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Medication reviews with computerised expert support
Evaluation of a method to improve the quality of drug utilisation in the elderly

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Abstract

Purpose – This paper aims to examine whether a computerised system for medication reviews can support physicians' decisions and improve the quality of drug treatment in the elderly.

Design/methodology/approach – This is a descriptive intervention study. The study included 275 patients living in community settings and nursing homes in Stockholm, Sweden. Patient data were analysed using computer software and scrutinised by a clinical pharmacologist. Pharmaco-therapeutic advice was sent to the physician responsible for each patient. The main outcome measures were initiation and discontinuation of drugs, changes of doses and rates of identified drug-related problems.

Findings – Expert opinions were given by the clinical pharmacologist, for 275 patients, mean age 85 years; 70 per cent female. An average of 3.3 remarks was given concerning unsuitable drugs, unclear indication, dosing when the kidney function was decreased, drug-drug interactions and quality indicators. On average 1.5 drug-related problems (DRP) per patient were attended to by the responsible physician at each unit. The most common action taken was withdrawal of a drug ($n = 208$). On average the drug use decreased from 10.4 to 9.5 drugs per patient, and several quality indicators were met. The drug costs decreased, and resulted in a more cost-effective drug therapy.

Originality/value – The paper develops and tests a method for intervention in the care of elderly patients. The method is based on a computerised expert support system for medication reviews at a distance and on education of the staff. A safer drug therapy with improved quality and cost-effectiveness is thus provided.

Keywords Pharmacology, Elderly people, Medicines, Information systems, Sweden, Health services

Paper type Research paper

Introduction

Drug therapy is a major treatment form in health care today. Drugs have the potential to cure, relieve, or prevent many diseases and symptoms (Colley and Lucas, 1993). The number of treatable diseases has increased, and more effective drugs have been developed.

Drug utilisation research includes assessment of the appropriateness of a drug therapy. Many reports have proved that drug therapy is associated with drug-related problems (Johnell and Fastbom, 2008; Ancelin *et al.*, 2006; Tissot *et al.*, 2003; Lefkovitz and Zarowitz, 2007). Elderly people often suffer from multiple diseases and symptoms and use many drugs (Nolan and O'Malley, 1988). Elderly also experience natural signs of old age. Some symptoms and diseases may no longer warrant treatment (Hanlon *et al.*, 2000; Bergman *et al.*, 2005). For the elderly patient, some treatments are inappropriate as well (Beers, 1997). In Sweden, a majority of elderly persons are treated with many drugs. Persons over 75 years of age constitute 8 per cent of the Swedish population but account for 25 per cent of all drugs prescribed. Persons 85 years or older admitted to internal medicine wards on average use nine daily drugs (Swedish National Board of Health and Welfare, 2007).

A drug-related problem (DRP) is defined as "an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes" (Strand *et al.*, 1990). There is a positive relationship between the number of drugs taken and the risk of adverse drug reactions (ADR) (Furniss *et al.*, 1998). In Sweden approximately 10-20 per cent of hospital admissions of elderly persons are attributable to ADRs (Bergman *et al.*, 2005; Sarlov *et al.*, 2001; Mjorndal *et al.*, 2002). However, ADRs categorised as mild, such as dizziness, fatigue, feeling ill or cognitive dysfunction, are not always recognised as ADRs and can be confused with symptoms of disease or aging. This may lead to reduced quality of life and unnecessary costs for the society. A majority of doctor-patient meetings result in the patient getting a prescription. To achieve appropriateness it is important that every prescription is based on an accurate indication. Careful assessment is required to identify problems as well as knowledge of the needs of the individual patient. Furthermore, the drug treatment should be consistent with up-to-date recommendations and also cost-effective. The complexity of prescribing increases when a drug is prescribed for primary or secondary prevention, which stresses the need of high-quality prescribing. However, the prescribing doctor meets with several problems such as lack of time, lack of overview, and lack of knowledge (Rahmner *et al.* 2009).

