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## ORIGINAL RESEARCH ARTICLE

### Pathology of Knowledge-Based Career Path Planning with High-Performance Approach with Data Processing Approach

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#### ABSTRACT

This research is done in a mixed way (thematic analysis and data mining). In the first step, based on the qualitative method of thematic analysis, the effective factors of knowledge-based career path planning with a high-performance approach and data processing approach are identified. The investigated population is the managers and decision-makers of Zone Ten of Iran's gas transmission operations. 10 people were purposefully selected and interviewed. These people had more than 10 years of work experience in this organization. Using the six-step coding method, the interviews were entered into the MAXQDA software, and the effective factors on career path planning with a high-performance approach based on organizational knowledge were identified. Data was collected in SPSS format and used as input in WEKA software. The path of career development in this research was determined based on the dimensions of individual factors, organizational factors, empowerment strategies, management strategy, culture-building strategies, process development, and management processes. The operationalization of these factors in data mining showed that the situation of the predicted career path has significant differences from the reality of the organization. This procedure can be improved by periodic knowledge extraction and long-term performance evaluation. The obtained results showed that the knowledge-oriented career path emphasizes the empowerment of employees in a specialty. The level of knowledge participation of employees does not only mean that the employee shows useful behaviors for the organization within the organization, but also includes the attitude of people towards the company and recognizing their existential value in the company. ©authors

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## 1. Introduction

In the era of the knowledge economy, the knowledge and skills of employees have become the main pillar of the organization (Darvazeh et al., 2022). The participation of employees and the improvement of their knowledge level are important for the realization of strategic goals, performance, and prospects of companies. Employee engagement is influenced by career planning based on organizational strategies (Jia-jung and Ming, 2022). Over the past decade, advances in processing power and speed have enabled us to move beyond manual, tedious, and time-consuming procedures to fast, easy, and automated data analysis. The more complex the collected data sets, the more potential there is to uncover relevant information. Retailers, banks, manufacturers, telecommunications providers, and insurers use data mining to discover relationships between everything from optimizing employee selection based on demographics to how economics, risk, competition, and social media influence models. They use commercial, revenue, operations and customer relations. (Geng et al., 2021). Such a look at the career path requires the existence of features that make the system efficient and effective and give dynamism to the organization and employees, which becomes possible in the shadow of the organization's data analysis (Li, 2020). The career path is one of the key and important elements in the field of human capital development; Because it deals with human thinking as a source of knowledge and it is the human who can be the agent of change and transformation and respond to environmental changes in order to make the organization successful and progressive (Wang et al, 2022).

Data mining in the organizational environment is of great importance in order to optimize the highly competitive organizational selection today. A new concept of data mining of business intelligence has now evolved, which is widely used by leading companies to stay ahead of their competitors. Data mining can help provide the latest information used for competitive analysis, market research, economic trends, consumer

behavior, industry research, geographic information analysis, etc. Data mining of business intelligence is very effective in the decision making of company managers to select employees. Data mining helps to sift through all the duplicate data. Find out the right information and then use that information well to evaluate the possible results and increase the speed of informed decision-making based on the knowledge of human resource management (Veri, 2021). Today's employees pay more attention to their long-term development and in this way benefit from training and experience (Sephovand et al., 2016) and acquiring organizational knowledge (Rajabi and Shirazian, 2016). Therefore, the career path is a process that includes a set called the career path system and it is considered a formal, organized, and planned effort to balance the needs of the individual and the needs of the organization. In this regard, the individual and the organization help each other provide the requirements for the effective and efficient performance of the jobs defined in the career path; in a certain period of time; A person acquires the necessary knowledge, skills, abilities, and awareness to achieve and perform jobs and is assigned to work based on that (Weer et al., 2020). Therefore, if organizations cannot respond to the material and spiritual needs of employees (Bashir et al., 2020), capable employees will inevitably seek to move, change jobs, and even leave the organization. Knowledge-oriented employees care more about career growth and achieving a better position in the organization than other employees. In addition to their material benefits, the organizational environment is considered a platform for their personal development and growth (Shirazi et al., 2016). When they feel that the organization provides them with the necessary infrastructure for growth, they feel more psychologically dependent on the organization, so emotional commitment is created, and as a result, they show high performance in the career path (Alamdari. et al., 2012). Based on digital developments, the capabilities of data science and machine learning have been able to provide valuable

contributions to the field of human resource management, human resource selection, and beyond, to the management of the organization with descriptive, diagnostic, predictive reports and analysis, and solutions. The evolution of technology and knowledge extraction and digitalization and data mining techniques have also affected the determination of the career path of employees and have been able to be one of the main trends in this area in recent years. One of the concerns of organizations is how data mining capabilities can be used in promoting and developing the career path of human resources and how this vital change will happen?

