

Case Report

# Cycle and Chain Algorithms for Optimizing Employee Transfers: A Case Study of Grade Medical Officer Transfers in Sri Lanka

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## Abstract

This article explores the application of the Cycle and Chain Algorithms in optimizing employee transfers, with a specific focus on Grade Medical Officers in Sri Lanka. Transfers in large organizations often involve complex cycles or chains of movement, where one employee is replaced by another in a linked sequence. These algorithms have been adapted to identify and track these patterns within the annual transfer system, efficiently processing thousands of requests while ensuring service continuity across healthcare institutions. The study reveals a significant reduction in manual workload and enhanced accuracy in identifying transfer patterns, particularly in complex scenarios where traditional methods may fail to detect hidden links between movements. The algorithms are demonstrated to be particularly valuable in the healthcare sector, where uninterrupted services are critical. By automating the identification of cycles and chains, they enable human resource managers to streamline workflows, improve transparency, and support fair decision-making processes. Furthermore, these algorithms are versatile and have broad potential applications beyond healthcare, including logistics, finance, and emergency services, where interdependent movements are common. Their systematic and efficient approach offers organizations a robust solution to handle complex movement processes, minimizing bottlenecks and reducing the likelihood of errors in decision-making. This study underscores the transformative potential of Cycle and Chain Algorithms in modern human resource management, demonstrating how their application can enhance operational efficiency, fairness, and transparency in transfer processes, while also offering insights for their adoption in other industries with similar logistical challenges.

## Keywords

Employee Transfers, Cycle and Chain Algorithms, HR Management, Sri Lanka, Graph Theory

## 1. General Overview

In today's fast-paced and interconnected world, many processes rely on interdependent actions, where one step directly unlocks or enables the next. This dynamic is evident in many fields such as human resource management (HRM), finance, and transportation. For example, in employee trans-

fers, one person's movement into a new role depends on another vacating that position, creating a chain of dependencies. Similarly, in stock exchanges, a trader must acquire shares before selling them, forming a sequential chain of transactions. Even in taxi services, picking up a passenger is dependent on

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completing the previous drop-off, creating a cyclical flow of actions.

What is often overlooked is that these kinds of interdependent actions are all around us and recognizing them is critical to improving efficiency and transparency. In some cases, like stock markets or HR systems, we have data that allows us to track these movements. In many other areas, however, we have not fully appreciated these dependencies, and as a result, have missed opportunities to optimize processes. This is where Cycle and Chain Algorithms come in—they offer a powerful way to identify and map these patterns.

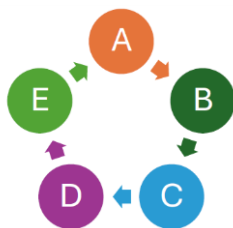
By applying these algorithms to systems such as employee transfers or stock exchanges, we can streamline processes, reduce bottlenecks, and ensure that resources are used effectively. The key is understanding that these interdependent actions are not isolated incidents but part of a broader cyclical or sequential flow. Revisiting actions with this perspective enable us to bring greater clarity and efficiency to systems that may have previously been inefficient or opaque.

In this context, Cycle and Chain Algorithms are invaluable tools for recognizing and addressing the inherent structure of these processes, transforming how we manage and optimize interconnected movements across various domains.

#### *Cycles and chains in interdependent actions*

Some interdependent actions like employee transfers of larger organizations mimic an exchange process where one is replaced by another in a cyclical or linear manner.

1. Cycle: A cycle in interdependent actions is a closed loop where each node (person or entity) is connected to another through edges (actions or movements), ensuring that every node is replaced by another without any gaps. The cycle is complete when all nodes have transferred their positions or resources along the edges, with every node participating both as a starting and ending point in the loop (Figure 1).



**Figure 1.** Cycles - cyclical movement in interdependent actions.

2. Chains: A chain in interdependent actions is a sequence of nodes (participants or entities) connected by edges (actions or movements), where each node receives a movement from the previous node and transfers to the next. The first node has no incoming movement from another node, and the last node has no outgoing movement to another node. This creates a deficit at the beginning and an excess at the end, with no loop connecting the endpoints. (Figure 2).



**Figure 2.** Chains - linear movement in interdependent actions.

## 2. Background

Employee transfers are interdependent actions frequently practiced in larger organizations and can be initiated by either the employees or the employers [1].

Employee-initiated transfers, such as the mutual transfers of nursing officers in Sri Lanka, typically require head-to-head exchanges in a cyclical manner for successful completion. This means that each employee seeking a transfer must have a replacement who is willing to move to their current position. In this process, every participant in the cycle must be fully aware of their role relative to others, and communication between them is essential to complete the loop. However, as the number of employees involved in the transfer process increases, the complexity escalates, making it challenging to manually track these connections.

