

Knowledge, Attitudes and Practices of Health Care Practitioners regarding Crushing or Splitting Oral Solid Dosage Forms in Benghazi Medical Centre, Libya.

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ABSTRACT

Background: Crushing or splitting oral solid dosage forms is a widespread practice among health care professionals for many reasons such as swallowing difficulty or dose adjustment. However, this practice may alter drug properties in ways that can result in increased toxicity or instability.

Aim of study: This study was conducted to investigate and compare the knowledge, attitudes and practices of health care practitioners toward crushing or splitting oral solid dosage forms in Benghazi Medical Centre.

Method: A cross-sectional study employing a self-administered questionnaire was conducted during March and April 2019 among health care professionals whom working in Benghazi Medical Centre. The data was analyzed using the Statistical Package for Social Sciences.

Results and discussions: This study demonstrated that around 35.6% of the participants believed that all types of oral solid medications can be split or crushed. Interestingly, 41.9% thought that this practice does not cause dangerous problems to patients, and 24% agreed that it is allowed to crush or split Omeprazole enteric coated capsule. Moreover, 32% said that it is allowed to crush or split Carbamazepine controlled release tablets. However, Omeprazole is inactivated by acid in the stomach if it is crushed, whereas Carbamazepine is a narrow therapeutic index drug and its crushing may lead to toxicity. Overall, there was a significant difference among the participants' knowledge, attitudes and practices regarding crushing or splitting oral solid dosages (p value= 0.00001).

Conclusion: This study concluded that there was a lack of awareness among health care professionals toward special formulations that should not be split or crushed. The knowledge, attitudes and practices toward crushing and splitting oral solid dosages was the poorest among nurses and the best among pharmacists. Pharmacists can play a major role in educating nurses and identifying situations where crushing maybe unnecessary and suggest appropriate alternatives. Therefore, educational programs, training and collaboration between them could improve this practice.

Key words: Health care practitioners, crushing or splitting OSDFs, Benghazi medical centre.

INTRODUCTION

Rational use of medications require that the right medication is administered to the right patient at the right dosage and at the right time, all this at the lowest possible cost for the patients and their communities [1,2]. There is a challenge in administering oral solid dosage forms (OSDFs) in patients who cannot swallow such as the critically ill, young children and elderly. Alternatives as the liquid, parenteral, rectal or transdermal dosage forms should ideally be prescribed for these patients [3,4].

However, oral solid medications are occasionally prescribed for such patients due to the unavailability of suitable alternatives [4,5]. In such situations, the oral solid medication is altered by crushing or splitting in order to be able to administer these medications to patients. Splitting refers to dividing a solid dosage form to obtain smaller doses, while crushing refers to the process of converting a solid dosage form into powder. Although, alteration of oral solid formulations before administering

to patients is an unlicensed practice and the drug manufacturer would not be held liable for any harm that results from taking such medications as it might be the only way to administer medication to a patient [4,6].

Reasons of crushing or splitting OSDFs include; to provide smaller doses when the medications are not available at the required strength. For instance, in pediatric or geriatric patients for whom, the required doses are often not available on the market. Furthermore, to start with the smallest possible dose and then increase the dose gradually until reaching the required dose to enable drug toleration and reduce possibility of adverse effects of certain drugs. Additionally, to overcome swallowing difficulty particularly in children and elderly [1,7-10].

On the other hand, this practice may cause problems for some specially formulated solid medications where it can alter their pharmacokinetic and pharmacodynamic

properties in ways that can result in decreased or loss of efficacy, increased toxicity, product instability, irritant effects, failure to reach intended site and potential hazards to health workers [3, 4,11]. There is a risk of inhalation of cytotoxic or teratogenic medications by nurses who practice crushing without using protective equipments such as gloves and masks. Moreover, drug–drug interactions, contamination and loss of recommended dose could be an outcome of crushing of multiple medications together as well as not observing proper hygiene during crushing. Also, drug-food interactions may result from mixing crushed medications with fruit juice or food [4,12,13].

There are specially formulated dosage forms which should not be crushed or split. For example, drug toxicity is a significant problem due to splitting or crushing sustained release dosage forms (SRDFs) or drugs with narrow therapeutic indices such as Carbamazepine or Digoxin, where there is a risk of releasing a large amount of drug at one time (dose dumping) with these types of dosage forms [7,14]. Moreover, crushing or splitting enteric coated formulations may cause medication inactivation by the acidic medium of the stomach or may cause irritation of the gastrointestinal tract (GIT) or unacceptable bitter taste [4,12].