However, the elements that makeup career growth and multidimensional participation are tangible resources (financial capital) and intangible resources (knowledge capital), which can be divided into different dimensions to develop this issue (Mahmoud Shahi, 2015). The description of the career path and the development activities of the interaction of knowledge workers also needs further study. In fact, the current problem and challenge of Iran's gas transmission region with its knowledge forces is the lack of a clear career path with a high-performance approach for them. In other words, preserving the knowledge capital and organizational thinking and using their experiences during the service is a problem that is currently considered one of the most important needs of this industrial organization, considering the more than ever need for gas transmission operations in the region. Iran, like other knowledge-based organizations, should extract knowledge based on the organization's data for its knowledge workers for empowerment, sustainable competitive advantage, and growth in individual, socio-cultural, economic, political, etc. dimensions. Therefore, it can be said that this research is looking for an answer to the question, what is the knowledge-based planning of the career path with a high-performance approach and a data processing approach?

## **2. Literature Review**

Undoubtedly, maintaining knowledgeable and capable managers and employees is one

of the most fundamental challenges facing organizations to overcome the difficult conditions of the current economy (Yu et al., 2020). What can help the organization to some extent against these challenges is the career development path based on organizational knowledge. Despite the lack of attention or lack of attention, it must be said that the issue of career path and choosing the right job for most employees is one of the important and ponderable concerns that many organizations are involved with. Perhaps the reason for this can be seen as increasing the awareness of the employees on the one hand and the responsiveness of the organization to the demands and needs of the employees on the other hand (Arthur et al., 2007). Therefore, in facing this challenge, various approaches have been proposed, and one of the best solutions is the implementation of the career path model. Meanwhile, the discovery of knowledge based on organizational data can clarify the progress of the organization in line with the employees (Carda et al., 2017).

The review of studies shows that the issue of career path in the field of human capital has not had much history and there are many theoretical dispersions in this regard. Nevertheless, extensive theoretical and practical efforts in the early 1975-1960s created a wave in organizations that focused on knowledge and enrichment of jobs and positions that could motivate employees and managers (Ozchelik et al., 2016). Economic growth and globalization in today's highly competitive environment lead organizations to preserve knowledge, retain employees and continuously increase the organization's performance based on the organization's information base (Siddique, 2004). On the other hand, the expectations of knowledge-oriented employees towards the organization in which they work have increased (Vijai et al, 2021). Therefore, the use of traditional human resource management not only does not meet the needs of employees and does not provide their satisfaction, but also prevents organizations from competing in this global environment (Pohjola, 2001). Organizations are looking for a system that can increase organizational survival and commitment, and also help the organization reach its ultimate

goal, which is to increase productivity and performance (Garcia et al., 2017).

According to what has been said, it seems that in the current career path of the region, not much attention has been paid to the planning management (individual aspect) of the career path and the organizational aspect (management of the career path). Whereas, according to the experts of the organization, the implementation and operationalization of both aspects can bring merits at three levels (organization, management, employees) (Mihala et al., 2016). These advantages can increase mobility and efficiency, improve services to the society, provide dignity and livelihood of employees, provide jobs, complete and proper implementation of the merit system in appointments, eliminate inefficient and ineffective trainings, create appropriate and equal opportunities for the advancement of employees. Help to clarify merit selection and succession, create work motivation and help to implement human resources strategies in urgent areas and create outstanding effects in the service process and performance of the organization (Michaelis et al., 2015).

