AN EXAMINATION ON THE ROLE OF GAMIFICATION IN ENHANCING MEDICATION ADHERENCE

Mahesh Kantilal Patil
(Research Scholar)
Dr. Martynujoy Manumdar
(Assistant Professor)
Department of Pharmacy
SunRise University, Alwar

Abstract

This research explores the role of gamification in enhancing medication adherence among rheumatoid arthritis (RA) patients through a multi-center randomized controlled trial conducted in outpatient rheumatology clinics of six hospitals from August 2020 to April 2022. The study incorporates two patient research partners in the design phase, emphasizing patient involvement. Utilizing game elements to motivate users, the trial assesses the impact of a serious game intervention on Disease-Modifying Anti-Rheumatic Drug (DMARD) implementation adherence over a three-month period. Despite the frequent engagement with the serious game, the trial reveals no statistically significant improvement in medication adherence or clinical outcomes. The findings underscore the challenges in applying gamification to medication adherence, prompting suggestions for future research, including integration into care pathways and a dynamic trial design. The research emphasizes the ongoing evolution of serious games, urging collaborative

efforts between researchers, game developers, and healthcare professionals to optimize interventions for chronic disease management.

1. INTRODUCTION

The term "gamification" was created in 2002 by British-born computer programmer and game developer Nick Pelling. Since it's still a new idea, there hasn't been a consensus definition established yet. The term "gamification" has two major definitions. The first is that video games are becoming more and more common in today's culture, impacting interactions and daily life. Previously, younger guys were the target audience for video games. This isn't the case for now, when people of all ages play and target video games, both male and female. As technology has advanced, gaming platforms have also grown, moving from consoles to PCs and smartphones, making video games more widely available and more reasonably priced than in the past. This study will concentrate on the second definition, which involves using video games or gaming aspects to encourage users to participate in longer and more intense activities. It is possible to make boring, repetitive work more entertaining and inspiring by incorporating game features into non-gaming contexts.

Gamification is an interdisciplinary field of study that consolidates game plan, client experience plan, conduct financial aspects, and inspirational brain science. It is characterized as "the purposeful utilization of game components for a gameful encounter of non-game errands and setting." More often than not, gamification is a necessary evil; that is, a ton of gamified administrations attempt to support inspiration and commitment with a definitive objective of empowering a particular way of behaving. As of this moment, most of survey concentrates on that deliberately look at the effect of gamification focus on a blend of mental results (like natural inspiration and commitment) or potentially broad conduct results (like use and maintenance).

1.1.The concept of adherence

Although the concept of adherence has long been utilised in other domains, the phrase is arguably most well-established in the health domain. Adherence is defined as "attachment or commitment to a person, cause, or belief". This definition teaches us that attachment and commitment involve persistent behaviour, whereas adherence does not refer to transient, one-time behaviour. Adherence is portrayed as "the reality of somebody acting precisely as indicated by rules, convictions, and so forth" by the Cambridge Word reference. As per this idea, rules and convictions exist; at the end of the day, an ideal way of behaving is imagined.Thus, the reader can infer from these two definitions that adherence implies both an intended usage aspect (behaviour as per norms, beliefs) and a temporal feature (behaviour as it develops over a longer period of time).

1.2.The Role of Gamification in Enhancing Medication Adherence

The role of gamification in enhancing medication adherence lies in its ability to leverage game design elements and principles to motivate individuals to consistently follow their prescribed medication regimens. Traditional approaches to promoting medication adherence often face challenges related to patient motivation, forgetfulness, and lack of engagement. Gamification addresses these issues by introducing elements such as rewards, challenges, and progress tracking, transforming the medication-taking experience into a more interactive and enjoyable process. By incorporating game-like features, such as virtual rewards, personalized challenges, and real-time feedback, gamification seeks to increase patient engagement and foster a sense of achievement, ultimately encouraging individuals to adhere to their medication schedules. This innovative approach capitalizes on the intrinsic human desire for achievement and competition, providing a potential solution to the longstanding issue of medication non-adherence and its associated negative impacts on health outcomes.