Employer-initiated transfers in some settings may involve scenarios where a single employee is moved without any corresponding replacements [2]. In such cases, these transfers may not follow the cyclical or linear patterns described here.

On the other hand, employer-initiated transfers, such as the annual transfers of Grade Medical Officers (MOs) in Sri Lanka, do not necessarily require direct head-to-head exchanges. These transfers can form either cycles or chains. Given that the process involves thousands of employees and operates under various conditions agreed upon by trade unions and transfer boards, publishing the final transfer list becomes a complex task. Additionally, implementation is challenging because service continuity must be maintained throughout the process. Therefore, higher HR officials and those responsible for implementing the transfers must be aware of the relative positions of all transfer loops or links to ensure smooth and effective execution.

Despite being an employer-initiated mechanism, the transfer process in Sri Lanka is influenced by the MOs' choices. Officers are given the opportunity to select their desired positions, and their chances of receiving a particular position depend on their serial numbering. While employer-initiated transfers are complex, they offer significant benefits by ensuring service continuity in difficult stations and reducing overall turnover rates, which helps lower costs associated with training, replacements, and separation pay [3]. However, even short-distance employee relocations can impose a considerable burden [4, 5] on the individuals involved, making it crucial for the transfer process to be both highly efficient and transparent.

The annual transfer system for Grade MOs plays a crucial role in maintaining medical service continuity by allowing doctors stationed in difficult or less desirable locations to transfer to preferred positions. These less desirable stations

are usually filled by newly appointed doctors following their internships. As such, the smooth functioning of this transfer process is vital for maintaining the balance and efficiency of the country's healthcare system.

In Sri Lanka, the medical service operates as a nationwide government-run system primarily managed by the Ministry of Health. This structure ensures that every healthcare institution across the country is staffed with an MO. To maintain this, an annual transfer system for MOs is in place, which facilitates the assignment of doctors to all stations, regardless of their desirability. This approach is vital for sustaining efficiency and coverage of the country's healthcare service.

A study conducted in Bangladesh [6] highlights a situation similar to that of Sri Lanka, where transfers often impose additional challenges on relocating officers. Hence, the transfer process should be designed to minimize the burden on these individuals.

According to the most recent Annual Health Bulletin published in 2023, Sri Lanka's health service employed 21,450 MOs in 2020, all of whom are eligible for transfers every four years. As a result, the annual transfer list typically includes three to four thousand doctors. Each year, all eligible MOs submit their transfer applications through the Human Resource Management Information System (HRMIS) software. Based on serial numbering, they are assigned a designation and station (hereafter referred to as "position"), and an interim transfer list is published. If an MO disagrees with their allocated position, they are given the opportunity to appeal. The final transfer list is published after incorporating valid requests made during the appeal process.

While many sectors are leveraging technology and algorithms to enhance HRM workflows [7-9], the annual transfers of Medical Officers in Sri Lanka remain a challenging process, with key aspects still dependent on manual methods.

## 2.1. Cycle and Chain Algorithms

The Cycle and Chain Algorithms are designed to track interdependent actions by efficiently matching movements between entities at specific locations. This method ensures continuous operations in a cyclical or chain-like manner, minimizing idle time and optimizing efficiency. The algorithms operate using three columns of data: the unique identifier of the entity, the unique identifier of the first location, and the unique identifier of the second location.

The algorithms can run three distinct processes: one for identifying cycles, another for chains, and a third for single-step isolated movements, all from a single database prepared in the required format. When every entity has a replacement, a cycle is formed, representing a closed loop of movements. When there is a gap in the process, where one entity does not have a replacement, a chain is formed, representing an open-ended sequence of movements.

These algorithms can be applied to various fields, including managing employee transfers. For instance, they are useful in

identifying complex transfer patterns, such as transfer loops or chains, in the annual transfers of Grade Medical Officers in Sri Lanka, which can be difficult to detect manually. By automating this process, HR managers gain a powerful tool for managing employee transfers more efficiently.

In large organizations, where repeated exchanges of locations or resources occur, these algorithms efficiently identify transfer loops or links. As no efficient manual method exists for recognizing such patterns, Cycle and Chain Algorithms offer a valuable alternative to traditional methods, providing an effective solution for managing interdependent movements like employee transfers.