Faruzandeh Junqani et al. (2022), in a research entitled the intelligent model of human resource management based on data science and machine learning, showed that intelligentization has improved the quality of decision-making in the field of human resources. Margherita (2021), showed that data mining and intelligence can be used in three categories of technical and organizational enablers, prescriptive, predictive and descriptive applications, and employee and organization values

In other words, the current problem and challenge of region 10 of Iran's gas transmission operations is also with the knowledge forces itself, the lack of clarity of the plan for the advancement and career promotion of employees and the existence of structural problems in it. In other words, maintaining the forces and using their useful experiences, the uniformity of things during the service and other consequences related to the lack of an effective plan, is a challenge. Which is currently considered one of the most important needs of the region. In addition,

issues such as client satisfaction, employee satisfaction with the current organizational promotion program, attention to career development training, are not accurately reflected in the existing program and bylaws related to their promotion. The existing bylaws are limited to the discussion of education and having work experience (which is not exactly visible in the current programs) and providing tables of the amount of education required for promotion, and issues such as attention to the creativity of employees, their independence, etc. in the program.

The existing issues have not been paid attention to, in addition to the fact that sometimes the appointments in the organization are made from outside the organization, regardless of seniority and regardless of performance, and these matters cause employees to stay in place and stay more than usual in organizational positions and the career plateau. It has become more evident. It should be noted that these things cannot be achieved unless the organization moves based on a set pattern, so increasing the transparency of the knowledge-oriented career path with high performance based on organizational data will empower the knowledge workers as much as possible, which is discussed in this research.

### 3. Method

This research is done in a mixed way (thematic analysis and data mining). In the first step, based on the qualitative method of thematic analysis, the effective factors on knowledge-based career path planning with high performance approach and data processing approach are identified. The investigated community is the managers and decision makers of zone ten of Iran's gas transmission operations. 10 people were purposefully selected and interviewed. These people had more than 10 years of work experience in this organization. Using the six-step coding method, the interviews were entered into the MAXQDA software, and the effective factors on career path planning with a high-performance approach based on organizational knowledge were identified.

Braun & Clarke (2006), theme analysis steps were implemented in the following steps:

Step 1: Research design

Step 2: Getting to know the collected data to discover themes (creating primary codes)

Step 3: Searching and knowing the subjects

Step 4: Extracting the organizing and comprehensive topics from the basic topics

Step 5: Drawing and analyzing the content network (Clarke & Braun, 2013).

In the second step, data mining method was used. According to the investigations carried out on the events, it was found that some of the messages recorded in this system are not related to the conditions of the employees, but are related to the complaints or requests of the employees and personnel of the agencies from the executive units of the zone ten of Iran's gas transmission operations. Therefore, due to the fact that basically these records did not find any relevance to the needs and problems of the zone ten of Iran's gas transmission operations, they were inevitably removed from the set of records under review.

In this analysis, organizational databases based on employment year, educational qualification, individual learning status, income increase, post promotion are used for data mining.

With the investigations carried out on the events, it was found that in some of these areas, the number of employees' information is very small and insignificant. In other words, their very low frequency among other problems indicated that the problems of that class were ad hoc and unimportant, and because it was feared that it would interfere with the process of reproducibility of messages. Therefore, with the possibility of querying the Sql 2008 software, these classes were identified and together with the problems of that class, they were removed from the total investigated data.

It was said that the data preparation stage is the most important and time-consuming part of the data mining process. In this section, the fact that most of the fields in the message table are Farsi, as well as the large volume of records, led to the lengthening of this stage, so that the researcher, in order to prevent the deletion of correct records, which

could occur due to the string type of the fields, spent this stage It took more time and accuracy. Finally, after the preparation stage, the data was collected in SPSS format and used as input in WEKA software. WEKA stands for Waikato Environment for Knowledge. Waka software was first written in a modern form in 1997 and released under the GPL license. In recent years, due to the expansion of information and communication technology and with the increase of digital data and the growth of computing power of computers, many commercial and educational software for data mining have been offered in various fields.

#### 4. Findings

In the first stage, according to the review and analysis of the content of the high-level documents mentioned in the previous chapter (the sixth development plan document, the administrative system reform plan and the oil human resources development document) by collecting the necessary information and then comparing the current situation and the desired situation to identify The injuries were discussed and then qualitative data were collected through in-depth interviews with the research participants. In the process of open coding, many themes were obtained, and during the back and forth process of data analysis, the set of these primary qualitative data was reduced to fewer categories. In the following, each of these dimensions obtained in the qualitative stage has been investigated. First, a few interviews have been reviewed. In Figure 1, an example of code analysis in the Max Qda software is shown on the conducted interviews.