2. LITERATURE REVIEW

Rahim, M. I. A., & Thomas, R. H. (2017): All age groups are affected by epilepsy, and we have been sluggish to adopt computer game-derived technology and psychologies. Similar to how smartphones have become more popular, gaming has also become mainstream and is no longer

the domain of younger men. "Gamification" encourages consumers to participate in longer and more intense activities. It is possible to make mundane jobs more entertaining and inspiring by incorporating game features into non-gaming contexts. Executives in marketing have taken use of this, but there are also obvious applications in the healthcare industry. This paper explored the use of previously published frameworks to support individuals with epilepsy in adhering to drug regimens in order to create an enjoyable, patient-focused, and adjustable experience.

Tran, S., Smith, L., El-Den, S., & Carter, S. (2022): New approaches in healthcare that target drug adherence include aspects taken from computer games or direct-to-patient incentives. We searched Embase, MEDLINE, PsycINFO, CINAHL, and Web of Science for pertinent English-language publications published between September 24, 2020, and the database's creation. This scoping audit was driven by the PRISMA-ScR checklist and the Arksey and O'Malley system (Favored Detailing Things for Efficient Audits and Meta-Analyses expansion for Scoping Surveys). Studies that specifically addressed medication adherence through the use of incentives or gaming components in mobile apps were included after a methodical screening approach. A risk of bias tool appraisal was also conducted for each study design. Agile methodology and an evidence-based co-design strategy are needed to address medication adherence with gamified and incentivized mobile apps. This review suggests that certain apps are being developed using an agile methodology; nevertheless, patient engagement is not present in the early phases.

Li, Y., Phan, H., Law, A. V., Baskys, A., &Roosan, D. (2023): Medicine non-adherence is a typical issue in medical services that prompts more regrettable wellbeing and higher clinical costs. The principal endeavor to give patients crucial data on possibly life-saving prescriptions and work on their adherence to treatment is MedScrab, a gamification-based portable wellbeing application. The improvement of MedScrab and a two-stage blended strategy ease of use assessment of MedScrab are introduced in this review. MedScrab's handiness was surveyed subjectively in Stage I through a verbally process procedure. Two subjects rose up out of the subjective information examination of Stage I, which included 51 members: the application's great usefulness and four regions that required turn of events. The plan of MedScrab thought about the improvement ideas. A famous mHealth Application Convenience Survey (MAUQ) was likewise approved in Stage I.

The underlying 18-thing MAUQ scale was diminished to a 15-thing scale with two elements — handiness and fulfillment (11 inquiries) and usability (4 things) — by quantitative information examination of Stage I information. A changed MAUQ was utilized in Stage II to study 83 individuals from Amazon Mechanical Turk. Solid inside consistency and high component loadings (somewhere in the range of 0.623 and 0.987) were found in the altered MAUQ scale. Planning, surveying, and refining mHealth applications can be directed strategically by the review plan of the convenience assessment. As indicated by the convenience appraisal, MedScrab was evaluated as being exceptionally helpful and fulfilling (5.72 out of 7) and simple to utilize (6.24 out of 7). The consequences of the quantitative information investigation approve the changed MAUQ as a solid instrument for surveying the MedScrab's ease of use.

2.1. OBJECTIVES

- To Evaluate the Impact of a Serious Game on Medication Adherence
- To Examine Beliefs about Medication Changes
- To Analyze Intervention Usage Patterns
- To Provide Suggestions for Future Improvement

3. MATERIALS AND METHODS

3.1. Trial setup and design

A multi-center, three-month follow-up randomised assessor-blinded controlled trial. Two patients inquire about accomplices made a difference plan the consider and two more understanding inquire about accomplices talked with one of the analysts around the discoveries and their suggestions. Between August 2020 and April 2022, the experiment was run in the outpatient rheumatology clinics of six institutions.

3.2. Recruitment and eligibility criteria

A list of eligible participants was made available by the hospital information system. These individuals were then randomly chosen using a random number generator, and after three weeks, they received a reminder along with an information letter and an informed consent form. The purpose of the study was presented to participants as an evaluation of how playing a puzzle game

affected their perception of the burden of RA disease. The purpose of not mentioning medication adherence was to keep individuals from changing their adherence practices.

Coming up next were expected for incorporation: a clinical determination of RA; current utilization of DMARDs without adherence rules; self-administration of medicine without carer help, home consideration, or utilization of a multi-portion drug conveyance framework; ownership of an iOS or Android cell phone or tablet; and a functioning email address.If a participant has taken part in another trial or was not fluent in the language, they were eliminated. The research team called participants to make sure they met the eligibility requirements after they gave their informed permission.