A previous study group stated that the law of negligence imposes a duty of care on practitioners towards their patients, and blindly carrying out the consequences of crushing without getting approval from the prescriber or consulting a pharmacist on the suitability and safety of a medication's crushing is not an excuse and in the court of law will not protect a nurse from responsibility in the case of patient harm [4,6].

The aim of the present study is to evaluate and compare the knowledge, attitudes and practices of health care practitioners (physicians, pharmacists and nurses) in Benghazi Medical Centre regarding crushing or splitting OSDFs using a cross sectional study.

METHOD:

Study design

A self administered questionnaire was handed out during March and April 2019 among a study sample of health care practitioners (physicians, pharmacists and nurses) whom are working in Benghazi Medical Centre in Benghazi city (a cross sectional study). A questionnaire form was designed through review of literatures and modified according to the study sample objectives. A total of 160 valid forms were used as a study sample. The questionnaire was based on four sections; the first part covered participants' demographic data, the second part covered their attitudes, the third part covered their knowledge, and the fourth part covered their practices regarding crushing or splitting OSDFs. The collected data was analyzed using the Statistical Package for Social Sciences (SPSS,21) software. Chi-square test was used to test for significant differences among different groups of the study sample with a statistical significance (*P*-value) of < 0.05.

RESULTS:

3. Results and discussions:

This was a descriptive study evaluating the knowledge, attitudes and practices of health care practitioners regarding crushing or splitting OSDFs in Benghazi Medical Centre. Previous related studies on this subject in Benghazi city were neither available nor found.

3.1. Demographic data:

The results of this study shows that the vast majority of the participants were females 87.5%. Physicians represented more than one half of the participants, followed by nurses 25%, and lastly pharmacists 16%. The age range between 30 to 39 years was represented by one half of the participants, while 43% of the participants were between 20 to 29 years. Regarding years of experience, approximately two thirds of the participants had job experience less than four years. The demographic data is summarized in table 1.

Table 1. Demographic data of participants.

Parameter	n (frequency)	%
Gender		
Female	140	87.5
Male	20	12.5
Specialization		
Physician	94	59
Pharmacist	26	16
Nurse	40	25
Age		
20 – 29	69	43.1
30 – 39	80	50
40 – 49	10	6.3
50 – 59	1	0.6
Years of experience		
≤ 2 year	67	51.9
3-4 year	19	14.7
5-6 year	18	14
7-8 year	5	3.9
> 8 years	20	15.5

3.2. Attitudes of participants toward crushing or splitting OSDFs:

Overall, there was a significant difference between different groups of the participants (physicians, pharmacists and nurses) in their attitudes toward crushing or splitting OSDFs (*p* value = 0.00001), the results are summarized in table 2.

In the present study, when the participants were asked whether all OSDFs can be crushed or split if required, 35.6% answered yes (25.5% of the physicians, 3.8% of the pharmacists, 80% of the nurses), whereas 59.4% answered no. In a previous study in Palestine among pharmacists and nurses, the results showed that only 20.8% of the respondents (3.5% of the pharmacists and 17.3% of the nurses) supported the idea that all tablets can be split or crushed if required [7].

Table 2. Participants' responses to questions about their attitudes toward crushing or splitting OSDFs.

Question	Total percent	Physician percent	Pharmacist percent	Nurse percent
Whether all OSDFs can be crushed or split if required?				
Yes				
No	35.6	25.5	3.9	80
Do not know	59.4	70.2	96.2	10
	5	4.3	0	10
OSDFs' splitting is a useful way to save money?				
Yes	34.4	17	76.9	47.5
No	53.8	68.1	23.1	40
Do not know	11.9	14.9	0	12.5
Do you think that crushing or splitting OSDFs may cause dangerous problems to patients?				
Yes	41.3	40.4	80.8	17.5
No	41.9	39.4	19.2	62.5
Do not know	16.9	20.2	0	20
Do you think that crushing or splitting OSDFs may cause potential hazards to health workers who crush or split them?				
Yes				
No	34.4	29.8	73.1	20
Do not know	45	41.5	26.9	65
	20.6	28.7	0	15
Do you think that adjusting of dosages through splitting or crushing OSDFs is a part of the pharmacist's role?				
Yes				
No	75	68.1	84.6	85
Do not know	17.5	21.3	15.4	10
	7.5	10.6	0	5

Over one third of the participants thought that OSDFs' splitting is a useful way to save money, whereas 53.8% did not think that. In this regard, the study in Palestine stated that 26.7% of

the participants thought that splitting of tablets is a useful way to reduce medications' cost [7]. Researchers in Canada evaluated the potential splitting of the top 200 prescription products in Canada as a cost-saving method and the results

found that such splitting practice appears to have limited usefulness as a cost-reduction strategy [8].

