Introduction

In India, the percentage of deaths caused by tobacco smoking is estimated to rise from 1.4% in 1990 to 13.3% by 2020. There are numerous evidence-based tobacco control strategies available, and newer ones are always being developed. However, on ceasing the habit, cigarettes users go through a period of withdrawal with an increased percentage of relapse before entering to a more stable condition of sobriety in the long run. In this review, Endnote software was used as resource material to collect literature, which was then carefully arranged in a synchronised way. The Markov model captures the dynamic character of the quitting/relapse process, allowing for more accurate figures of abstinence rate, treatment outcomes and evaluating the performance of newer cessation initiatives during tobacco cessation counselling, as well as suggesting pathways for survivability.

Abstract

Smoking is still a major public health issue that causes morbidity and mortality all over the world. The percentage of deaths caused by tobacco smoking has escalated from 1.4% in 1990 to 13.3% by 2020. There are numerous evidence-based tobacco control strategies available, and newer ones are always being developed. Nonetheless, because the number of potential approaches is growing, a choice must be made which to execute, keeping in mind that intervention intensity raises intervention costs. Because acute smoking impacts potential health hazards, the consequences of tobacco smoking on health last for a long time; similarly, quitting smoking today will cause health hazards to progressively fade away. Thus, a lifelong approach is required to assess the cost-efficiency of smoking cessation treatments, taking into account a plethora of different costs and consequences.[2] As a result, numerical modelling of future occurrences as a result of smoking is a well-established review.

Keywords: Addiction, cessation, cigarette, Markov model, smoking, tobacco

Introduction

In India, the percentage of deaths caused by tobacco smoking is estimated to rise from 1.4% in 1990 to 13.3% by 2020.[1] Smoking is still a major public health issue that is causing morbidity and mortality all over the world. According to the Global Burden of Disease Study, cigarette consumption is the second most common cause of mortality in the world. In 2017, there were 7.1 million deaths and 182 million disability-adjusted life years (DALYs). There are numerous evidence-based tobacco control strategies available, and new ones are always being developed.[3]

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This method allows you to model the changing nature of the quitting process, allowing for more accurate estimates of long-term abstinence rates, treatment efficacy measurements, descriptions of fresh quit attempts and development of stochastic process theory, particularly the long-term behavior of such systems.

Markov models offer an upper hand over decisional-analytical modelling is becoming increasingly popular for estimating the cost efficiency of healthcare intervention strategies. One of the promising models is the Markov model; programmes and software tools based on it are cost-effective and have shown promising results in economic evaluation for tobacco cessation. This method allows you to combine and extrapolate the optimum accessible material from a myriad of sources on a given specific topic. It is also feasible to discover factors that have a significant impact on a technology's economic feasibility. Markov models offer an upper hand over decisional-analytical modelling is becoming increasingly popular for estimating the cost efficiency of healthcare intervention strategies.

In the United States, tobacco leads to 440,000 untimely deaths and $157 billion in losses related to health deterioration per year. The habit is obstinate, with approximately 90% of unsupported quitters smoking again in under a year, and even the most effective therapies barely reduce this to 15% or more. Often, many of these trials terminate in barely some weeks, leaving most of the attempts ineffective to evaluate therapies for longer than 3 months. Information from the early epochs may be used to improve conclusions about long-term abstention if the relapse process was better understood. Feldman I et al. proposed a paradigm that considers the homogeneity of multiple entities of survival at the same rate to the right tail. The current work responds to this need by presenting a Markov model of transitions between phases of the cessation process.

### History
Andrey Andreyevich Markov, (born: June 14, 1856, Ryazan, Russia; died: July 20, 1922, Petrograd (now St. Petersburg)), a Russian mathematician, was the one who contributed to the development of stochastic process theory, particularly the Markov chains. His contribution has been extensively recognized and used in the biological and sociological areas, depending on the analysis of the likelihood of mutually dependent events.

### What is Markov’s Model and its Significance
A Markov model is a stochastic strategy for dynamically changing systems in which future states are expected to be independent of previous states. All conceivable states, as well as transitions, transition rates and probabilities between them, are depicted in these models. Markov models are frequently used to predict the possibilities of varying states and the rates at which they change. Modelling systems is a common application of the approach. Pattern recognition, prediction and learning the statistics of serial data can all be performed using Markov models.

Depending on the situation, there are four types of Markov models:
- **Markov chain**: Autonomous systems with fully observable states adopt this method.
- **Hidden Markov model**: When the state of an autonomous system is only partially accessible, this method is applied.
- **Markov decision processes**: Controlled systems with fully observable states adopt this method.
- **Partially observable Markov decision processes**: When the state of a controlled system is only partially accessible, this method is applied.