3.3.Randomisation and blinding

A 1:1 ratio was used to assign participants to the intervention or control groups. Variable block randomization with block sizes of two, four, and six was carried out by Castor EDC, stratified by hospital, and was hidden prior to allocation.

3.4.Data collection

A research code was given to each participant, and CastorEDC, an electronic data management programme that complies with ISO 9001 and 27001 standards, was used to log all data. Email surveys were also distributed via CastorEDC. Questionnaires on medication adherence and attitudes were gathered at baseline, one, and three months. Moreover, benchmark segment data, gaming experience, and clinical patient-detailed results were accumulated at 90 days, as well as mediation play information at one and 90 days.

3.5.Instruments Used

The primary outcome was the adherence to DMARD execution following three months. This was estimated by looking at the level of members who were not sticking (under 80%) between the mediation bunch (serious game and normal consideration) and the benchmark group (regular consideration). The Consistence Survey on Rheumatology (CQR, 19 Likert-scaled things, thing

scores going from 1 to 421) was utilized as the discriminant device. Following the recoding of the negative formed things, a urgent cut-off score of −0.5849 was figured to recognize disciples (≥80%) and nonadherents (<80%).

At one and 90 days, members additionally finished the Convictions about Medication Survey Explicit (BMQ-Explicit, 10 Likert-scale things, thing scores going from 1 to 523 24), which assesses convictions in regards to the need of drug and stresses over prescription. The need concerns contrast (NCD) score (range: −20 to 20) was gotten by deducting the aggregate scale score for fundamental convictions from the aggregate scale score for concern convictions. At the point when a NCD score is great, need convictions offset concern convictions.

The Rheumatoid Joint pain Infection Movement Record (RADAI, 5 things) and the Wellbeing Appraisal Poll (HAQ, 20 inquiries with five aspects) were assembled at 90 days to assess the effect of the mediation on clinical results.

The accompanying information was extricated from Google Firebase to decide the use of the intercession: absolute play time, number of meetings, normal meeting length, number of conduct undertakings performed, and span of movement perception.

3.6. Sample size

In arrange to realize 80% control to identify a 15% single-sided contrast in adherence after three months with a 15% follow-up misfortune, a target test estimate of 120 members per arm was calculated.

Table 1: Sample Size

Participants	Frequency
Eligible Participants	2000
Randomized	250
Participation	120
Follow Up (1 Month)	96

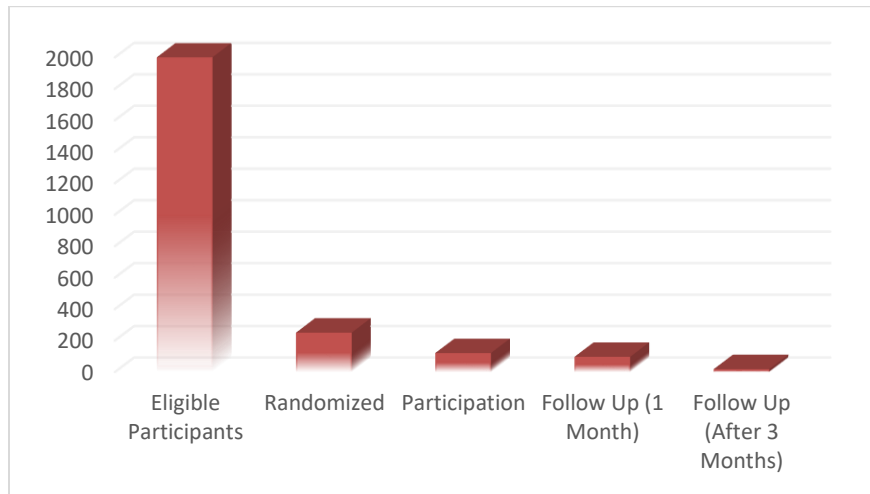| Follow Up (After 3 Months)	18

Figure 1: Graphical representation of Sample size

3.7.Statistical analysis

To depict the quiet and condition, graphic insights were utilized. The essential result, adherence at three months utilizing the CQR discriminant work, was evaluated employing a Chi-square test to compare extents between think about bunches. Two test t-tests and a Wilcoxon rank-sum test were utilized to compare ponder bunches for regularly and nonnormally dispersed information. Essential examinations taken after the intention-to-treat rule (ITT). In a per-protocol investigation, all mediation members who played the amusement for more than an hour were considered to have taken after the convention. Furthermore, exposure-response investigations were done. The relapse coefficient was calculated by plotting add up to play time against ceaseless results (CQR, BMQ NCD, RADAI, and HAQ). The CQR was utilized to plot recess to decide in the event that disciple and non-adherent intercession members had distinctive normal playtimes. P values beneath 0.05 were critical. Stata 13.1 was utilized for measurable examination.

