaborative Arthritis Centres: Aachen/Köln/Bonn (E. Genth); Berlin (J. Sieper); Dresden (H.E. Schröder); Düsseldorf (M. Schneider); Erlangen (G. Weseloh); Westliches Ruhrgebiet (H. Warnatz); Gießen/Bad Nauheim (K.L. Schmidt); Greifswald (D. Köster); Hannover (H. Zeidler); Heidelberg (W. Eich); Jena (G. Hein); Leipzig (H. Häntzschel); Lübeck/Bad Bramstedt (W.L. Gross); Magdeburg/Vogelsang (J. Kekow); Mainz/Bad Kreuznach (R. Dreher); München (M. Schattenkirchner); Münster (M. Gaubitz); Ostwestfalen/Lippe (H. Mielke); Regensburg/Bad Abbach (U. Mueller-Ladner); Rhein-Main (J.P. Kaltwasser); Rostock (M. Keysser); Saarland (M. Pfreundschuh); Südbaden (H.H. Peter); Südwürttemberg (R. Maleitzke).

REFERENCES

1. Pilote L, Califf RM, Sapp S, et al. Regional variation across the United States in the management of acute myocardial infarction. N Engl J Med 1995;333:565-72.
2. Guadagnoli E, Hauptman PJ, Ayanian JZ, Pashos CL, McNeil BJ, Cleary PD. Variation in the use of cardiac procedures after acute myocardial infarction. N Engl J Med 1995;333:573-8.
3. Chassin MR, Kosecoff J, Park RE, et al. Does inappropriate use explain geographic variation in the use of health care services? A study of three procedures. JAMA 1987;258:2533-7.
4. Newbold KB, Eyles J, Birch S. Equity in health care: methodological contributions to the analysis of hospital utilization within Canada. Soc Sci Med 1995;40:1181-92.
5. Keller RB, Soule DN, Wennberg JE, Hanley DF. Dealing with geographic variations in the use of hospitals. The experience of the Maine Medical Assessment Foundation Study Group. J Bone Joint Surg 1990;72:1286-93.
6. Price CE, Paul EA, Bevan RG, Holland WW. Equity and medical practice variation: relationships between standardized discharge ratios in total and for selected conditions in English districts. J Epidemiol Community Health 1992;46:58-62.
7. Ben-Shlomo Y, Chaturvedi N. Assessing equity in access to health care provision in the UK: Does where you live affect your chances of getting a coronary bypass graft? J Epidemiol Community Health 1995;49:200-4.
8. Hannan EL, Kilburn HJr, O'Donnell JF, Lukacik G, Shields EP. Adult open heart surgery in New York State: an analysis of risk factors and hospital mortality rates. JAMA 1990;264:2768-74.
9. O'Connor GT, Plume SK, Olmstead EM, et al. A regional prospective study of in-hospital mortality associated with coronary artery bypass grafting. JAMA 1991;266:803-9.
10. Fries JF, McShane DJ. ARAMIS (The American Rheumatism Association Medical Information System). West J Med 1986;145:798-804
11. American College of Rheumatology ad hoc committee on clinical

guidelines. Guidelines for the management of rheumatoid arthritis. Arthritis Rheum 1996;39:713-22.

12. American College of Rheumatology ad hoc committee on clinical guidelines. Guidelines for monitoring drug therapy in rheumatoid arthritis. Arthritis Rheum 1996;39:723-31.

13. Criswell LA, Such CL, Yelin EH. Differences in the use of second-line agents and prednisone for treatment of rheumatoid arthritis by rheumatologists and non-rheumatologists. J Rheumatol 1997;24:2283-90.

14. Blaauw AA, Schuwirth LW, van der Vleuten CP, Smits F, van der Linden S. Assessing clinical competence: recognition of case descriptions of rheumatic diseases by general practitioners. Br J Rheumatol 1995;34:375-9.

15. Stross JK. Relationships between knowledge and experience in the use of disease-modifying antirheumatic agents. JAMA 1989;262:2721-3.

16. Mazzuca SA, Brandt KD, Katz BP, Li W, Steward KD. Therapeutic strategies distinguish community-based primary care physicians from rheumatologists in the management of osteoarthritis. J Rheumatol 1993;20:80-6.