Medication review is a method for following up, analysing, and re-considerating a patient's drug treatment. Medication reviews with pharmacological expertise, such as a pharmacologist or a pharmacist, is a way of securing high quality drug treatment (Mannheimer *et al.*, 2006; Bergqvist *et al.*, 2008). The medication review may contribute to the detection of DRPs and to increase the awareness of the problems (Hanlon *et al.*, 1996; Christensen *et al.*, 2004). To improve patient safety, solutions should be developed that provide access to the list of all currently used drugs with alerts for relevant prescribing problems, e.g. therapeutic duplication, excess dose, potential drug-drug interaction or dose adjustment according to weight and renal impairment (Tamblyn *et al.*, 2003).

The aim of the present study was to evaluate if a computerised expert support for medication reviews at a distance could help physicians improve the quality of the drug treatment of elderly patients.

Participants and methods

The present study was performed January-October 2006. Seven caregivers (e.g. rehabilitating wards, service flats, community dwellings or nursing homes) were recruited, and the units were chosen from different parts of the Stockholm county council. The units that took part in the study were recruited by letter sent to persons in charge. The letter presented the aim of the study and a summary of the method, including the educational intervention (see below). A medical review is normally not offered patients in Sweden other than when it is obvious that the medical treatment is not correct. Altogether 12 physicians participated, and 275 patients were scrutinised (Figure 1). The study protocol aimed at a total of 400 patients, which was considered a reasonable amount in relation to the number of inhabitants in the area. It was not possible to achieve this number, but a total of 275 patients were included. After inclusion one unit, withdrew due to change of responsible physician (12 patients), and data for another unit were not completed due to lack of time at the unit (30 patients). Six units carried out medication reviews for a total of 233 patients.

The patients eligible for the study had to be 75 years or older and be treated with at least five drugs. The participating physicians were responsible for nursing homes, hospital rehabilitating wards, or community dwellings. Before the patient information was gathered, an identification code was created and all data were marked with the
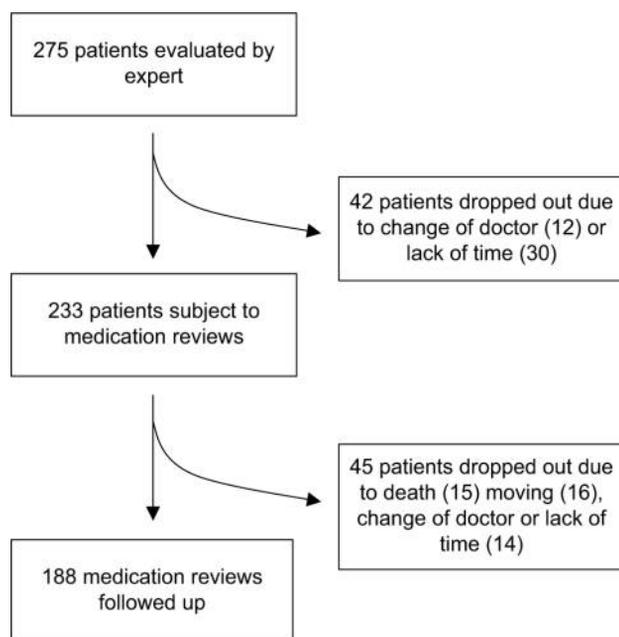

Figure 1.
Activity schedule

code. The code key was kept in a secure place at each participating unit. Descriptive statistics were used to summarise the patient characteristics.

According to the Swedish law (SFS, 2003), approval by an ethics committee is needed for research that implies physical or psychological influence on the participants. This study did not include the use of patient identifiers but was run as a quality assessment project and therefore did not require ethical permission. All patient documentation was coded by the participating units and kept at the respective nursing home, rehabilitating ward, or community dwelling. The information sent to the researchers was anonymous. All codes were destroyed by the participating physicians at the end of the study.

