ANALYSIS

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# Current disposal practice of unused and expired medicines amongst patients visiting a tertiary care hospital in North India

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## ABSTRACT

*Background*: Expired/Unused medicines are potentially toxic substances that are to be disposed of safely for protection of the environment and prevention of various health hazards directly and indirectly. Therefore, this study was conducted to assess knowledge, practice, and awareness towards disposal of left over medications among general public visiting tertiary care hospitals. *Methods*: A cross-sectional, observational and questionnaire based study conducted among 555 patients in north Indian tertiary care hospital during the period of December 2019 to February 2020. *Results*: A total of 555 patients had finished the review which included 55.5% females and 44.5% males. The majority of them were illiterate (42%). Less than half (46%) of the patients were aware about the meaning of expired medicines. An overwhelming proportion (87%) of the consumers admitted of keeping unused medications at home, out of which analgesics (46%) was the predominant one. Self-discontinuation (58.7%) was given the main reason for accumulation of medications at home and most exercised method among them was disposal in the trash (71%). All the contestants were in the favour of a programme to collect unused/expired medications from their home. *Discussion*: It has been seen that different methods of drug disposal is in practice which are unsafe for the environment as well as for the population. So in this study, it has been highlighted the need for establishment of uniform guidelines for the harmless disposal of medicines. The healthcare giver should provide safer medicine dumping directions on scheduled patient training session.

**Keywords**: Left over medications, drug disposal, environment, cross sectional study

## 1. INTRODUCTION

India continues to have the persisting environmental problem of disposal of expired, unused, unwanted medicines (Garg et al., 2017). The patients after buying the prescribed medicines by the doctor are not able to consume all, reason being patients fail to tolerate adverse effects of medications, dose is altered on next follow up, feeling of being healthy lead to discontinuation of medicines, medicines reaching expiration date or promotional practices by manufacturers, physicians prescribing practices, or dispensers practices (Seehusen et al., 2006; Bashaar et al., 2017). Many households discard such leftover medications through general municipal waste bins, sinks, or flush them down their toilets (Sivasankaran et al., 2018).

Many pharmaceuticals are made up of hazardous chemicals that can affect the surrounding environment and produce toxic effects in humans as well as animals (Michael et al., 2019). For example, non-steroidal anti-inflammatory drug (NSAID) diclofenac has been show to induce renal failure in vultures following the ingestion of carrion from cattle treated with this drug (Oaks et al., 2004). In the USA, many drugs such as acetaminophen, verapamil, and estradiol are find in water ways (Bashaar et al., 2017; Kinrys et al., 2018). The presence of expired medicines in the sewerage system can lead to increased resistance to antibiotics available (Michael et al., 2019). In spite of these serious threats to human life, still there is no proper guideline for safe disposal of leftover medicines.

## 2. MATERIALS AND METHODS

### Study design

This cross sectional, observational and questionnaire-based study was conducted at in-patient and outpatient departments of tertiary care teaching hospital in north India. The study was conduct during the period of December 2019 to February 2020.

### Study population

A total of 555 patients were involved in this study after getting their written consent to participate in this study. The investigators casually selected various departments of the hospital including in-patient and outpatient for administering the survey form. Contributors who had any thoughtful of exposure/usage of any over the counter drugs or prescription and obtained drugs themselves were recruited for this study. The study population consists of either gender, above the age of 18 years in various departments of north Indian tertiary care hospital. There was no upper regulation for the patients. Written informed consent was obtained from every patient who answered the questionnaire. Those who were not willing to participate were excluded from the study.

### Data collection

There were three sets of pre-designed questionnaire based on knowledge, attitude, and practice used for this study. An interviewer administered questionnaire which contain a set of 3 questions to assess attitude, 4 questions to assess knowledge, and 8 questions to assess practices of patients regarding the disposal of left-over medicines which was already used by a case report study of article entitled current disposal practice of used and expired medicines among general public in Delhi and National Capital Region, India. A prior permission or validation for using questionnaire was taken by mail. Investigators expressed a pilot questionnaire based on understanding from earlier similar studies conducted and also upon consultation refined by the internal experts in the department of General Medicine and Pharmacy Practice and the final questionnaire was expressed by the investigators. The pilot questionnaire was checking in a little sample of casual Out-Patient-Department and In-Patient-Department accessing patients. After ethical approval, the final validated questionnaire was administered to 555 patients in different departments of north Indian tertiary care hospital.

