

# National Survey of the Pharmacokinetics Services at the Ministry of Health Hospitals in Saudi Arabia: Prescribing and Dispensing Medication

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## Abstract

**Objectives:** To explore the pharmacokinetics services at the Ministry of Health (MOH) hospitals in Saudi Arabia with an emphasis on prescribing and dispensing medication. **Methods:** This is a 2-month cross-sectional national survey of pharmacokinetics services. The study consisted of two parts: the first part captures demographic information and the second part is a questionnaire with 43 questions divided into three domains. The questions are derived from the guidelines of the American Society of Health-System Pharmacists (ASHP) and from the literature. We used the 5-point Likert response scale system to obtain responses of the participants; there were close-ended questions. The electronic questionnaire was distributed to all the coordinators of the clinical pharmacy services or to the drug information centers at MOH hospitals. The data were collected through the Survey Monkey system. **Results:** A total of 43 hospital pharmacies responded to the survey; the response rate was found to be 86%. The pharmacists and nurses had privileges of prescribing medication as per pharmacokinetics services in nearly 18 (46.15%) and 16 (41.03%) hospitals respectively. At 14 (37.84%) hospitals, pharmacists have the privilege to request an estimation of patient's drug levels and at 12 (30.77%) hospitals, they have the privilege to change drug sampling time. At 15 (38.46%) hospitals, nurses have the privilege to request an estimation of patient's drug level and at 12 (31.58%) hospitals, they have the privilege to change drug sampling time. The commonly prescribed medications via pharmacokinetics consultation were gentamicin (23 (71.88%)), phenytoin (23 (71.88%)), carbamazepine (22 (70.97%)), sodium valproate (22 (70.97%)) and warfarin (22 (70.97%)). The pharmacokinetics altering system during an electronic prescription was found in 9 (26.5%) hospital pharmacies and the pharmacist was found to participate in pharmacokinetics research in 8 (23.5%) hospitals. **Conclusion:** Healthcare providers including the pharmacists and nurses have a significant role in providing pharmacokinetics services to the patients. Expanding these services with standard guidelines and the electronic prescription is required in order to prevent drug- Pharmacokinetics related problems, improve the clinical outcome of the patient and reduce the economic burden.

**Key words:** Pharmacokinetics, Prescribing, Medication, Dispensing, Ministry of Health, Saudi Arabia.

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## INTRODUCTION

The Clinical pharmacokinetics services (CPK) and Therapeutic drug monitoring (TDM) is expanding services hospital over the past several in Saudi Arabia. [1,2] Clinical pharmacists play an essential role in the

improvement of the clinical outcome of the patient and reduce the economic burden on the healthcare system in the Kingdom of Saudi Arabia (KSA). [3-5] Several publications have described the privilege of prescribing medications and monitoring the use of medications by a clinical pharmacist on a daily basis. [1,2,6-7] Most of the

current recent literature shows survey data regarding the general pharmacy practices in hospitals.<sup>[1,8]</sup> However, in this study, we aimed to perform in-depth research on the pharmacokinetics practice at MOH hospital. Therefore, the objective of this study was to conduct national survey of pharmacokinetics practice with an emphasis on prescribing and dispensing stage of drug therapy and management at the Ministry of Health hospital in Saudi Arabia.

## METHODS

This is a 2-month cross-sectional national survey of pharmacokinetics services with a focus on prescribing medication and dispensing at MOH hospitals in Saudi Arabia. This study consists of two parts: the first part captures demographic information and the second part is a questionnaire with 43 questions divided into three domains that are derived from the guidelines of the American Society of Health-System Pharmacists (ASHP) and from the literature.<sup>[2,8-10]</sup> The domains were related to pharmacy management and resources, medication prescribing and dispensing, drug monitoring and pharmacy education and perceptions and barrier of services implementations. We used the 5-point Likert response scale system to obtain the responses of the participants; there were close-ended questions. An electronic questionnaire was distributed to coordinators of all the clinical pharmacy services or drug information centers at MOH hospitals. The data were collected through the Survey Monkey system.