## 2.2. Objectives

The objective of this paper is to introduce the Cycle and Chain Algorithms and demonstrate its effectiveness in identifying transfer sequences through the Grade MO transfers in Sri Lanka. Tables will be generated, summarizing cycles, chains, and transfers with no associations to other serial numbers, which will be reviewed and analyzed.

## 2.3. Significance

The Grade MO transfer case study is significant because it provides a real-world context to showcase the practical application of the Cycle and Chain Algorithms. The MO transfer system in Sri Lanka presents a unique and complex environment, where the annual redistribution of thousands of MOs directly affects healthcare delivery across the country. By applying the algorithms to this system, the case study demonstrates how innovative technological solutions can be used to manage large-scale employee transfers with greater efficiency and transparency. The choice of this particular group and system for testing highlights the relevance of the algorithms in optimizing employee movements, ensuring continuity in essential services, and reducing administrative burdens in organizations where employee transfers are a frequent necessity.

The critical need for advanced HRM systems to attract and retain skilled professionals has been widely examined [10, 11]. Research in the context of Indian healthcare underscores that inadequate human resource availability and retention significantly contribute to increased customer dissatisfaction and diminished institutional performance [12].

## 3. Case Study

### 3.1. Introduction

The case study focuses on the challenges faced by Grade MOs and implementers during the implementation of the Annual Transfer List. Each year, nearly one-fourth of MOs in the government sector become eligible for transfers. The Ministry of Health initiates the process by calling for appli-

cations through the HRMIS web platform. After application submissions, the Ministry prepares an interim list, followed by a period for appeals. Once the process is complete, the Ministry publishes the final list in the given format (Table 1),

which is then made available to implementers, including hospital directors, medical superintendents, MOs in charge, and transferees.

**Table 1.** Format of the annual transfer list.

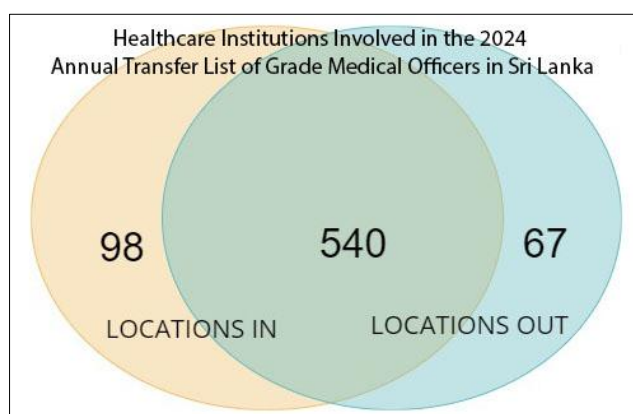
Serial Number	SLMC no	Name	Current station	Current designation	Applied station	Applied designation	Remarks
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The concerned transfer list highlights the following numbers.

- 1) Number of MOs in the transfer process – 3200
- 2) Number of new vacancies created – 148

- 3) Number of health institutes participating the transfer process – 705

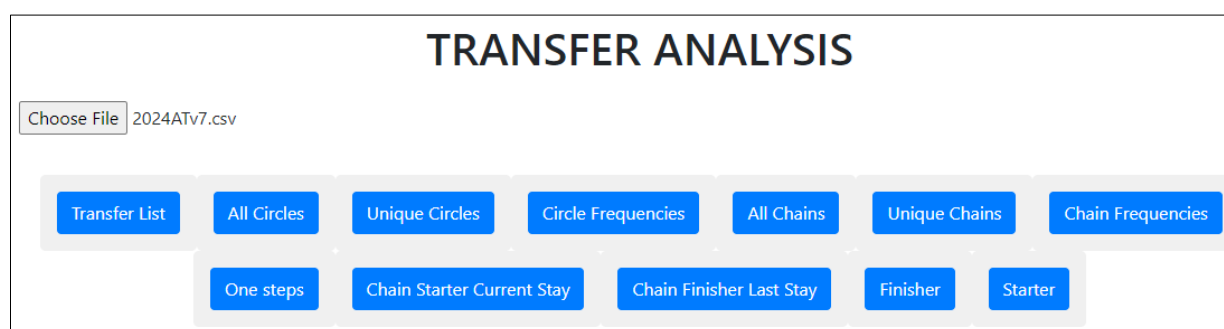
The Venn diagram (Figure 3) demonstrates how those 705 institutes are involved in the transfer process.



**Figure 3.** Health institutes influenced by the MO transfers.

### 3.2. Use of Cycle and Chain Algorithms

Cycle and Chain Algorithms are web-based applications with the following interface (Figure 4).