The aim and proceedings of the study were presented to the staff involved, i.e. doctors, nurses and nurses' assistants, and three 60 minute lectures in geriatric pharmacology were given. The lectures informed on how elderly people absorb, metabolise and excrete drugs as well as pharmacodynamic effects in elderly. The lectures were adapted to suit the levels of knowledge, and led by a clinical pharmacologist and a registered nurse with expertise knowledge of drug utilisation, both with extended pedagogical experience. After these introductory lectures, the participating units were asked to collect and send information on patients who were treated with five drugs or more (drugs for external use were not included). The information collected was gender, age, body weight, serum creatinine, blood pressure, diagnoses, current drug use (name, dose, and administration form). A symptoms assessment form containing 20 health issues was used to collect symptoms and common adverse effects (for example: dizziness, headache, fatigue) from the patients. These items were assessed on a Likert scale 0-4, where 0 means no problem and 4 means a severe problem. The form has been validated in previous studies (Mannheimer *et al.*, 2006; Ulfvarson *et al.*, 2003). The symptoms assessment form was used to identify adverse effects as well as under-treatment, and was given to the patients by the nurses at each unit. The form was filled in by the patients, if needed with the help of a nurse. All data were entered and analysed in computer software developed for drug utilisation reviews. The software programme used in the study for gathering and analysing data gives warnings and explanations of drug-drug interactions (DDI) (Eliasson *et al.*, 2006), and makes quality analyses of the drugs listed with references to recommended and appropriate drugs and quality indicators established by the Swedish National Board of Health and Welfare (2003). Examples of indicators are: concurrent use of three or more psychotropic drugs, use of long-acting benzodiazepines, use of anticholinergics, and at least one clinically relevant potential drug-drug interaction. The lower the proportion of each indicator is, the better the quality of the drug therapy. The proportion should be as low as possible not stating any number, since it is important to take individual considerations. The software programme also calculates the patient's kidney function by the Cockcroft and Gault (1976) formula, based on serum creatinine, age, gender and weight, and categorised as 60 mL/min (normal), 30-59 (moderately reduced kidney function) and < 30 mL/min (severely reduced kidney function).

Diagnoses were assembled and classified according to the International Classification of Diseases (ICD) (World Health Organization, 2004). Drug-drug interactions (DDIs) were classified according to the Swedish system that categorises clinical relevance (A-D) and level of documentation (1-4) (Sjöqvist, 1997).

Classification definitions
Clinical relevance:

- Minor interaction of no clinical relevance.
- Clinical outcome of the interaction is uncertain and/or may vary.
- Clinically relevant interaction that can be handled, e.g. by dose adjustments.
- Clinically relevant interaction, drug combinations that should be avoided due to high risk of ADR or nil effects.

Level of documentation:

- Data derived from incomplete case reports and/or in vitro studies.
- Data derived from well-documented case reports.
- Data derived from studies among healthy volunteers and/or pilot studies among patients.
- Data derived from controlled studies in relevant patient populations.

After the computerised assessment, a clinical pharmacologist reviewed the report and wrote an expert opinion. The advice was sent to the responsible physician at each unit, and the decision to consider taking action was up to him/her.

Data collection
The data collection was divided into two steps:

(1) *Pharmacological advice.* After the introduction with lectures and information on how to collect patient data, the participating units included patients who met the inclusion criteria, and collected the data needed. The data (gender, age, body weight, serum creatinine, blood pressure, diagnoses, current drug use and the symptoms assessment form) was either sent by mail to the researchers or sent on-line. The data was then processed in the computer software as well as analysed by a specialist in clinical pharmacology, and medical advice was sent as a report to the participating physician at each unit. All data including the results from the computer analysis and the expert advice were given to the responsible physician, who identified the patient with the identification code key.

(2) *Medication review.* A medication review was performed at the respective unit when the report including the computer analysis and the expert opinion was received from the researchers. The review was done by the responsible physician, together with nurses and health care staff. Based on the expert advice and the clinical knowledge of the patient, drug-related problems (DRPs) were identified and decisions made on how to manage them. Six units carried out medication reviews for a total of 233 patients.

Outcomes measures
The primary outcome measures were rates of identified drug-related problems according to quality indicators, initiation and discontinuation of drugs, and changes of doses. The secondary outcome was the number of drugs together with the amount of inappropriate drugs before and after intervention.

Results

A total of seven units completed the collection of data for the expert advice and subsequent medication review resulting in data collected from 275 patients. The mean age was 85 years and 70 per cent ($n = 192$) were female. The mean number of prescribed drugs was 10.6 per patient. The clinical pharmacologist made 3.3 expert comments as a means of advice to the participating doctors, e.g. inappropriate drug, unclear indication, dose not adjusted to kidney function, drug duplication and drug-drug interaction (DDI).