## RESULTS

A total of 43 hospital pharmacies responded to the survey; the response rate was found to be 86%. Most of the hospitals responded were with 200–299 beds (14 (32.6%)) and with 100–199 beds (10 (23.3%)). Most of the hospitals had accreditation from the Central Board for Accreditation of Healthcare Institutions (CBAHI) (17 (39.53%)) and from the Joint Commotion USA (11 (25.59%)); however, 8 (16.6%) hospitals did not have any accreditations (Table 1). The highest level of education of the responders was found to be Bachelor of Pharmacy (22 (51.2%)), Master of Science (12 (27.91%)) and Doctor of Pharmacy (11 (25.58%)). Most of the responders were with greater than or equal to 6 and 1–3 years of experience in the field of pharmacokinetics services (9 (20.9%)). None of the responders had Board of Pharmaceutical Specialties (Table 2). The pharmacists and nurses had privileges of prescribing medication as per pharmacokinetics services at nearly

**Table 1: Demographic hospital information.**

Number of beds at your hospital	Response Count	Response Percent
< 50	3	7.0%
50-99	6	14.0%
100-199	10	23.3%
200-299	14	32.6%
300-399	6	14.0%
400-499	4	9.3%
500-599	0	0.0%
= or > 600	0	0.0%
Medical City	3	7.0%
Answered question	43	
Skipped question	0	
The hospital accreditation	Response Count	R e s p o n s e Percent
CIBAHI	17	39.53%
Joint Commotion USA	11	25.58%
Canada	0	0.00%
Saudi commission of health accreditation	7	16.28%
Non	8	18.60%
Answered question	43	
Skipped question	0	

18 (46.15%) and 16 (41.03%) hospitals, respectively. At 14 (37.84%) hospitals, the pharmacists have the privilege to request an estimation of patient's drug level and at 12 (30.77%) hospitals, they have the privilege to change the drug sampling time. At 15 (38.46%) hospitals, the nurses have the privilege to request an estimation of drug level and at 12 (31.58%) hospitals, they have the privilege to change drug sampling time (Table 3). The commonly prescribed medications via pharmacokinetic consultation were gentamicin (23 (71.88%)), phenytoin (23 (71.88%)), carbamazepine (22 (70.97%)), sodium valproate (22 (70.97%)) and warfarin (22 (70.97%)) (Table 4). The pharmacokinetics altering system during an electronic prescription was found in 9 (26.5%) hospital pharmacies, whereas in 8 (23.5%) hospital pharmacies, the pharmacist participated in pharmacokinetics research (Table 5).

## DISCUSSION

According to our results, the response rate was found to be good in different geographical areas of KSA. In KSA, we found a significant impact of the pharmacist on the pharmacokinetics services; therapeutic drug monitoring pharmacist had a significant impact on the patient condition and outcome.<sup>[4]</sup> The results of our study demonstrate that the prescribing privileges of pharmacokinetics services for pharmacists and nurses in MOH hospitals varied. However, Pedersen *et al.*