### Result analysis

Responses of patients were note down and entered in Microsoft Access 2016 and then all the data is export to Microsoft Excel 2016®. Microsoft Excel, SPSS (Statistical Package for the Social Sciences) and Prism software, analyzed data for percentage and frequency responses.

## 3. RESULT

The current study assessed a total of 555 Patients who visited to the hospital, out of which majority (234, 42%) were of young age in the range of 18-39 years and minimum patients (94, 17%) belongs to elder age group 60 years or above. Based on gender evaluation females seeking the health advice were more (308, 55.5%) as compared to males (247, 44.5). Majority of population were

Illiterate (232, 42%), followed by higher secondary/12th (93, 17%) and a complete bar graph represent all demographic parameters shown in (figure 1).

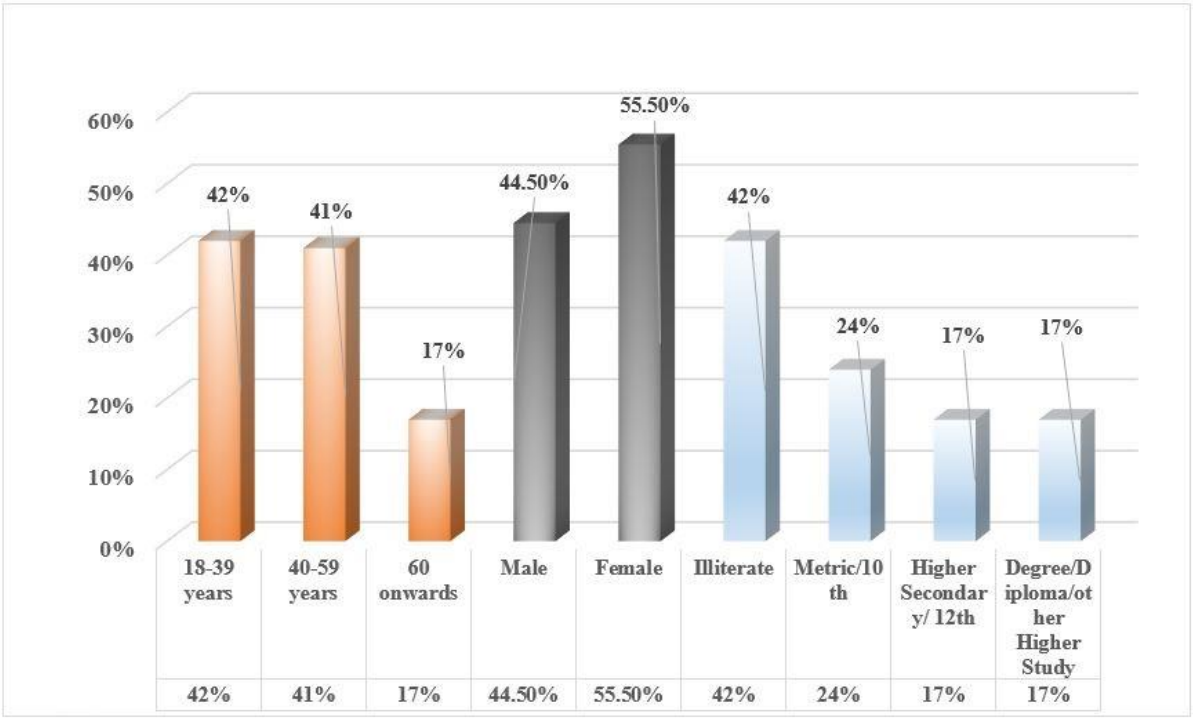


**Figure 1** Demographic parameters

**Knowledge evaluation**

In the evaluation of knowledge, maximum patients (46%) understood the concept of expired medicine as production of toxins, treatment failure, and loss of shelf life. According to (22%) patients, expired medicines produced toxic effect, (18%) of them thought treatment failure; remaining (14%) said loss of shelf life. A smaller portion of patients (22%) knew that expired medicines show a part in drug resistance, while majority of them (72%) were unaware about it. Most of the patients had the knowledge that expired medicines lead to environmental pollution. Major chunk of literate patients knew that expired medicines cause adverse drug reaction, whereas illiterate did not know it (Table 1).