Interestingly, around 41.9% of the participants (39.4% of the physicians, 19.2% of the pharmacists and 62.5% of the nurses) did not think that crushing or splitting OSDFs may cause dangerous problems to patient. Moreover, a large percentage of the participants 45% (41.4% of the physicians, 26.9% of the pharmacists and 65% of the nurse) think that crushing or splitting OSDFs may not cause potential hazards to health workers who crush or split them, while 34.4% disagreed with this statement.

In this study, over 75% of the participants (68.1% of the physicians, 84.6% of the pharmacists and 85% of the nurses) thought that adjusting of dosages through splitting or crushing OSDFs is a part of the pharmacist's role. In comparison, a similar study in Palestine showed that more than one half of the participants thought that splitting or crushing OSDFs is a part of the physician's role or responsibility [7].

3.3. Knowledge of participants toward crushing or splitting OSDFs:

Similarly, there was a significant association between different groups of the participants (physicians, pharmacists and nurses) in their knowledge toward crushing or splitting OSDFs (p value = 0.00001). Regarding the source of information about crushing or splitting OSDFs, about 29% of the participants (60.6% of the physicians, 3.8% of the pharmacists and 60% of the nurses) said that their source of information is the physician, but 24% chose the pharmacist (32.9% of the physicians, 69.2% of the pharmacists and 45% of the nurses), other sources as websites, package leaflets, books and ministry of health were chosen by small percentages only. On the other hand, the previous study in Palestine reported that 49.1% of the participants expect to find information about this practice in the package leaflets [7]. Owing to the fact that splitting or crushing OSDFs depends on the type of dosage form or class of medication, the source of information could be the pharmacists as this practice is related to their field, it could also be found in related books. The type of dosage form could be found in the package leaflets.

When the participants were asked regarding the reasons of crushing or splitting OSDFs, around one half stated that for ease of swallowing and 34.6% said that to obtain the required dose, while to save money was accounted by a small percentage only. These results resemble the previous study in Mexico, where about 50% of respondents said that the main reason was for ease of swallowing, while 22% said that their reason was dose adjustment [1].

Regarding the potential problems that could result from crushing or splitting OSDFs, around 42% of the participants (57.4% of the physicians, 46% of the pharmacists and 22.5% of the nurses) stated that this would lead to loss of drug efficacy, while bitter taste problem was accounted by 15%, and 12.9%

mentioned possibility of toxicity. Similarly, 40% of respondents said that it could cause loss of drug effect in the study that was done in Mexico [1]. The crushing of multiple medications which could result in drug–drug interactions, loss of required dose and contamination problems were not accounted by any of the participants [15].

Interestingly, when the participants were asked regarding whether or not it is allowed to split or crush any type of SRDFs, approximately 54.4% answered correctly no (54.3% of the physicians, 92.3% of the pharmacists and 30% of the nurses), while around 16.3% answered yes. On the other hand, in the previous study in Palestine, only 20.5% of respondents correctly answered no (29.3% of the pharmacists and 10% of the nurses), and a large percentage 53% answered yes [7]. Moreover, 20% of the participants (6.4% of the physicians, 19.2% of the pharmacist and 52.5% of the nurses) said that it is allowed to split or crush coated dosage forms, whereas about 70% disagreed with that as shown in table 3.

Furthermore, when the participants were asked regarding whether it is allowed to crush or split anti-cancer medications or not, about 14.37% answered yes (1% of the physicians, 23% of the pharmacists and 40% of the nurses), whereas 60% answered correctly no and almost a quarter did not know as seen in table 3. But the study in Palestine showed that about 46.4% of the respondents (29% of the pharmacist and 68% of the nurses) did not know that anti-cancer drugs should not be split or crushed as this will expose health workers to health hazards [7].