**Figure 4.** Web interface of the Cycle and Chain Algorithms.

The algorithms can be applied to analyze any transfer list through the following steps:

- 1) Prepare the data according to the guidelines under “Data Preparation.”

- 2) Access the algorithms via the web interface or Application Program Interface (API).
- 3) Upload the prepared Comma separated Value (CSV) file.
- 4) Click the appropriate button to generate the desired list.
- 5) Perform additional analysis using spreadsheet functions, using the raw file provided by the Ministry of Health as a reference key.

### 3.3. Data Preparation

The Cycle and Chain Algorithms operate on three columns of data: the unique identifier of the exchange entity, the unique identifier of the first location of the exchange entity, and the unique identifier of the second location of the exchange entity. However, the annual transfer data for MOs in Sri Lanka includes seven columns: serial number, Sri Lanka Medical Council (SLMC) number, name, current station, current designation, applied station, applied designation, and remarks (Table 1).

To align the data for use with the algorithms, the data needs to be restructured. The first column for the algorithms requires a unique identifier. This can be derived from either the serial number, SLMC number, or name. The second column (representing the unique identifier of the first location of the exchange entity) can be formed by combining the current station and current designation. Similarly, the third column (representing the unique identifier of the second location of the exchange entity) can be formed by combining the applied station and applied designation.

The annual transfer lists of MOs in Sri Lanka, originally available as seven-column tables on the websites [www.health.gov.lk](http://www.health.gov.lk) and <https://hrmis.health.gov.lk/>, were downloaded and converted into editable formats for this research. To maintain confidentiality, the serial numbers in the first column were randomized and transformed into four-digit alphanumeric characters, further safeguarding the identities of the MOs. Additionally, the data in the second and third col-

umns were uniquely coded using Excel functions to ensure that the information remained untraceable. Despite these security measures, the algorithms' functionality was preserved, yielding the same results as it would have with the original data. To prevent duplication in the second and third columns, any repeated values were re-coded by appending a running number to each duplicate entry (Table 2).

**Table 2.** Screenshot of the prepared data table.

Serial number	Current position	Applied position
QM34	H - 186 ? D - 177 ? 1	H - 298 ? D - 49 ? 2
PT55	H - 354 ? D - 17 ? 1	H - 131 ? D - 18 ? 1
QF78	H - 529 ? D - 126 ? 1	H - 552 ? D - 49 ? 1
MM43	H - 530 ? D - 113 ? 2	H - 290 ? D - 201 ? 1
VI68	H - 290 ? D - 49 ? 1	H - 530 ? D - 113 ? 1
BQ46	H - 375 ? D - 106 ? 1	H - 270 ? D - 14 ? 1
CO65	H - 521 ? D - 24 ? 1	H - 520 ? D - 49 ? 1
KI85	H - 288 ? D - 10 ? 1	H - 529 ? D - 126 ? 1

The excel file prepared as above was saved as a CSV file to be used with algorithms.

### 3.4. Results for Different Patterns of Transfers

#### 3.4.1. Transfer Cycles

A screenshot of the output of the transfer cycles is given below (Figure 5).

The screenshot shows a web interface titled "TRANSFER ANALYSIS". At the top, there is a "Choose File" button and a text input field containing "2024ATcoded.csv". Below this is a row of buttons: "Transfer List", "All Circles", "Unique Circles", "Circle Frequencies", "All Chains", "Unique Chains", and "Chain Frequencies". Underneath these is another row of buttons: "One steps", "Chain Starter Current Stay", "Chain Finisher Last Stay", "Finisher", and "Starter". At the bottom, there is a table with 3 columns: "S No.", "Merit order", and "Transfer Circles". The table contains 16 rows of data.

S No.	Merit order	Transfer Circles
1	QW30	QW30, RA72
2	CO65	CO65, RN28
3	RA72	RA72, QW30
4	JI47	JI47, ZU89
5	TR30	TR30, XM45
6	LN03	LN03, IR18
7	QR29	QR29, VD59
8	XM45	XM45, TR30
9	AZ70	AZ70, NL99
10	XH23	XH23, FX15, WZ68
11	ZU89	ZU89, JI47
12	RN28	RN28, CO65
13	VS30	VS30, GZ20, XN97
14	IR18	IR18, LN03
15	MG94	MG94, OG32
16	ZN95	ZN95, BF50

**Figure 5.** Screenshot of the transfer cycles output.



Table 3 shows the transfer cycle of serial number VS30 shown in the above diagram copied from the raw file of the transfer list.