**Table 1** Knowledge evaluation

| Questions | | Response % (n) | Demographic Parameters (Maximum) | | | Demographic Parameters (Minimum) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Age | Gender | Qualifications | Age | Gender | Qualifications |
| Q.1. What do you understand by the expiry of medicine? | a) Loss of Service life | 14% (80) | 40Y (35) | F (44) | I (56) | 18Y (11) | M (36) | D(3) |
| | b) Producing toxic effect | 22% (124) | 40Y (57) | M (66) | I (57) | 18Y (31) | F (58) | D (10) |
| | c) Loss of effect/ treatment failure | 18% (98) | 40Y (51) | F (59) | I (57) | 18Y (23) | M (39) | D (5) |
| | d) All the above | 46% (253) | 18Y (131) | F (147) | D (77) | 60Y (46) | M (106) | $12^{th}$ (56) |
| Q.2. Do expired medicines produce Drug resistance? | a) Yes | 22% (121) | 18Y (71) | F (67) | D (55) | 60Y (15) | M (54) | I (19) |
| | b) No | 6% (34) | 40Y(8) | F (18) | I (12) | 18Y (17) | M (16) | $10^{th}$ (5) |
| | c) Do not | 72% (400) | 40Y | F (223) | I (201) | 18Y | M (177) | D (33) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | know | | (176) | | | (108) | | |
| Q.3. Do expired medicines lead to environmental pollution? | a) Yes | 71% (395) | 18Y (163) | F (226) | I (134) | 60Y (81) | M (169) | 12th (72) |
| | b) No | 10% (53) | 40Y (18) | M (27) | I (25) | 60Y (17) | F (26) | D (4) |
| | c) Do not know | 19% (107) | 40Y (50) | F (56) | I (73) | 18Y (15) | M (51) | D (7) |
| Q.4. Do expired medicines produce adverse drug reactions? | a) Yes | 45% (250) | 18Y (109) | F (150) | D (71) | 60Y (53) | M (100) | 12th (53) |
| | b) No | 7% (39) | 40Y (17) | M (20) | I (14) | 60Y (7) | F (19) | D (8) |
| | c) Do not know | 48% (266) | 40Y (114) | F (139) | I (152) | 18Y (72) | M (127) | D (16) |

**Practice evaluation**

A larger portion (87%) of the patients declared they possessed medicines, which were unused at home. Almost 2/3rd of total patients specified that they read/see the expiry date before buying medicines. More than 1/2 of the people (63%) pay for medicines with prescription, a substantial proportion (33%) procured OTC and very few patients (1%) were there who received medicine from friend or other. Amongst the unused medicines, which are stored at home, analgesics (46%) were found in majority, following anti-diabetic (24%), anti-hypertensive (16%) and anti-microbial (4%). Majority of patients (56%) admitted self-discontinuation of medicines as the reason of excess drug at home, while (32%) others gave the reason of discontinuation by the treating doctor. We also found that a certain population (10%) has a complaint of over dispensing of medication. Unfortunately, it was found that 92 % of the population threw away the excess medication instead of returning it to the medical store or donating it to NGO. It was also distinguished that the main stream of people (71%) threw the leftover medications in household trash, while 20% of the population preferred burring the medicines in the ground, remaining proportion practiced burning 5% and flushing down the medicines 4% (figure 2 & Table 2).