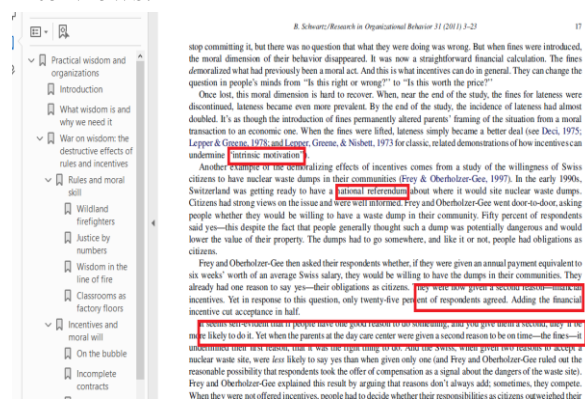


Figure 1. Example of review of articles and identification of codes

In the following, the preliminary coding for the factors that make up thematic analysis has been discussed:

**Table 1.** Knowledge-based career path coding

Basic themes	Secondary themes
Personal experiences	Individual factors
Personality pattern (traits)	
Individual values	
Spirituality at work	Organizational factors
Organizational values	
organizational will	
Selection and appointment	Empowerment strategies
Educational and knowledge interventions	
Organizational knowledge management	
Participatory Management	Management strategy
Data-driven management	
Evolution of data-driven decision making	
Foundation knowledge strategy	Cultural strategies
Structural strategy	
Trust building strategy	
Empowerment organization	Processing
Management features	
Management skills and expertise	Management processes
Business development	
Data driven experience	

At this stage, the following steps are followed, the details of which are described below:

- Selection of modeling techniques
- Model making
- Evaluation of the model

For modeling, it is necessary to choose the modeling technique first. Considering that the purpose of this research is to perform different techniques on the events of the database of ten gas transmission operations in Iran and to examine the results obtained from each technique; therefore, various data mining techniques such as clustering, dependency rules, decision tree, generalized linear model were performed on the data and the results are given below. In each step, it has been tried to choose the best algorithm according to the type of data.

At this stage, the following steps are followed, the details of which are described below:

- Evaluation of the results
- Reviewing the process

The results obtained in the previous stage are considered as the knowledge extracted from the research. In the previous stage, the results of the implementation of data mining techniques in each section were compared with another algorithm. Then, according to

the comparisons, the appropriate algorithm has been selected. To ensure the correctness of the performed operation, the work process has been reviewed at the end.

In the last stage, the final report of the knowledge information of the employees is made in the organizational units. The main work of the analyst or data mining has been completed in the previous stage, and in this research, the results, in the form of a report of the entire work, are available to the relevant organization or volunteers to make a decision about the use of the results.

The point that needs to be mentioned at the end of this section is that the research was done - it could be more comprehensive if there were some other fields of information. SVR technique is used in this research. In general, in the regression problem, given the training data

$$S = \{(X_1, Y_1), (X_2, Y_2), \dots, (X_N, Y_N)\} \subset R^n \times R$$

The goal is to find a function like  $f(x)$ , which is as far away  $\epsilon$  from the real goal  $y_i$  as possible and is also sufficiently smooth (differentiable).