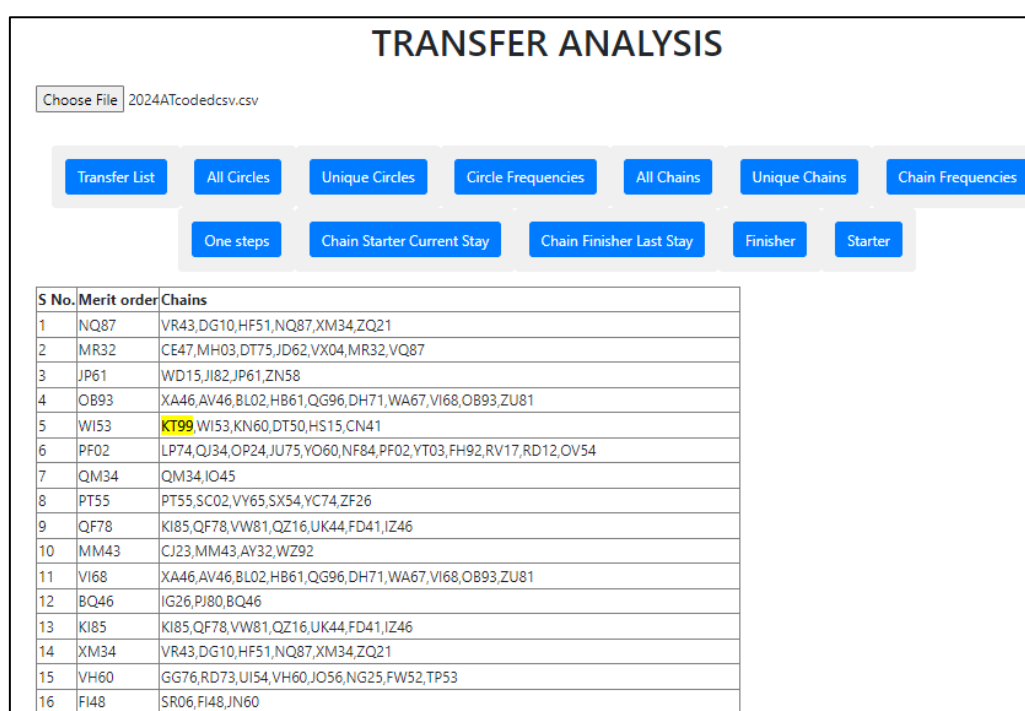
**Table 3.** Example of a transfer cycle.

Serial number	Current position	Applied position
VS30	H - 635 ? D - 206 ? 1	H - 567 ? D - 206 ? 1
GZ20	H - 567 ? D - 206 ? 1	H - 61 ? D - 49 ? 1
XN97	H - 61 ? D - 49 ? 1	H - 635 ? D - 206 ? 1

Without the algorithms, we would have to manually search for each link in the cycle, using spreadsheet functions or scanning the list for every serial number one by one. However, with the algorithms, we can identify all the links in seconds.

### 3.4.2. Transfer Chains

A screenshot of the output of the transfer chains is given below (Figure 6).



**Figure 6.** Screenshot of transfer chain output.

The Table 4 shows the transfer chain containing serial number KT99 shown in the above diagram copied from the raw file of the transfer list.

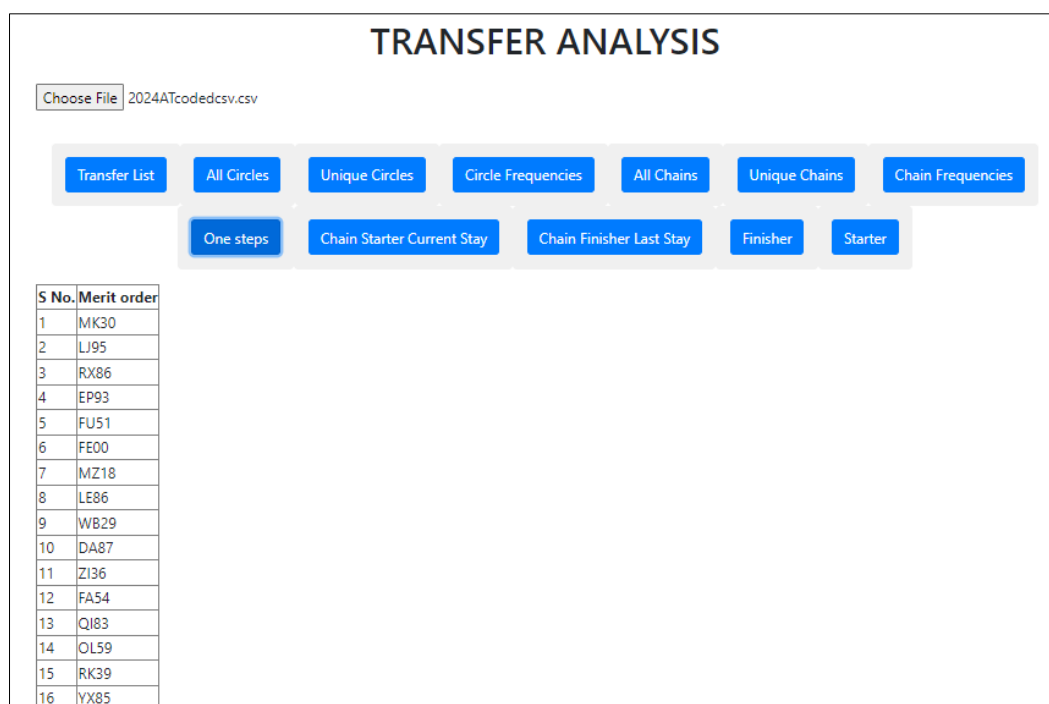
**Table 4.** Example of a transfer chain.