4. RESULTS

4.1.Participants

2000 qualified people in all were welcomed to take part, coming about in 111 people starting the ponder within the control group and 139 people within the intercession bunch. The think about populace and dropouts did not alter, but more men within the intercession gather were misplaced to follow-up. Taking after method, 130 members who did not play the intercession for more than an hour were avoided, clearing out 120 for examination.
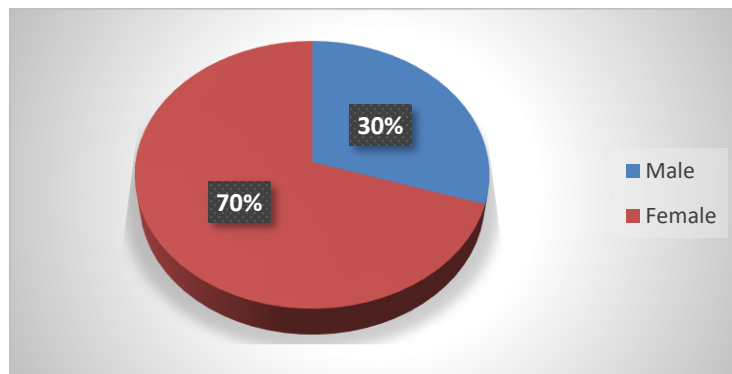

Figure 2: Graphical representation of Gender

67% of the members had positive rheumatoid element/hostile to citrullinated protein antibodies and had RA for a middle of a decade. Members in the benchmark group (35%) and the mediation bunch (39%) were non-disciple at standard.

4.2.Primary outcome

Compared to 54% of the control group, 63% of intervention participants remained faithful after three months. P= 0.13 indicates that this difference was not statistically significant. The percentage of adherent individuals differed at one month (64% vs. 53%; p=0.06), however the change was still not statistically significant.

4.3.Secondary outcomes

At three months, the serious game had no effect on the results of secondary medications. When comparing the percentage of adherent participants based on their subjective CQR self-report with the overall population, medication adherence as determined by the objective pill count was greater

(mean adherence around 95%). At one month, self-reported medication outcomes were similar. Additionally, there was no discernible impact of the serious game intervention on self-reported clinical outcomes.

4.4.Serious game play data

96 (80%) of the 120 mediation members who started the preliminary introduced the game. At one month and 90 days, these people's middle recess was 6.2 hours and 9.7 hours, individually. Throughout the span of the preliminary, the middle number of meetings developed from 16 at one month to 36 at 90 days, with a typical meeting term of approximately 25 minutes.At one month and three months, the individuals had performed a median of twenty behavioural tasks during play. Out of 90 players, eighty percent (84%) have been playing the game for at least 30 days. Between January 6, 2021, and February 24, 2021, there was no user data because of a communication problem with Google Firebase. Consequently, twelve participants' data were lacking.

Table 2: Game Play Data

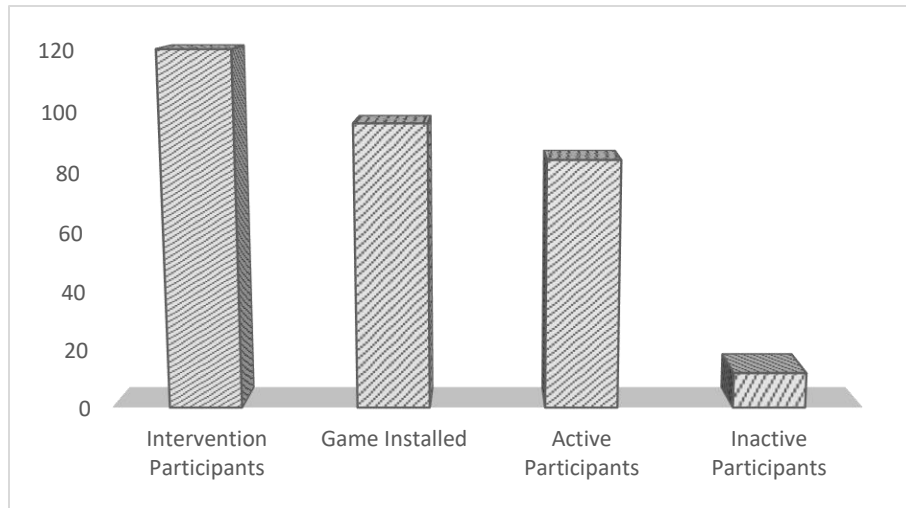| Serious Game play Data	Number of Participants
Intervention Participants	120
Game Installed	96
Active Participants	84
Inactive Participants	12