17. Raspe HH, Mau W, Wasmus A. Treatment profiles in different groups of RA-sufferers: Description, analysis, evaluation. Scand J Rheumatol 1989; 79 Suppl:57-65.

18. Ward MM. Trends in the use of disease modifying antirheumatic medications in rheumatoid arthritis, 1980-1995: results from the National Ambulatory Medical Care Surveys. J Rheumatol 1999;26:546-50.

19. Kay EA, Pullar T. Variations among rheumatologists in prescribing and monitoring of disease modifying antirheumatoid drugs. Br J Rheumatol 1992;31:477-83.

20. Henke CJ, Epstein WV. Practice variation in rheumatologists' encounters with their patients who have rheumatoid arthritis. Med Care 1991;29:799-812.

21. Pincus T, Marcum SB, Callahan LF, et al. Longterm drug therapy for rheumatoid arthritis in seven rheumatology private practices: I. Nonsteroidal antiinflammatory drugs. J Rheumatol 1992; 19:1874-84.

22. Pincus T, Marcum SB, Callahan LF. Longterm drug therapy for rheumatoid arthritis in seven rheumatology private practices: II. Second line drugs and prednisone. J Rheumatol 1992;19:1885-94.

23. Liang MH. The study of practice variation in managing rheumatic diseases. Bull Rheum Dis 1994;43:6-8.

24. Zink A, Braun J, Listing J WJ. Disability and handicap in rheumatoid arthritis and ankylosing spondylitis - results from the German rheumatological database. J Rheumatol 2000;27:613-22.

25. Zink A, Listing J, Klindworth C, Zeidler H for the German Collaborative Arthritis Centres. The National Database of the German Collaborative Arthritis Centres. Structure, aims, and patients. Ann Rheum Dis 2001;60:199-206.

26. Zink A, Listing J, Niewerth M, Zeidler H for the German Collaborative Arthritis Centres. The National Database of the German Collaborative Arthritis Centres. II. Treatment of patients with rheumatoid arthritis. Ann Rheum Dis 2001;60:207-13.

27. Arnett FC, Edworthy SM, Bloch DA MD, et al. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum 1988;31:315-24.

28. Lautenschlaeger J, Mau W, Kohlmann T, et al. Comparative evaluation of a German version of the Health Assessment Questionnaire (HAQ) and the Hanover Functional Status Questionnaire (HFSQ). [Vergleichende Evaluation einer deutschen Version des Health Assessment Questionnaires (HAQ) und des Funktionsfragebogens Hannover (FFbH)]. Z Rheumatol 1997; 144-55.

29. Norusis MJ. SPSS Advanced Statistics 6.1. Chicago (SPSS Inc.)1994.

30. Galindo-Rodriguez G, Avina-Zubieta JA, Fitzgerald A, LeClerq SA, Russell AS, Suarez-Almazor ME. Variations and trends in the prescription of initial second line therapy for patients with rheumatoid arthritis. J Rheumatol 1997;24:633-8.

31. Suarez-Almazor ME, Soskolne CL, Saunders LD, Russell AS. Use of second line drugs for the treatment of rheumatoid arthritis in Edmonton, Alberta. Patterns of prescription and longterm effectiveness. J Rheumatol 1995;22:836-43.

32. Maetzel A, Bombardier C, Strand V, Tugwell P, Wells G. How Canadian and US rheumatologists treat moderate or aggressive rheumatoid arthritis: a survey. J Rheumatol 1998;25:2331-8.

33. Criswell LA, Redfearn WJ. Variation among rheumatologists in the use of prednisone and second-line agents for the treatment of rheumatoid arthritis. Arthritis Rheum 1994;37:476-80.

34. Seichert N, Senn E. Electrotherapy in the rheumatic diseases. [Elektrotherapie bei rheumatischen Erkrankungen]. Arthritis Rheum 1999;19:90-6.

35. Rush PJ, Shore A. Physician perceptions of the value of physical modalities in the treatment of musculoskeletal disease. Br J Rheumatol 1994;33:566-8.

36. Ward MM, Fries JF. Trends in antirheumatic medication use among patients with rheumatoid arthritis, 1981-1996. J Rheumatol 1998;25:408-16.

37. Criswell LA, Henke CJ. What explains the variation among rheumatologists in their use of prednisone and second line agents for the treatment of rheumatoid arthritis? J Rheumatol 1995;22:829-35.