Markov models can be presented either as equations or as graphical representations. In graphic Markov models, circles (each containing states) and directed arrows are used to show probable transitions between them. The rate or the variable for the rate is mentioned on the directional arrows.

| System state is fully observable | System state is partially observable |
|---------------------------------|-------------------------------------|
| System is autonomous            | Markov chain                        |
| System is controlled            | Markov decision processes           |
|                                 | Partially observable                |
|                                 | Markov decision processes           |

### Various Applications/Implications
Implications of Markov modelling include:
1. Modelling languages
2. Natural language processing (NLP)
3. Image processing
4. Bioinformatics
5. Speech recognition
6. Modelling computer hardware and software systems
7. Habit cessation monitoring

### Markov’s Model in Tobacco Cessation
Tobacco consists of monoamine oxidase inhibitors (MAOIs); MAOIs in tobacco boost nicotine’s reinforcing power. In terms of direct effects and interactions with nicotinic effects and serotonergic effects, As a result, MAOIs have now become a major culprit in tobacco addiction. The MAOIs present in tobacco increase the potency of reinforcement that is caused due to nicotine. By suppressing MAOs, tobacco kicks up the optimum levels of neurotransmitters, which thereby boosts attention, motivation and reinforcement of the cigarettes users.

A three-state Markov model is used to portray the survival functions of smoking cessation therapies. When a smoker quits, he/she goes through a period of withdrawal, which is marked by an increased rate of relapse, before switching to a safer zone of prolonged abstention. The Markov model encircles the changing nature of the quitting process, allowing for more accurate estimates of long-term abstinence rates, treatment efficacy measurements, descriptions of fresh quit attempts and pathways for survivability.
It just takes a few cigarettes for some people to become addicted to smoking again, and most vulnerable people quickly lose control over their smoking addiction. On the contrary, the initial few days of quitting smoking are very crucial. On day 1, behaviour and adreno-cortical disturbance indicate brief abstinence, and in the following month, attrition proceeds at a considerably slower pace. Although a single slip in decision to quit does not imply guilt to resumption of habitual smoking, it is a strong foreseer and has an impact on the occurrence of rebound and enters a higher rate of relapse of about 60%–80%. A three-state model was devised to reflect this contrast between early and late relapse processes, with conditions that correlate to routine use, the essential initial stage of withdrawal and the long right tail of cautious cessation.

A three-state model was devised to reflect this contrast between early and late relapse processes, with conditions that correlate to routine use, the essential initial stage of withdrawal and the long right tail of cautious cessation.

The representation shown in Figure 1 depicts a classic Markov chain correlating to the P transition matrix and describing the way odds of behavioural and clinical events vary for different observations.

However, this model does not reflect a fully recovered condition. The continuous and active battle of the second state, with its increased risk of rebound, is only one lapse away for most abstainers. There has been no strategy for relapse prevention that has been shown to be efficient in the long run.

\[
P = \begin{pmatrix}
1 - \alpha & \alpha & 0 \\
\rho & 1 - \rho - \beta & \beta \\
0 & \lambda & 1 - \lambda
\end{pmatrix}
\]

The rows in Eq. (1) indicate the regular use, withdrawal and renormalization of brain functions that already exist and long-term abstinence, while the columns indicate the condition on the following day.

- The probability that a smoker will continue to smoke (1 - \(\alpha\)) or cease (\(\alpha\)) and therefore shift into the second state, W, is given by the entries in the first row.
- The second row indicates the likelihood that a person in W will undergo relapse (\(\rho\)), continue in W (1 - \(\rho - \beta\)) or successfully shift to long-term abstinence (\(\beta\)) by the next assessment.
- The third row shows the possibility of lapsing from abstinence (\(\lambda\)), a lapse that enhances the risk of extra consumption by restarting the withdrawal process, bringing him/her back to habitual smoking with probability \(\rho\).

Markov models, in particular, are not related to the history of the habit; the chance of shifting into any state is determined only by the present stage, neither by the length of time the individual has lived in it nor the number of previous visits to it. This may sound contradictory, yet the pattern of abstainers’ first lapse times was essentially exponential in one of the few studies that reported such data.

Conclusion

Tobacco smoking is among the leading factors of mortality all over the globe. The disease prevalence, health care expenses and other budgetary losses associated with early deaths due to tobacco use are increasing significantly in rapidly expanding nations like India. In 2004, the WHO predicted 58.8 million deaths worldwide, including 5.4 million fatalities due to tobacco use.

There are numerous means of tobacco cessation that are being put into practice every day, and many more are being discovered and invented with every passing minute. Amidst all these, Markov’s model of tobacco cessation is one way to check the efficacy and efficiency of these methods. When a smoker quits, he/she goes through a period of withdrawal, which is marked by an increased incidence of relapse, before entering into a safer state of prolonged abstinence. The Markov model captures the changing character of the quitting process, allowing for more accurate estimates of long-term abstinence rates, treatment efficacy measurements, descriptions of fresh cease attempts and pathways for survivability. With such mathematical models, we can accurately calculate the abnormalities and defects and rectify them, which in turn will benefit many individuals who wish to quit smoking to choose the right method to do the same and hence, benefit the society towards its betterment.

Moreover, the Markov model not only quantifies the probability of relapse but also well notifies the direction and the success.
of tobacco cessation counselling by measuring the period of abstinence in which the tobacco user remains after quitting. Henceforth, this matrix model will ultimately shield the users from the possible squeal of tobacco abuse and will serve as a cornerstone in the process of tobacco cessation. As a channel for providing primary health care, the Markov model obviates the users from life-threatening consequences of tobacco use by foreseeing the repercussions of tobacco addiction.

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Conflicts of interest
There are no conflicts of interest.

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