<b>Table 2: Demographic information related to the responder's qualifications.</b>		
<b>Academic Qualification (s):</b>	<b>Response Count</b>	<b>Response Percent</b>
Diploma. Pharmacy	4	9.30%
Bsc. Pharmacy	22	51.16%
Master of Science	12	27.91%
Doctor of Pharmacy	11	25.58%
Two years Residency (R1)	1	2.33%
Three years Residency (R2)	0	0.00%
Ph. D	1	2.33%
M.B.A.	1	2.33%
Answered question	43	
Skipped question	0	
<b>Board of Pharmaceutical Specialty</b>	<b>Response Count</b>	<b>Response Percent</b>
Board Certified Ambulatory Care Pharmacist (BCACP)	0	0.0%
Board Certified Critical Care Pharmacist (BCCCP)	0	0.0%
Board Certified Nuclear Pharmacist (BCNP)	0	0.0%
Board Certified Nutrition Support Pharmacist (BCNSP)	0	0.0%
Board Certified Oncology Pharmacist (BCOP)	0	0.0%
Board Certified Pediatric Pharmacy Specialist (BCPPS)	0	0.0%
Board Certified Pharmacotherapy Specialists (BCPS)	0	0.0%
Board Certified Psychiatric Pharmacist (BCPP)	0	0.0%
Non	38	100.0%
Other (please specify)	0	0.0%
Answered question	38	
Skipped question	5	
Total years of Experiences in Pharmacokinetic services	Response Count	Response Percent
< 1 year	4	9.3%
1 – 3 years.	9	20.9%
4-6 years.	7	16.3%
= or > 6 years.	9	20.9%
No experiences	11	25.6%
Other (please specify)	3	7.0%
Answered question	43	
Skipped question	0	

**Table 3: The prescribing privileges of pharmacokinetics services for pharmacists and nurses in the relevant hospital.**

<b>Answer Options</b>	<b>Independent Prescribing</b>	<b>Refill Prescribing</b>	<b>Prescribing under physician supervision</b>	<b>Not at all</b>	<b>No of existed</b>	<b>Percent of excited</b>	<b>Response Count</b>
For Pharmacists Medications	10	3	12	21	18	46.15%	39
Requesting of Drug levels	7	2	9	23	14	37.84%	37
Requesting of Sampling times	7	3	6	27	12	30.77%	39
For Nurses Medications	8	4	10	23	16	41.03%	39
Requesting of Drug levels	6	4	10	24	15	38.46%	39
Requesting of Sampling times	6	4	7	26	12	31.58%	38
<i>answered question</i>							39
<i>skipped question</i>							4

**Table 4: The medication of the pharmacokinetics consultation.**

Answer Options	76-100 % of patients	51-75 % of patients	25-50 % of patients	< 25 % of patients	We do not have it	No of existed	Percent of excited	Response Count
Gentamicin	7	6	5	5	9	23	71.88%	32
Tobramycin	2	5	2	1	19	10	34.48%	29
Amikacin	6	8	2	5	11	21	65.63%	32
Vancomycin	10	8	1	4	10	23	69.70%	33
Theophylline	3	5	3	6	12	17	58.62%	29
Digoxin	9	5	3	5	10	22	68.75%	32
Phenytoin	7	7	3	6	9	23	71.88%	32
Carbamazabine	6	7	4	5	9	22	70.97%	31
Sodium Valproate	5	8	5	4	9	22	70.97%	31
Lithium	4	4	3	3	16	14	46.67%	30
Heparin	9	6	0	3	11	18	62.07%	29
Warfarin	12	5	0	5	9	22	70.97%	31
Cyclosporine	4	2	4	6	12	16	57.14%	28
Methotrexate	4	6	1	5	12	16	57.14%	28
Tacrolimus	2	3	3	6	14	14	50.00%	28
Everolimus	2	2	4	1	19	9	32.14%	28
answered question								34
skipped question								9

**Table 5: The availability of drug-pharmacokinetics alerting system (e.g., checking allergy, drug levels (trough and peak), maximum dose, pregnancy and lactation, pharmacokinetics calculation and drug compatibility) with computerized physician order entry (CPOE).**