In this study one unit withdrew due to change of responsible physician, i.e. six units carried out medication reviews. The mean age of the remaining 233 patients was 86 years and 68 per cent ($n = 158$) were female. The five most common diagnoses were heart failure, hypertension, dementia, depression or atrial fibrillation. Twenty seven per cent of the patients were judged having had at least one episode of cognitive failure, such as failure of memory actions and perception, during the past three months, 12 per cent showed signs of orthostatic hypotension. A total of 18 per cent had had a recent fall, and 37 per cent showed behavioural symptoms (e.g. shouting, restless walking).

The kidney function could be calculated for 171 of the 233 patients. Of those, 74 per cent ($n = 127$) had an estimated creatinine clearance < 60 mL/min, indicating reduced kidney function and almost every fifth patient (19 per cent) had calculated a major reduction (< 30 mL/min).

The symptoms assessment form was completed by 183 of the 233 patients. The symptoms reported as moderate or severe are shown in Table I. The most common symptom was fatigue, reported by 52 per cent of the patients. Anxiety, pain and dry mouth were reported by approximately 30 per cent of the patients.

The 233 elderly patients who were subjected to the medication review consumed an average of 10.9 drugs per patient, out of which 2.4 were prescribed "as needed". The

Symptom	n (total 759)	%
Fatigue	95	52
Anxiety	68	37
Pain	64	35
Dry mouth	55	30
Constipation	48	26
Sleeping problems	46	25
Restlessness	40	22
Sadness	40	22
Edema (foot, leg)	38	21
Dizziness	38	21
Shortness of breath	38	21
Poor appetite	29	16
Pruritus	29	16
Cough	27	15
Stomach ache	24	13
Micturition problems	22	12
Diarrhoea	20	11
Headache	20	11
Nightmares	11	6
Nausea	7	4

Table I.
Occurrence of 20 symptoms reported as severe or moderate. Patients could report more than one symptom

four most common groups of drugs were analgesics (e.g. paracetamol), laxatives, sedatives, and antithrombotic agents (85 per cent were low-dose salicylic acid). These drugs were all used by over 50 per cent of the patients studied.

Psychotropic drugs were frequent. Sedative-hypnotic drugs were used by 60 per cent ($n = 140$), anxiolytics by 51 per cent ($n = 119$), antidepressants were used by 47 per cent ($n = 110$) and antipsychotic drugs by 21 per cent ($n = 49$) of the patients. A total of 34 per cent of all patients used three or more psychotropic drugs.

In total 343 DRPs, leading to some kind of adjustment, or other types of measures taken, were identified, i.e. a mean of 1.5 DRPs per patient. Tables II and III show DRPs identified and type of action taken.

The medication review was followed up after two months in 188 of the 233 patients (80 per cent). A total of 15 of the patients had died, 16 moved and 14 follow-ups were not done due to lack of time and change of responsible physician (Figure 1). Measures taken due to DRPs were evaluated in 294 of the 343 DRPs. Of these, 72 per cent

DRP	n (total 343)	%
Inappropriate or missing indication	115	33.5
Drug is not used	44	12.8
Inappropriate drug	41	11.9
Adverse reaction	33	9.6
Under-/over-dosing	32	9.3
Other[a]	29	8.4
Ineffective drug	15	4.3
Not recommended drug	11	3.2
Drug interaction	9	2.6
Inappropriate preparation	7	2
Contra-indication	4	1.1
Combination of several DRPs	3	0.8

Notes: [a] Polypharmacy of psyhcotropic drugs; Reduced need for drug; New drug replacing withdrawn drug; Problems to swallow drug; Need for consulting a specialist (psychiatrist, nephrologists)

Table II. Prevalence of drug-related problems attended to, in patients whose medication was reviewed in the study

Action taken	n (total 343)	%
Withdrawal of drug	208	60.6
Reduction of dose	86	25
Change of drug	17	4.9
Introduction of drug	10	2.9
Increase dose	7	2
Change of dose interval	4	1.1
Change of drug preparation	2	0.5
Change to recommended drug	2	0.5
Other[a]	7	2

Notes: [a] Consultation of psychiatrist or nephrologist; Measure that did not interfere with the drug treatment; Problem already identified and attended to

Table III. Measures taken after a written opinion on drug-related problems given by the pharmacological expert

($n = 213$) did not lead to any observed change in the patient's health status. In 17 per cent ($n = 51$) of the patients, an improvement was observed, and 10 per cent ($n = 30$) deteriorated. In the cases, where deterioration was seen, re-introduction of the drug led to improvement of the health status for 80 per cent of the patients.