Figure 3: Graphical representation of Game Play Data

4.5.Per-protocol and exposure–response analyses

The primary and secondary outcomes of the protocol analyses were identical to those of the ITT analyses. For every outcome, there was no evidence of an exposure-response impact.

5. DISCUSSION

This multicenter randomised controlled trial assessed how well a serious game may increase adherence to implementation. At three months, it revealed that although the serious game was played regularly, it had no positive effect on medication adherence or clinical results. There are few research on serious games designed to improve drug adherence, making comparisons with other interventions challenging. Furthermore, there is a large deal of variation in the study design, medication adherence evaluation, and intervention approach. Prior research has mostly focused on the creation and evaluation of serious games that either directly encourage medication adherence through education or gamify medication adherence behaviour by rewarding medication ingestion. There is little to no consistent impact on medication understanding and adherence. There is a wealth of information regarding different interactive eHealth interventions that can be used to improve medication adherence in addition to serious gaming. According to a recent systematic review, interactive eHealth interventions, particularly those delivered via calls, mobile

applications, Interactive Voice Response, or Short Messaging Service, can be successful in enhancing medication adherence. This shows that while eHealth can be a useful tool for increasing medicine adherence, serious game application still need improvement.

6. SUGGESTIONS

To expand the possibilities of mediation viability, future undertakings ought to investigate combination of the serious game in the consideration pathway. Also, the social undertakings ought to be additionally examined to decide the best conduct assignments and relating portion force. While exploring the impacts of the changes, the preliminary plan ought to fit the quickly developing nature of eHealth to keep the mediation from being static over longer timeframes, for instance utilizing a preliminary inside partners plan where a companion is constantly estimated and for each plan cycle, another irregular member test is offered the intercession and results looked at between the example and the accomplice.

7. FUTURE SCOPE

In the future, research should focus on refining serious game interventions by integrating them into comprehensive care pathways and tailoring them to individual patient preferences. Exploring optimal behavioral tasks and dose intensity, as well as adopting dynamic trial designs, could enhance the efficacy of these interventions. Collaborative efforts between researchers, game developers, and healthcare professionals are essential for the ongoing evolution of serious games as valuable tools in improving medication adherence and overall health outcomes, particularly in chronic disease management.

8. CONCLUSION

In conclusion, this multi-center randomized controlled trial assessing the impact of a serious game on medication adherence among rheumatoid arthritis patients demonstrated that, within the studied timeframe, the intervention did not significantly improve adherence or clinical outcomes. While these findings indicate the current limitations of the implemented serious game, they also highlight valuable insights for future research. The need for tailored interventions, integration into

comprehensive care pathways, and exploration of optimal design elements and dose intensity becomes evident. As the field of eHealth continues to evolve, collaborative efforts and innovative trial designs are essential to refine and optimize serious game interventions for enhancing medication adherence and overall health outcomes in chronic disease management.

REFERENCES

1. Rahim, M. I. A., & Thomas, R. H. (2017). Gamification of medication adherence in epilepsy. Seizure, 52, 11-14.

2. Tran, S., Smith, L., El-Den, S., & Carter, S. (2022). The use of gamification and incentives in mobile health apps to improve medication adherence: scoping review. JMIR mHealth and uHealth, 10(2), e30671.

3. Li, Y., Phan, H., Law, A. V., Baskys, A., &Roosan, D. (2023). Gamification to improve medication adherence: a mixed-method usability study for MedScrab. Journal of Medical Systems, 47(1), 108.