Answer Options	No. of Hospital Beds:								Response Percent	Response Count
	<50	50-99	100-199	200-299	300-399	400-599	= or > 600	Medical City		
Yes	0	0	4	3	2	0	0	0	26.5%	9
No	2	5	2	8	2	2	0	0	61.8%	21
I do not know	0	1	0	1	0	2	0	0	11.8%	4
answered question										34
skipped question										9
<b>The pharmacy participating in drug-pharmacokinetics research? Pharmacist performs drug-pharmacokinetics research either as principal investigator or co-investigator .pharmacist is likely to be (co-) author of a published paper. While drug-pharmacokinetics research shall develop mechanisms, in the form of policies and procedures, for the approval, protocols, planning and simple protocols.</b>										
Yes	0	0	2	4	1	1	0	0	23.5%	8
No	3	6	4	8	2	3	0	0	76.5%	26
answered question										34
skipped question										9

reported in 2017 a contradictory results, which might be the country of research had well-established TDM services.<sup>[11]</sup> Most of the requests for the estimation of drug level and change in sampling time were prescribed by the supervising physician. This finding is slightly more than what has been reported by Alsultan *et al.* who conducted a national survey of pharmacy practice. This difference in results might be related to

the time of conducting these studies.<sup>[1]</sup> However, our results were found to be lower than what has been reported by Pedersen *et al.* in 2016, which is related to the pharmacokinetics services founded in the study country more than 60 years ago.<sup>[8]</sup> European hospital pharmacies deliver a variety of patient-oriented clinical activities, including the provision of drug information, pharmacokinetic consultations, TDM and

management and prevention of adverse drug reactions and medication errors. Pharmacists' involvement in managing all these activities has a great outcome in maximizing patient safety.<sup>[12]</sup> The commonly prescribed medication during pharmacokinetics consultation was gentamicin, which is an antibiotic belonging to the class of drugs known as aminoglycosides. In the National Survey of Extended-Interval Aminoglycoside Dosing,<sup>[12]</sup> some of the respondents may not be monitoring "true troughs" but instead may be monitoring random serum aminoglycoside concentrations delayed in the dosing interval. Moreover, there are approximately 5% of the hospitals that do not monitor serum aminoglycoside concentrations. The effect of clinical pharmacokinetics consultation service on the use of gentamicin studied at a university hospital is promising.<sup>[14]</sup> The finding that gentamicin is the most common medication monitored through pharmacokinetics services has also been reported Ab Rahman *et al.* in 2013, who conducted a similar study in Malaysia, but their results showed lower frequency than that of ours. This difference might be because Ab Rahman *et al.* study is related to the TDM services that was established and developed prior to the MOH hospitals.<sup>[15]</sup> The rate of pharmacokinetics altering system during an electronic prescription was found to be low at hospital pharmacies. This shows that hospital pharmacies have the potential need to initiate the electronic pharmacokinetic altering system among MOH hospitals.<sup>[12]</sup> A competent pharmacokinetics researcher must have both pharmacokinetic calculations and TDM and dispensing skills. To enhance their knowledge on these skills, they were given more opportunities to perform pharmacokinetic calculations and TDM on essential medications in the context of enhancing patient-related outcomes. It is crucial to all pharmacists to learn according to the Accreditation Council for Pharmacy Education (ACPE) Standards and the ASHP accreditation guidelines for Postgraduate Year One PGY-1 and PGY-2 residency programs. They suggest pharmacokinetic skills are an expected area of competency in the workforce for pharmacists. In addition, the pharmacy students are expected to perform both pharmacokinetic calculations as well as TDM more frequently.<sup>[16-18]</sup>

## CONCLUSION

Healthcare providers including pharmacists and nurses had a significant role in providing pharmacokinetics services. Expanding these services with standard guidelines and electronic method of prescribing medication is needed to prevent drug-related problems,

improve clinical outcome of the patient and reduce economic burden.

## ACKNOWLEDGMENT

None.

## CONFLICT OF INTEREST

None.

## ABBREVIATIONS

**KSA:** Kingdom of Saudi Arabia; **MOH:** Ministry of Health; **PK:** Clinical Pharmacokinetic; **CPS:** Clinical pharmacokinetics services; **ASHP:** American Society of Health-System Pharmacists; **TDM:** Therapeutic drug monitoring.

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