Serial number	Current position	Applied position
KT99	H - 538 ? D - 159 ? 1	H - 537 ? D - 10 ? 1
WI53	H - 537 ? D - 10 ? 1	H - 538 ? D - 49 ? 1
KN60	H - 538 ? D - 49 ? 1	H - 228 ? D - 173 ? 1
DT50	H - 228 ? D - 173 ? 1	H - 538 ? D - 195 ? 1
HS15	H - 538 ? D - 195 ? 1	H - 139 ? D - 17 ? 1

Serial number	Current position	Applied position
CN41	H - 139 ? D - 17 ? 1	H - 36 ? D - 149 ? 1

### 3.4.3. Transfers with No Associations to Other Serial Numbers

Some transfers can occur without the involvement of other MOs due to an imbalance between the number of vacancies and the number of eligible doctors on the transfer list. As a result, a doctor may be transferred to a new station without requiring a replacement for either their current station or the station they are moving to. The list of MOs is generated as given in Figure 7.



**Figure 7.** Screenshot of transfers with no associations to other serial numbers.

The results generated by the algorithms can be further analyzed using spreadsheet tools like Excel. Implementers can filter data based on specific healthcare institutions, while HR

managers can focus on aggregated insights, as shown in [Table 5](#). This table was created by combining raw data with the algorithms' results using Excel's functionality.

**Table 5.** Algorithms output according to transfer board decisions.

Row Labels	Chains	Cycles	Single	Grand Total
60+ - remain on same station			17	17
Allocated - review	53		30	83
Medical - remain on same station			17	17
Medical - remain on same station (review)	3		4	7
Not adequate preference	32		4	36
Not eligible for concerned year			49	49
Noted - not applied (eligible list)	48		9	57
Noted - not applied (not eligible for concerned year)			12	12
Temporarily withheld by Public Service Commission	60	1	19	80
No remarks	2467	59	316	2842
Grand total	2663	60	477	3200

[Table 6](#) and [Table 7](#) show the frequencies of the number of links in each cycle and chain.

**Table 6.** Cycle frequencies.

S No.	Cycle Length	Frequency
1	2	20
2	3	4
3	4	2
Total		26

**Table 7.** Chain frequencies.

S No.	Chain Length	Frequency
1	2	418
2	3	266
3	4	183
4	5	97
5	6	76
6	7	56
7	8	44
8	9	25
9	10	19
10	11	17
11	12	8
12	13	4
13	14	5
14	15	4
15	16	2
Total		1224

#### 3.4.4. Challenges in Preparing the CSV File

The file provided by the ministry was not designed for this specific use, requiring significant preparatory work:

- 1) Inconsistent naming of locations and designations: The same location was listed under different names for current and intended positions, with about 100 instances of such discrepancies.
- 2) Incompatible spelling: The vacancy list did not align with the final published list of vacancies.

Due to issues like these, the algorithms generated more chains than cycles. For better analysis, a well-prepared final list should include the following:

- 1) Eliminate data ambiguity by allowing users to select predefined options instead of manually typing them.
- 2) Use standardized terminology for locations and designations throughout the process.

As a result of these inconsistencies, the algorithms produced an unexpectedly high number of chains. Ideally, the number of chains should match the new vacancies for the year concerned, which is 148. However, due to terminology issues, 1224 unique chains were generated instead of 148. Correcting or mapping the terminology properly should reduce the number of chains and increase the number of cycles, leading to a complete and more accurate list of cycles and chains.