$$f(x) = \langle \omega, \varphi(x) \rangle + b$$

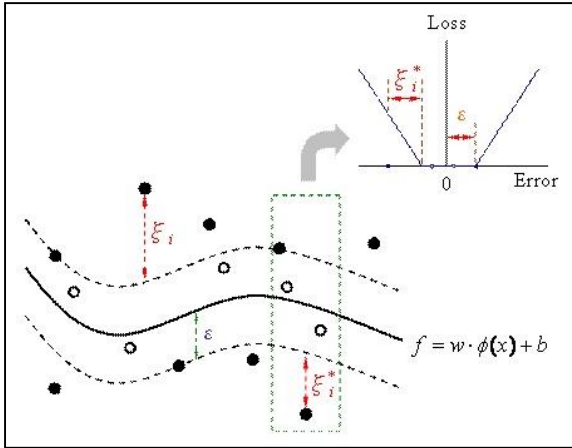


Figure 2. Parameters used in SVM

In which, the skew coefficient parameter  $b$  is a weight vector  $\omega \in R^{n_k}$  and  $\varphi(\cdot) : R^n \rightarrow R^{n_k}$  Anon-linear function that virtually moves the dimensional data to a higher dimension, in fact, the  $n$  dimension is implicitly defined and may even be infinite. As mentioned, the goal of the problem is to deviate from the true target values by at most for all training samples  $f(x)$ , in other words, less errors  $\varepsilon$  are ignored. Therefore, a threshold limit  $\varepsilon$  is used in order to increase the margin and reduce the overall error. This method uses the following function  $\varepsilon$  - insensitive to determine the error.

$$|y - f(x, \omega)|_\varepsilon = \begin{cases} 0, & \text{if } |y - f(x, \omega)| \leq \varepsilon \\ |y - f(x, \omega)| - \varepsilon & \text{otherwise} \end{cases}$$

And the support vector regression

$$\min \frac{1}{2} \|\omega\|^2 + C \sum_{k=1}^N (\xi_k + \xi_k^*)$$

optimization problem will be as follows:

The loose parameters  $\xi_i$  and  $\xi_i^*$  variables determine the upper  $\omega$  and lower limits  $C$  of the model output, the parameter is the width of the margin and the constant coefficient. By changing the parameter  $C$ , the model determines whether the margin width is more desirable or the resulting error. If the coefficient  $C$  is small, it indicates that the smoothness of the problem is more important than the resulting error. In optimization, the following conditions must be met:

$$y_k - \langle \omega, \varphi(X_k) \rangle - b \leq \varepsilon + \xi_k$$

$$\langle \omega, \varphi(X_k) \rangle + b - y_k \leq \varepsilon + \xi_k^*$$

$$\xi_i, \xi_i^* \geq 0$$

To solve the problem, the method of Lagrange coefficients is used and we will have the following form:

$$L_{SVM} = \frac{1}{2} \|\omega\|^2 + C \sum_{k=1}^N (\xi_k + \xi_k^*)$$

$$- \sum_{k=1}^N \alpha_k (\varepsilon + \xi_k - y_k + \langle \omega, \varphi(X_k) \rangle + b)$$

$$- \sum_{k=1}^N \alpha_k^* (\varepsilon + \xi_k^* + y_k - \langle \omega, \varphi(X_k) \rangle - b)$$

$$f(x) = \sum_{k=1}^N (\alpha_k - \alpha_k^*) \langle \varphi(X), \varphi(X_k) \rangle + b$$

where are  $\alpha, \xi_k, \alpha^*, \xi_k^*$  the Lagrange coefficients. To find the saddle point, it is taken from the mentioned function, relative to the derivative variables  $\omega, b, \xi, \xi^*$  and set equal to zero, and finally we will have

According to Mercer's theory, inner multiplication  $\langle \varphi(X), \varphi(X_k) \rangle$  can be defined as a kernel, so the above equation can be rewritten as below.

$$f(x) = \sum_{k=1}^N (\alpha_k - \alpha_k^*) K(X, X_k) + b$$

In general, there are many kernels, the most famous of which are linear, polynomial, and radial basis function kernels.

$$\text{Linear: } K(X, X_k) = \langle X, X_k \rangle$$

$$\text{Polynomial kernel } K(X, X_k) = (\langle X, X_k \rangle + p)^d \quad d \in N, p > 0$$

In this research, Radial Basis Function (RBF) is used as kernel.

$$\text{Radial Basis Function kernel: } K(X, X_k) = \exp\left(-\|X - X_k\|^2 / 2\sigma^2\right)$$

This phase is the main stage and goal of a data mining project. At this stage, complex analytical techniques and methods are used to extract knowledge and information from the data set. The general purpose of the experiment is to investigate the knowledge-based career path prediction model. For this purpose, the input and target variables are

used in accordance with the established rule. One of the results of the model implementation is the achievement of a comprehensive analysis regarding the identification of the prediction model using data mining techniques. In this research, the leaving-one-out method is used for training and testing. In this method, in each step, one data is used as test and the rest of the data is used for training, and this process is repeated for all data. The advantage of this method is that all data is used once for testing.