At follow-up the number of drugs had decreased from 10.4 to 9.5 per patient in the studied population, i.e. a reduction of 0.9 drugs per patient (SD 1.4 (-6 to 3)). The use of drugs that should be avoided or prescribed with caution in connection with impaired kidney function was reduced by 17 per cent in patients with mild to severe renal impairment (estimated creatinine clearance < 60 ml/min). The drug costs decreased by on average SEK 1345 (€149) per patient. However, the medication reviews resulted not only in withdrawal or initiation of drugs, but also in dosage changes. Figure 2 shows changes in the total number of defined daily doses (DDD) for each group of drugs. Drugs showing the greatest decrease in DDD were calcium, antipsychotics, drugs for peptic ulcer treatment, anxiolytics, and sedatives-hypnotics.

The quality of drug use improved according to all drug-specific quality indicators listed by the Swedish National Board of Health and Welfare. The lower the proportion of each indicator is, the better the quality of the drug therapy. The proportion of
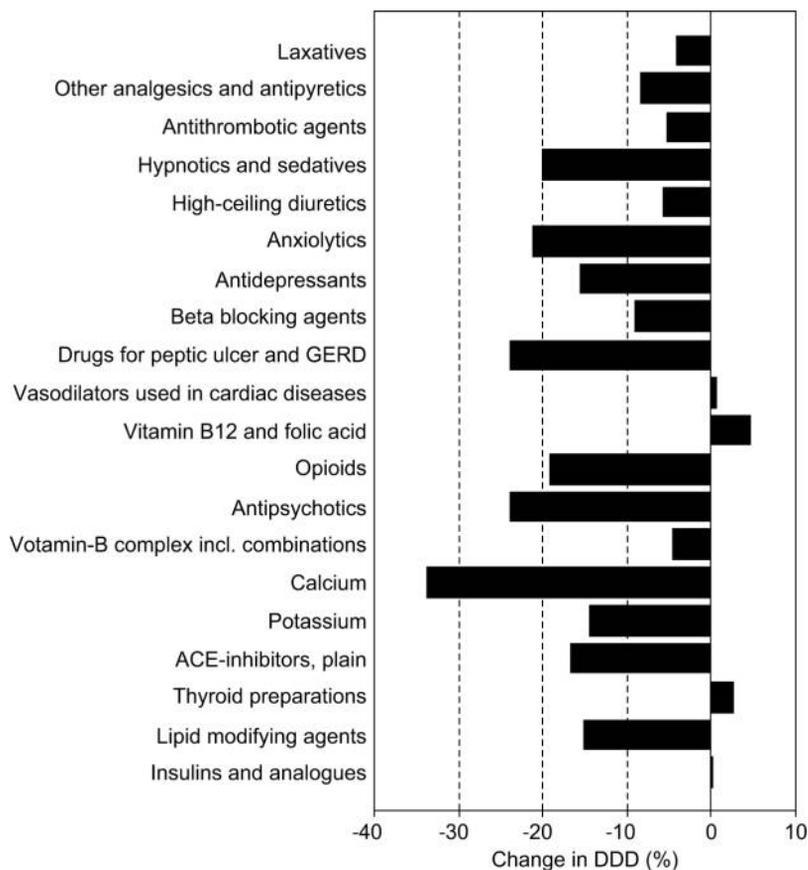

Figure 2.
Change in total number of DDD for the 20 most common drug groups, following the medication review

individuals taking anticholinergic drugs decreased by 40 per cent and by 17 per cent for long-acting benzodiazepines. Drug duplications decreased by 30 per cent, and the use of three or more psychotropics by 19 per cent. The proportion of individuals with potential DDIs decreased by 24 per cent for category C and 41 per cent for category D. Inappropriate drug use for some diagnoses, for example use of NSAID for heart failure, decreased overall by 48 per cent.

Discussion

In this study we observed an improved quality of drug use, in relation to the quality indicators for drug use in elderly published by the Swedish National Board of Health and Welfare (2003). Reductions were noticed for all indicators. Marked reductions of treatment with inappropriate drugs for some diagnoses were also noticed, as well as decline in the use of drugs that should be avoided or prescribed with caution in connection with impaired kidney function.