**Table 2** Practice evaluation of possession and disposal of unused medicines

| Questions | | Response % (n) | Demographic Parameters (Maximum) | | | Demographic Parameters (Minimum) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Age | Gender | Qualifications | Age | Gender | Qualifications |
| Q.1. Did any quantity of purchased medicine remain unused at home? | a) Yes | 87% (485) | 40Y (189) | F (270) | I (201) | 60Y (126) | M (215) | D (82) |
| | b) No | 13% (70) | 40Y (30) | F (38) | I (31) | 60Y (14) | M (32) | 12th (9) |
| Q.2. Do you check the expiry date of the medicines? | a) Yes | 59% (327) | 18Y (137) | F (183) | I (108) | 60Y (63) | M (144) | 12th (62) |
| | b) No | 41% (228) | 40Y (92) | F (125) | I (124) | 18Y (59) | M (103) | D (25) |
| Q.3. Ways of Procuring Medicines? | a) Purchased on prescription | 63% (350) | 18Y (140) | F (200) | I (130) | 60Y (75) | M (150) | 12th (64) |
| | b) Purchased over the counter | 33% (181) | 40Y (74) | F (97) | I (85) | 18Y (49) | M (84) | D (20) |
| | c) Purchased upon the advice of known person | 3% (16) | 60Y (7) | M (12) | I (12) | 18Y (3) | F (4) | 12th (0) |
| | d) Received from friends /other | 1% (8) | _ | F (7) | I (5) | _ | M (1) | D (0) |
| Q.4. Medicines commonly stored by you? | a) Analgesics | 46% (257) | 18Y (114) | F (138) | I (93) | 60Y (55) | M (119) | 12th (48) |
| | b) Antimicrobials | 4% (21) | 18Y (10) | F (15) | D (7) | 60Y (4) | M (6) | 12th (3) |
| | c) Anti-hypertensive | 16% (90) | 40Y (40) | F (51) | I (40) | 18Y (21) | M (39) | D (10) |
| | d) Anti-diabetic | 24% (132) | 40Y (59) | F (79) | I (70) | 18Y (33) | M (53) | D (17) |
| | e) Other | 10% (55) | 40Y (25) | M (30) | I (22) | 60Y (12) | F (25) | 12th (7) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Q.5. Reasons for the excess medication in the home? | a) Discontinuation of medication by the doctor | 32% (177) | 40Y (74) | F (100) | I (72) | 60Y (45) | M (77) | 12th (26) |
| | b) Self-discontinuation | 58.7% (326) | 40Y (130) | F (183) | I (141) | 60Y (82) | M (143) | D (42) |
| | c) Buying medication because of advertisements | 0.3%(2) | 18Y (2) | F (2) | _ | _ | _ | _ |
| | d) Over prescription/ over dispensing" | 9% (50) | 18Y (22) | M (27) | I (19) | 60Y (13) | F (23) | 10th (9) |
| Q.6. What do you do with the unused medicines? | a) Throw away | 29% (159) | 40Y (74) | F (84) | I (63) | 60Y (33) | M (75) | D (18) |
| | b) Donate to Hospitals/NGOs | 3% (17) | 18Y (9) | F (13) | D (6) | 60Y (2) | M (4) | 12th (2) |
| | c) Return to the medical store | 27% (153) | 40Y (66) | F (83) | I (76) | 60Y (41) | M (70) | D (23) |
| | d) Keep at home until expired | 41% (226) | 18Y (89) | F (128) | I (87) | 60Y (64) | M (98) | 12th (39) |
| Q.7. What do you do with the expired medicines? | a) Throw away | 92% (509) | 40Y (201) | F (291) | I (214) | 60Y (130) | M (218) | 12th (82) |
| | b) Donate to Hospitals/NGOs | 0.3% (2) | 18Y (2) | _ | _ | _ | _ | _ |
| | c) Return to the medical store | 2.3% (13) | 60Y (5) | M (10) | I (7) | _ | F (3) | - |
| | d) Keep at home | 5.4% (31) | 40Y (14) | M (18) | I (11) | 60Y (5) | F (13) | D (4) |
| Q.8. How are the expired medicines discarded at home? | a) Flushed in sewer water | 4% (21) | 18Y (9) | F (12) | I (11) | 40Y (5) | M (9) | - |
| | b) Throw away in Household trash | 71% (396) | 40Y (166) | F (215) | I (157) | 60Y (85) | M (181) | D (68) |
| | c) Bury in the ground | 20% (112) | _ | F (66) | I (53) | 18Y (34) | M (46) | 12th (14) |
| | d) Burning at home | 5% (26) | _ | F (15) | I (11) | 18Y (8) | M (11) | 12th (2) |