### 3.5. Case-Specific Analysis

Geographic relocation as part of a job change uniquely challenges employees by requiring adaptation to new job responsibilities, coworkers, supervisors, organizational norms, and physical arrangements while simultaneously adjusting to a new city, cultural differences, and non-work routines, making it a multifaceted and intensive change experience [1]. Therefore, employee relocations often negatively affect job satisfaction [13-15], making an efficient and transparent transfer process essential, especially in systems with established policies like the annual transfers of MOs in Sri Lanka. The algorithms described can play a crucial role in supporting this effort, ensuring smoother, fairer, and more efficient transfers.

The solution provided by the algorithms is novel and has not been tested before. Tracing partner links (cycles and chains) in employee movements during complex transfers or relocations has not been routinely practiced. In the past, when traced, it was typically done reactively, focusing only on problematic transfers. However, with this new solution, implementers can proactively analyze entire chains and cycles, identify bottlenecks in the transfer process, and take preemptive actions to ensure smoother transfers and maintain service continuity across institutions in an objective manner.

The implementation of these transfers is a complex process, as it requires maintaining service continuity across all institutions, even during large-scale relocations. Newly assigned MOs may lack the specific knowledge or skills of the MOs they are replacing. As a result, negotiations between administrators of different institutions may be necessary to ensure smooth operations and uninterrupted services. In some cases, a period of training for incoming officers might be required before the outgoing MO can be transferred. The solution proposed in this paper offers implementers a more objective approach to handling such complex scenarios, enabling smoother transitions and better coordination across institutions.

Implementers often face a dilemma when releasing MOs because direct head-to-head replacements are not easily identifiable from the final list published by the ministry. This challenge becomes even more complicated when multiple MOs of the same designation are eligible for transfer. The solution presented here provides clarity by identifying exactly who will be replaced and by whom, eliminating the



uncertainty in the process.

The process can be further streamlined by integrating the algorithms into the existing HRMIS platform. The algorithms will help identify and correct terminology issues and errors in the selection process. If there is a mismatch between the number of transfer chains and newly added vacancies, the algorithms can prompt further investigation to identify the cause. In this way, algorithms can also be used to detect and address defects within the HRMIS platform, improving its overall accuracy and efficiency.

## 4. Discussion

The successful application of the Cycle and Chain Algorithms in the case study illustrates its potential as a novel and transformative solution for optimizing human resource management (HRM) processes. The ability of the algorithm to efficiently handle complex employee transfers not only benefits the individuals involved but also streamlines operations for institutions, leading to improved organizational performance. Its effectiveness in managing transfers, reshuffles, promotions, and other HR functions marks the algorithm as an innovative tool for the modern workplace.

The potential of the algorithms extends far beyond the realm of HRM. The core concept of identifying and managing cycles and chains of movement is applicable to many other fields. With the ability to process and analyze data rapidly, these algorithms can offer substantial benefits in areas where fast decision-making and efficient resource distribution are crucial. Sectors such as logistics, healthcare, and finance could see significant improvements in how personnel, resources, or information are transferred or allocated, leading to greater operational efficiency.

Despite the clear advantages demonstrated in HRM, the full range of the algorithm's capabilities has yet to be fully explored. Its potential applications across various industries remain largely untapped, as different sectors may reveal new

possibilities. Areas like stock trading, transportation systems, and emergency response operations could benefit from the algorithm's ability to streamline complex processes, optimize workflows, and reduce inefficiencies. Given the need for real-time, multi-party coordination in these sectors, the algorithm could play a crucial role in improving outcomes and productivity.

One of the most powerful real-time applications of the algorithm is its ability to facilitate employee-initiated transfers. For example, mutual transfers, which involve employees from different locations agreeing to swap positions, can be automated by integrating online requests with the Cycle and Chain Algorithms. Once a cycle is identified, the system can notify the relevant parties and streamline the process, reducing delays and enhancing the transparency and fairness of the transfer process. This not only saves time but also improves employee satisfaction and organizational efficiency.

Moreover, the algorithm's potential extends beyond HRM. In transportation, particularly taxi services, real-time passenger requests and driver availability can be matched more efficiently by optimizing routes based on the algorithm's logic. This can reduce idle times for drivers, minimize passenger-less return trips, and lower operational costs, benefiting both the service provider and its customers.

The potential applications of the algorithm are vast, ranging from resource allocation in healthcare to optimizing data routing in telecommunications networks. Its ability to process complex, multi-party exchanges in real time could transform how industries handle logistical challenges. Additionally, by reducing human error and decision-making bottlenecks, the algorithm paves the way for more automated and intelligent systems that can respond dynamically to changing conditions.