Interestingly, approximately 32% of the participants said that it is allowed to crush or split Carbamazepine controlled release (CR) tablet, whereas 40.6% disagreed with that as shown in table 3. Similarly, the results of the study in Palestine reported that the respondents were also less knowledgeable about whether Carbamazepine CR tablets can be split or crushed, where 53% disagreed with crushing of Carbamazepine while 22.2% agreed with that [7].

When the participants were asked regarding whether it is allowed to crush or split Nifedipine coated tablets or not, more than one half answered correctly no, while about 17.5% (14.9% of the physicians, 11.5% of the pharmacists and 27.5% of the nurses) answered yes as shown in table 3. Indeed, Nifedipine coated tablet should not be crushed because the drug is highly light sensitive [7].

When the participants were asked regarding whether it is allowed to crush Omeprazole enteric coated capsules or not, approximately two thirds (84% of the physicians, 92.3% of the pharmacists, and 10% of the nurses) answered correctly no, whereas about 24% answered yes as illustrated in table 3. While the study in Palestine showed that 46% of the participants agreed that Omeprazole enteric coated capsules should not be crushed as this will inactivate the active ingredients by the acid in the stomach [7].

Table 3. Participants' responses to questions about their knowledge regarding crushing or splitting OSDFs.

Question	Total	Physician	Pharmacist	Nurse
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	percent	percent	percent	percent
Whether it is allowed to split or crush any type of SRDFs or not?				
Yes				
No	16.3	11.7	7.7	32.5
Do not know	54.4	54.3	92.3	30
	30	34	0	37.5
Whether it is allowed to split or crush coated dosage forms or not?				
Yes	20	6.4	19.2	52.5
No	70	85	80.8	27.5
Do not know	10	8.5	0	20
Whether it is allowed to crush or split anti-cancer medications or not?				
Yes	14.4	1.06	23.1	40
No	60	72.3	76.9	20
Do not know	25.6	26.6	0	40
Whether it is allowed to crush or split Carbamazepine CR tablets or not?				
Yes	31.9	20.2	38.5	55
No	40.6	45.7	61.5	15
Do not know	27.5	34	0	30
Whether it is allowed to crush or split Nifedipine coated tablets or not?				
Yes	17.5	14.9	11.5	27.5
No	56.3	59.6	88.5	27.5
Do not know	26.3	25.5	0	45
Whether it is allowed to crush Omeprazole enteric coated capsules or not?				
Yes	23.8	9.6	7.7	67.5
No	66.9	84	92.3	10
Do not know	9.4	6.4	0	22.5

3.4. Practices of the participants toward crushing or splitting OSDFs:

Similar to the participants' attitudes and knowledge, there was also a significant association between different groups of

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the respondents (physicians, pharmacists and nurses) regarding their practices toward crushing or splitting OSDFs (p value = 0.00001). In the present study, when the participants were asked whether they had prescribed or had been ordered to crush or split sustained release or coated dosage forms, about 25% answered yes (14.9% of the physicians, 7.7% of the pharmacists and 60% of the nurses), whereas 69.4% answered no, as shown in figure 1.

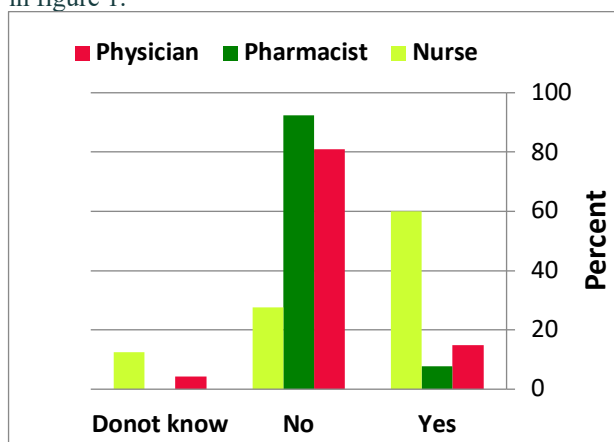


Figure 1. Participants' responses regarding whether they had prescribed or had been ordered to crush or split sustained release or coated dosage forms.