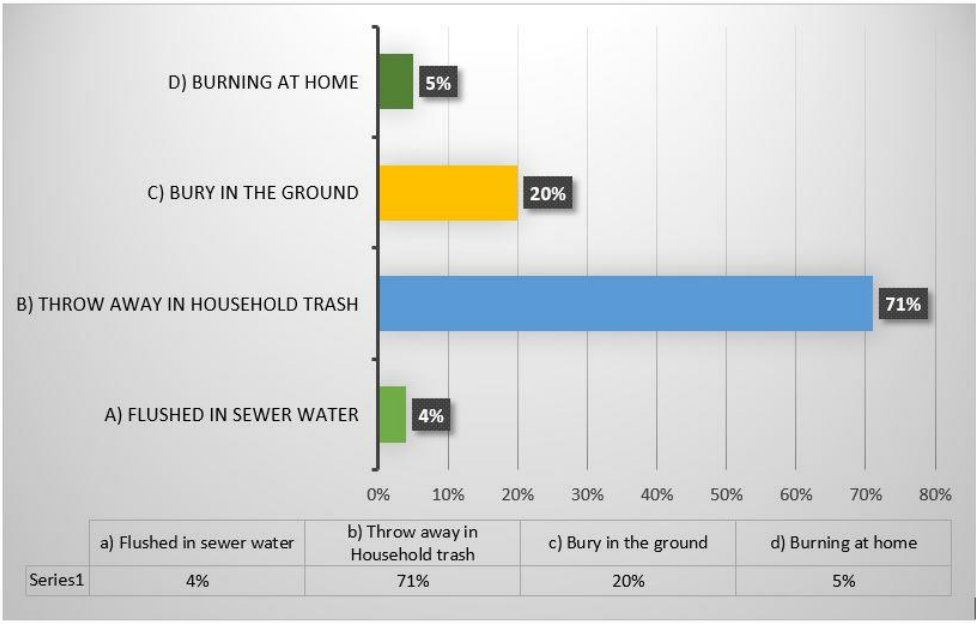


**Figure 2** Methods of disposal of drugs by the patients

**Attitude evaluation**

In this evaluation, all patients agreed to the statement of safe disposal of medicines being necessary. When asked about the requirement for a platform to collect leftover medicines from household and when asked about the necessity of awareness campaign, nearly all of them agreed to it (table 3).

**Table 3** Attitude towards practice of disposal of unused medicines

| Questions | | Response % (n) | Demographic Parameters (Maximum) | | | Demographic Parameters (Minimum) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Age (Years) | Gender (Female) | Qualifications | Age | Gender | Qualifications |
| Q. 1. Is the safe disposal of medicines necessary? | a) Agree | 100% (555) | 40Y (240) | F (308) | I (232) | 60Y (140) | M (247) | $12^{th}$ (93) |
| | b) Neither Agree nor Disagree | - | - | - | - | - | - | - |
| | c) Disagree | - | - | - | - | - | - | - |
| Q. 2. Is there any need for a program to collect unused or expired medicines from home? | a) Agree | 99.8% (554) | 40Y (240) | F (307) | I (232) | 60Y (140) | M (247) | $12^{th}$ (93) |
| | b) Neither Agree nor Disagree | - | - | - | - | - | - | - |
| | c) Disagree | 0.2% (1) | 18 Y (1) | F (1) | $10^{TH}$ (1) | - | - | - |
| Q. 3. Is awareness regarding the hazards of unsafe disposal and methods of safe disposal of medicines among the general public required? | a) Agree | 100% (555) | 40Y (240) | F (308) | I (232) | 60Y (140) | M (247) | $12^{th}$ (93) |
| | b) Neither Agree nor Disagree | - | - | - | - | - | - | - |
| | c) Disagree | - | - | - | - | - | - | - |

## 4. DISCUSSION

Currently medicine waste management and disposal is a hot subject grabbing consideration because it has been understood that improper disposal can infect the environment and pose the risk to water, air, agricultural products, food chain and even harm animals/ livestock. Due to harmful effects of disposed medicines, studies are being conducted all over the world to form a policy for proper disposal (Bashaar et al., 2017). This study is conduct to evaluate the medicine disposal practice and knowledge among the patients included in the study. It was seen majority of them were of young age group and predominantly females. Concerning education, most of them were illiterate contributing to fact about unawareness regarding expiry of the drugs and harmful effects of using such medications and disposal of leftover medications. Somewhat same findings were seen in the study among the general population of Delhi and Gujarat also.