Table 8 provides an overview of additional potential applications of the Cycle and Chain Algorithms across various sectors, further illustrating its versatility and impact.

**Table 8.** Potential Applications of the Cycle and Chain Algorithms.

Sector	Application Example	Nodes	Edges
Stock Exchange	Identify circular and insider trading	Shareholders	Buy/sell shares, commodities
Library Systems	Popular book exchanges	Readers	Lending/receiving books
Social media and E-commerce	Exchange-based auctions, trades	Participants	Buy/sell goods/services
HRM	Annual transfers, mutual transfers, reshuffles	Employee location/position	Receive/send employees
Emergency Services	Resource tracking during natural disasters	Resource locations	Receive/send resources or personnel
Healthcare	Hospital resource allocation	Medical resource locations	Receive/send supplies and personnel

Sector	Application Example	Nodes	Edges
Taxi Services	Matching passenger drop-off and pick-up locations	Passenger and driver locations	Drop-off/pick-up passengers
Postal and Courier Services	Fleet management and parcel distribution	Parcel/document locations	Submit/receive packages
Telecommunications	Optimizing call/data routing	Network nodes (routers, switches)	Send/receive data
Sports	Player transfers among sports clubs	Sports clubs	Player transfers
Real Estate/Vehicles	Buying and selling properties/vehicles	Buyers and sellers	Exchange of assets
Research Community	Identifying citation chains in academic papers	Research articles	Citations
Social Networks	User interaction patterns, content sharing	Social media users	Friend requests, comments, content sharing

The versatility of Cycle and Chain Algorithms makes it a powerful tool not just for data-driven HR systems but for any industry where complex exchanges or transfers take place. The ability to operate in real time and automate multi-party transactions marks a significant step forward in optimizing resource use and decision-making. As industries increasingly move toward automation, the adoption of such algorithms will be critical in improving operational efficiency and enhancing the user experience.

By continuing to test and refine the algorithm across different sectors, its potential for driving transformative change in modern industries will only grow. Researchers and practitioners are encouraged to explore its applications further, helping to unlock its full potential in various domains.

## 5. Conclusion

The Cycle and Chain Algorithms represent a significant advancement in optimizing employee transfers, as demonstrated in the case study of Grade Medical Officer transfers in Sri Lanka. By automating the identification of complex transfer patterns such as loops and chains, these algorithms enable HR managers to manage staff movements more efficiently, reducing the time and effort required for manual tracking and minimizing service disruptions.

However, the potential applications of these algorithms extend far beyond the health sector. Any organization that manages large-scale, interdependent transfers or resource allocations—such as in corporate restructuring, educational staffing, or supply chain logistics—can benefit from this technology. The algorithms offer a scalable solution for tracking complex movement patterns, ensuring operational continuity, improving decision-making transparency, and ultimately boosting overall efficiency.

In essence, Cycle and Chain Algorithms provide a versatile and effective approach for managing dynamic, interconnected movements in various domains. Whether applied to

employee transfers, resource management, or other logistical processes, these algorithms offer a powerful tool for optimizing workflows and enhancing organizational performance.

## Abbreviations

HRM	Human Resource Management
MO	Medical Officer
HRMIS	Human Resource Management Information System
SLMC	Sri Lanka Medical Council
CSV	Comma Separated Value

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## Author Contributions

Sugath Pathiraja is the sole author. The author read and approved the final manuscript.

## Ethical Considerations

Personally identifiable information, such as names and registration numbers of MOs in Sri Lanka, is publicly accessible through the Sri Lanka Medical Council website. Additionally, full transfer lists of MOs are published on websites like [www.health.gov.lk](http://www.health.gov.lk) and <https://hrmis.health.gov.lk/>. However, for this case study, even though the information is

publicly available, it was not directly used. To ensure confidentiality, the serial numbers were replaced with alphanumeric codes, and both current and applied positions were re-coded, rendering the data untraceable while maintaining the accuracy of the analysis. The research focuses solely on the functionality and effectiveness of the algorithms, rather than on the confidential information of MOs involved in the transfer process. As a result, ethical and administrative clearance was not sought for this study.

## Data Availability Statement

The interface to run the algorithms and display results, along with the option to download a sample CSV file for testing, is available at <https://ssumethods.com/candc/>.

## Conflicts of Interest

The author declares no conflicts of interest.

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## Research Fields

**Sugath Pathiraja:** Health Informatics