Alterations of the characteristics of some special oral solid medications as result of crushing them have been reported in literature. For instance, crushing of sustained-release Isosorbide Monohydrate tablets have led to loss of effectiveness when administered to a 78-year-old patient through a percutaneous endogastric tube [16]. Another study have reported a patient's death due to administration of crushed controlled release Nifedipine tablets [17]. A further study mentioned a patient's death from respiratory depression due to administration of crushed sustained release codeine preparation, and loss of efficacy of crushed Omeprazole enteric coated tablets [4,9]. The variation in the amount of drug reaching the systemic circulation due to formulation change may have impact on efficacy and the potential side effects, especially in narrow therapeutic indices drugs as; Phenytoin, Digoxin, Carbamazepine, Sodium valproate, Theophylline, Lithium, Warfarin and Citalopram [18].

The vast majority of the participants 91.9% did not get training or workshops regarding crushing or splitting OSDFs. In addition, when the participants were asked if they had informed patients regarding potential risks that could result from crushing or splitting OSDFs, approximately 37% answered yes (35% of the physicians, 61.5% of the pharmacists and 25% of the nurses), whereas a large percentage 61% answered no, as seen in figure 2.

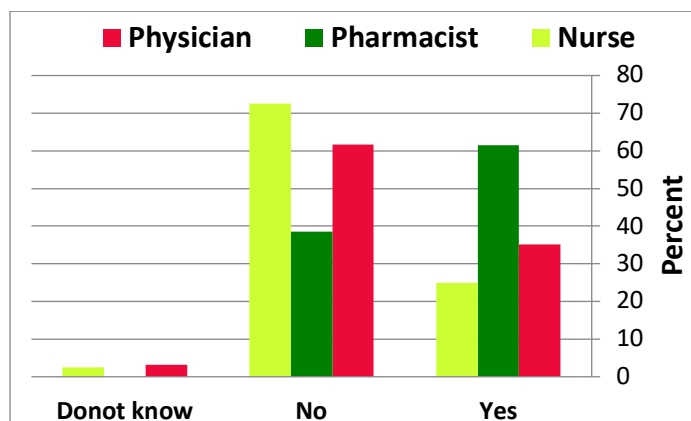


Figure 2. Participants' responses regarding if they had informed patients about the potential risks that could result from crushing or splitting OSDFs.

Moreover, when the participants were asked to mention names of medications that they had been involved with their crushing, the majority mentioned the drug name without mentioning the type of the dosage form. Indicating that most of them are unaware of the importance of knowing the type of dosage form.

The results showed that some of the participants were involved with crushing a number of medications, that should not be crushed. For example, nine nurses mentioned Rantidine and one physician mentioned Ibuprofen where both drugs have an unacceptable bitter taste thus they are administered as film coated tablets. In addition, one physician mentioned Diclofenac sodium which is known to cause GIT irritation thus it is administered as coated tablets while another physician mentioned Amlodipine which is a very light sensitive drug therefore if crushed must be used immediately. Furthermore, one pharmacist and one nurse mentioned Valproic acid which causes mucosal irritation and one nurse mentioned Carbamazepine CR tablets which should not be crushed as it is a narrow therapeutic index drug. In addition, three physicians mentioned Omeprazole which should not be crushed as it is destroyed by acid in the stomach but the capsule can be opened and its content (coated granules) can be mixed with food [1].

As well as, some of health care professionals were involved with splitting a number of medications, that should not be so. For example, four physicians, one pharmacist and three nurses mentioned Carbamazepine CR tablets . Furthermore, one physician mentioned Nifedipine, one physician and three pharmacists mentioned Ciprofloxacin which has an unacceptable bitter taste and it is available as coated tablets [1,7].

Conclusion and recommendations:

Overall, there was a lack of awareness among health care practitioners regarding special oral formulations that should not be split or crushed. The present study concluded that nurses' knowledge, attitudes and practices toward splitting and crushing OSDFs was less than that of pharmacists and physicians.

This study raises the requirement of continuing education programs for health care professionals about this important practice in order to minimize practice errors during their future work. Collaboration among health care professionals particularly nurses and pharmacists could improve this practice. Pharmacists can play a major role in educating nurses and identifying situations where crushing maybe unnecessary or should be avoided and suggest appropriate alternatives (e.g. liquid, transdermal, injectable, rectal, intranasal and sublingual formulations).

Limitations of study

Overall, the size of study sample was relatively small. Another limitation is unequal number of different groups of the participants (physicians, pharmacists and nurses), thus the results of comparison cannot be generalized.

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