In Figure 3, a view of the implementation of data in the MLP model in the Weka software is shown:

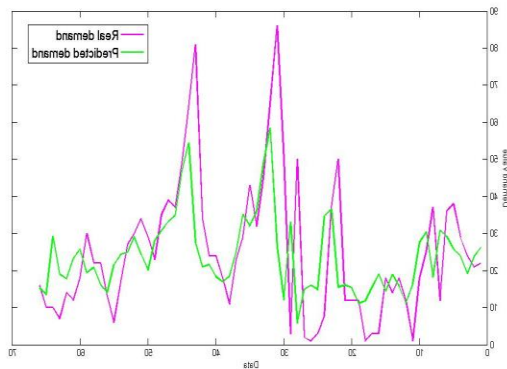


Figure 3. The real state of the career path and predicted by the SVR algorithm

Figure 3 is marked in purple and green. The purple color has shown the current status of the employees' career development, and the green color represents the potential and requests of human resources.

**Table 2. The results of applying the introduced algorithms**

Measure Methods	MSE	MAE	MAPE	RMSE	R2
MLP	582.22	16.61	2.14	29.12	0.72
SVR	258.69	10.64	1.46	16.08	0.85

Table 2 shows that based on the entered information, the power of prediction based on the coefficient of determination can be 85%.

**5. Discussion**

The obtained results showed that the knowledge-oriented career path emphasizes the empowerment of employees in a specialty. The level of knowledge

participation of employees does not only mean that the employee shows useful behaviors for the organization within the organization, but also includes the attitude of people towards the company and recognizing their existential value in the company. In this research, based on data mining, the amount of employees' criticisms and complaints was analyzed. Knowledge workers attach great importance to the issue of career development with a high performance approach, whether they can get good development opportunities and resources in the company, which to some extent shows that career development has a significant impact on employees' work attitudes. Individuals will reciprocate with high levels of performance when organizations provide employees with opportunities to improve their professional ability.

Knowledge resources stored in the organization to improve the professional level of employees can improve their work performance. The path of career development in this research was determined based on the dimensions of individual factors, organizational factors, empowerment strategies, management strategy, culture building strategies, process development and management processes. The operationalization of these factors in data mining showed that the situation of the predicted career path has significant differences with the reality of the organization. This procedure can be improved by periodic knowledge extraction and long-term performance evaluation.

Lin (2020), also showed that based on organizational data, organizational strategies can be changed in order to empower human resources. Faruzandeh Junqani et al. (2022), introduced intelligence as the right way to plan and develop a career path. which is consistent with the results of the present research. Margherita (2021), also introduced the use of data mining as the best option to reduce human resource selection errors in the future study of human resources.

**6. Conclusion**

The findings of this research are useful for data sharing database management. First, it is



suggested to find a better job growth platform for knowledge workers and consider the development needs of individuals and organizations. Targeted career discussions at career goal progress levels can promote a clear development plan so that individual development goals and organizational planning are aligned. In terms of developing professional ability, the internal training system of employees needs to be improved and the content of professional training should be enriched with dual development programs - for management and professional orientation. Assign challenging tasks to knowledge workers to promote their career growth, provide a platform for them to share their experience and insights, and enhance their professional identity. In terms of organizational efficiency growth, it is necessary not only to meet the wage expectations of knowledge workers, but also to achieve efficient capital allocation. It is also important to engage in regular face-to-face communication to ensure that employees have equal status, rewards, rights and responsibilities within the organization and are willing to prioritize mobility within the organization to achieve a win-win.

Based on the obtained results, the following suggestions are provided:

In order to enter into advanced human resources analysis, the organization needs to have human resources systems with acceptable data quality, because in this field, quality and reliable data plays the main role. Data quality is one of the most important obstacles on the way. Development of advanced analysis of organizational human capital. Therefore, it is suggested to create a protocol to increase the quality of organizational data.

Web mining, text mining, process mining, deep learning algorithms, meta-heuristic algorithms, hybrid algorithms, as well as innovative methods should be used in all stages of human resource management.

Before implementing data mining to determine selection frameworks, necessary knowledge and skills in this field must be established in the human resources profession, and human resources professionals can make deep decisions with

quality data that is the output of comprehensive human resources systems.

Future work

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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