Computerised drug reviews can improve the safety, quality and cost-effectiveness of drug prescribing (Tamblyn *et al.*, 2006). However, if the problems leading to avoidable ADRs are not managed, there is a risk of making considerable investments without the expected return in the form of error reduction and improved patient safety. The opposite problem exists as well: a computerised support can be extensive and time consuming instead of providing effectiveness (Mannheimer *et al.*, 2006). The intervention in this study was also assessed as to the prescribing physician's acceptance of the advice. His/her experience of the intervention will be reported elsewhere. One statement by a participating physician was that dormant knowledge came to life thanks to the intervention.

One of the main problems with computerised screening tools is that they tend to produce too many non-significant warnings, leading to non-adherence by the prescribing physicians (Sjoborg *et al.*, 2006). This study addressed the problem by consulting a clinical pharmacologist's expertise.

Information and decisions on a patient's drug treatment are as important as the patient's history of disease and caring needs (Gustafsson *et al.*, 2003). The quality of the care is often no better than the quality of the communication between the patient and the physician (Beach *et al.*, 2006). In Sweden, to get a complete overview of a patient's drug list, you must compare the drugs listed by the GP, the pharmacy and, of utter importance, the patient himself. In this study the patients reported their symptoms, and the health care personnel could more easily recognise adverse reactions of drugs after the educational intervention. Other studies have shown that an education in clinical pharmacology of the nurses increases the detection of ADRs (Bergqvist *et al.*, 2008). One of the positive side-effects of this study was an increased teamwork between physicians, nurses and nurses' assistants. With an increased awareness of the importance of detecting ADRs, every caregiver involved gets to understand the value of reporting symptoms.

There are different types of medication reviews. The traditional model is when a pharmacist together with the caregiver, systematically evaluates a patient's drug treatment (Lenaghan *et al.*, 2007; Krueger *et al.*, 2003). Such reviews have been found to improve the quality of the drug treatment and in some cases the patient's health as well. But even if they have a cost-saving effect, due to withdrawal or exchange of expensive drugs, the cost of this kind of review is quite high. It is also time-consuming

(Rollason and Vogt, 2003). Lack of time is a problem in today's health care and could be the major obstacle for medication reviews. Therefore it is important to find ways and routines to simplify medication reviews. The use of computerised support tools is one possibility. Because of the method we chose it was not possible to measure admissions to hospital or any other aspect of cost-effectiveness. This study was conducted to evaluate a method. Additional research must be done to assess the feasibility of the method in different contexts and different patient categories.

The difficulty of withdrawing of a drug is a well-known problem among prescribers (Hanlon *et al.*, 19966). In the present study, the physicians expressed that the advice given by the pharmacological expert supported their decision of a drug withdrawal, which was often seen as a confirmation of existing knowledge.

Conclusion

The study shows that this model – a clinical pharmacologist working with a computerised support at a distance – has resulted in the detection of a number of DRPs. The participating physicians regarded the support as a sufficient basis for a medication review. Overall the intervention was appreciated and regarded as useful. The intervention was in one way cost-effective; a mean sum of SEK 1,345 per patient (€149) was saved after the withdrawal and changes of drugs and doses. Even though the cost of the intervention is not taken into account, the savings per patient are satisfactory. Beyond the monetary savings, the intervention probably avoids suffering from adverse drug reactions, and improve quality of life. The model is based on co-operation. The staff involved with the patient's care is encouraged to take part in the identification of DRP and to watch out for inappropriate drug use and potential DDI. When the problems of drug use are understood, the importance of teamwork is acknowledged. The knowledge of what to observe and how to confirm suspicions, as well as experience from previous cases are a couple of the model's advantages. The clinical pharmacological expert advice ascertains the quality of the advice given before the medication review. An educational intervention for the staff involved in the care of elderly patients together with a computerised support for medication reviews at a distance, will provide improved quality in the drug therapy, as well as a safer and more cost-effective drug therapy.

Further research is needed in aspect to the patients' point-of-view, for example, how they perceive this kind of interventions, and adherence to advice given from different professions involved in their drug treatment.

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