The U.S. Food & Drug Administration (FDA) mandated specifying expiration dates on all medicines in the late 1970s. Wide-range of drugs is not toxic when expired, but indeed lose their effectiveness over time. The expiration date means the date till which the product is safe and potent (Raja et al., 2018). Out of total, nearly half understood the concept of expiration date of drugs meaning loss of shelf life and leading to treatment failures. Around 72% patients were not aware about the drug resistance, hence acting as a risk factor for promoting the antibiotic resistance in the population.

The countries like Germany and Sweden follow practice of returning leftover medication to the pharmacy.US Food and Drug Administration had initiated the drug take back programme on 25 September 2010, for preventing and controlling problems like antibiotic resistance and to reduce the harmful effects from disposal of medications by patient itself (Raja et al., 2018). As per this study, larger proportion (87%) admitted they possessed the leftover medications at home and only $2/3^{rd}$ of total patients check the expiry date before purchasing medications. Most of them were aware about the harmful impact and adverse drug reaction upon exposure to such medications, still 92% threw away the excess medications. Most common reason studied among the population for

storing medication was for later needs. The most common drug stored were analgesics followed by oral hypoglycaemic drugs, anti-hypertensive and anti-microbial (Mamo et al., 2018).

The American Pharmacists Association recommends that unwanted medications be beaten or dissolved in water prior to blending with the unwanted substance. Health care groups along with Connecticut Department of Environmental Protection recommended 4 easy steps for medicine disposal: First; preserve medicine its unique field and pass outpatient's call or dispose of the label. Second: adjust the medicinal drugs to deter consumption, as an example for capsules: added a small quantity of water to partly dissolve them; for liquid medicinal drugs: added charcoal, salt, kitty litter, flour or powdered spice to make a pungent, unlikable product that prevents it from consumption by anyone; blister packs can be wrapped with three four layers of adhesive tapes (like duct tapes). Further the medicine container should be closed with packing or adhesive duct tape and again covered by an opaque covering material or plastic bag. The precaution need to be taken is, the medicines should not be mixed with any food item because stray animals may consume them. Finally; discard it in the trash (Bashaar et al., 2017).

It is important to realise that discarding the leftover medications through improper ways can pollute the environment and expose the people to health hazards (Michael et al., 2019). Good medicine disposal practice is an essential aspect of public fitness preventive offerings completed via way of means of community pharmacists because of their proximity and accessibility to fitness seekers. As per the study, it has been concluded that health seekers have lack of awareness regarding safe disposal of medications so proper awareness programme is the need of an hour to tackle the issues arising from improper drug disposal.

## 5. CONCLUSION

According to this study, majority of the patients were practicing inappropriate methods of drug disposal though they were aware of the consequences to the environment, the lack of proper guidance for safe disposal renders them vulnerable for such practices. To minimize it, government should implement a national level drug take-back programmes and awareness programmes to be conduct periodically to inspire general population for safe disposal.

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**Author contributions**

All authors were involved in conception, designing of the study, result analysis. Paras Monga and Rubi were involved in collection of data, analyzed and interpreted data. Paras Monga, Rubi and Taniya Pruthi prepared the Initial draft of the manuscript. The manuscript finally modified, reviewed and approved by all the authors.

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**Conflicts of interest**

The authors declare that there are no conflicts of interests.

**Informed Consent**

Written informed consent was obtained from all individual participants included in the study and all the information regarding this is included in this paper.

**Ethical Approval**

The study was approved by the Institutional ethics committee of Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana provided ethical approval (Approval Letter Number IEC-1558/2019-20) on date 10/12/2019.

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**Data and materials Availability**

All data associated with this study are present in the paper.

**Peer-review**

External peer-review was done through double-blind method.

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