4. Pasma A, Schenk CV, Timman R, et al. Non-adherence to diseasemodifying antirheumatic drugs is associated with higher disease activity in early arthritis patients in the first year of the disease. Arthritis Res Ther2015;17:1–10.

5. Murage MJ, Tongbram V, Feldman SR, et al. Medication adherence and persistence in patients with rheumatoid arthritis, psoriasis, and psoriatic arthritis: a systematic literature review. Patient Prefer Adherence 2018;12:1483–503.

6. K. Seaborn and D. I. Fels, "Gamification in theory and action: A survey," International Journal of human-computer studies, vol. 74, pp. 14–31, 2015.

7. J. Hamari, J. Koivisto, and H. Sarsa, "Does gamification work? – a literature review of empirical studies on gamification," in 2014 47th Hawaii international conference on system sciences, (Hawai, USA), pp. 3025–3034, IEEE, 2014.

8. A. Rapp, F. Hopfgartner, J. Hamari, C. Linehan, and F. Cena, "Strengthening gamification studies: Current trends and future opportunities of gamification research," International Journal of human-computer studies, vol. 127, pp. 1–6, 2019.

9. Lumsden J., Skinner A., Coyle D., Lawrence N., Munafo M. (2017). Attrition from web-based cognitive testing: A repeated measures comparison of gamification techniques. Journal of Medical Internet Research, 19(11), e395.

10. Aburahma M. H., Mohamed H. M. (2015). Educational games as a teaching tool in pharmacy curriculum. American Journal of Pharmaceutical Education, 79(4), 59.

11. Alblas EE, Folkvord F, Anschütz DJ, et al. A health game targeting children's implicit attitudes and snack choices. Games Health J 2020;9:425–35

12. Pouls BP, Bekker CL, van Dulmen S, et al. A serious puzzle game to enhance adherence to antirheumatic drugs in patients with rheumatoid arthritis: systematic development using intervention mapping. JMIR Serious Games 2022;10:e31570

13. van HM, den ECHMvan, Dulmen S. Electronic monitoring feedbackfor improving medication adherence and clinical outcomes in patients with early rheumatoid arthritis: a randomised clinical trial;15:1107–9.

14. Pouls BPH, Van den Bemt BJF, Vriezekolk J. Effectiveness of eHealth interventions on medication adherence in adults with chronic medication: a systematic review 2019;23:e18901.

15. Bekker CL, Aslani P, Chen TF. The use of medication adherence guidelines in medication taking behaviour research. Res Social Adm Pharm 2022;18:2325–30.

Author's Declaration

I as an author of the above research paper/article, hereby, declare that the content of this paper is prepared by me and if any person having copyright issue or patentor anything otherwise related to the content, I shall always be legally responsible for any issue. For the reason of invisibility ofmy research paperon the website/amendments/updates, I have resubmitted my paper for publication on the same date. If any data or information given by me is not correct, I shall always be legally responsible. With my whole responsibility legally and formally I have intimated the publisher (Publisher) that my paper has been checked by my guide (if any) or expert to make it sure that paper is technically right and there is no unaccepted plagiarism and hentriacontane is genuinely mine. If any issue arises related to Plagiarism /Guide Name /Educational Qualification / Designation /Address of my university/college/institution/Structure or Formatting/ Resubmission / Submission /Copyright / Patent/Submission for any higher degree or Job/Primary Data/Secondary Data Issues. I will be solely/entirely responsible for any legal issues. I have been informed that the most of the data from the website is invisible or shuffled or vanished from the data base

due to some technical fault or hacking and therefore the process of resubmission is there for the scholars/students who finds trouble in getting their paper on the website. At the time of resubmission of my paper I take all the legal and formal responsibilities, If Ihide or do not submit the copy of my original documents (Aadhar/Driving License/Any Identity Proof and Photo) in spite of demand from the publisher then my paper may be rejected or removed from the website anytime and may not be consider for verification. I accept the fact that as the content of this paper and the resubmission legal responsibilities and reasons are only mine then the Publisher (Airo International Journal/Airo National Research Journal) is never responsible. I also declare that if publisher finds any complication or error or anything hidden or implemented otherwise, my paper maybe removed from the website or the watermark of remark/actuality maybe mentioned on my paper. Even if anything is found illegal publisher may also take legal action against me

Mahesh Kantilal Patil
Dr. Martynujoy Manumdar

****