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Effectiveness of peer to peer strategy in reducing accidents and injuries at a selected platinum mine in Zimbabwe

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ABSTRACT

The selected mining company implemented the "Peer to Peer" strategy in 2008 to fast track achievement of zero tolerance to injuries and fatalities incidents at its workplace. Our study, therefore, sought to assess the effectiveness of this strategy in reducing accidents and injuries at this selected platinum mine in Zimbabwe. A mixed-method cross-sectional survey was conducted on 32-day shift employees using a semi-structured questionnaire with closed and open-ended questions. Furthermore, incident trend analysis was done on data obtained from the records from 2004 to 2017. Covert observations were then employed to triangulate findings from data collected using the questionnaire on practices. The tests Hotelling, Chi-square, time series plots, and Multiple Logistic Regressions were employed to compare the variables of interest before and after implementing the peer to peer strategy. There was a significant drop in the number of incidents after implementing the peer to peer strategy. There was no association between tested demographic characteristics and the level of employees' knowledge of the strategy. Employees were afraid to implement the strategy to their superiors fully. Findings pointed out that this strategy was effective despite being part of a cocktail of strategies. There was a vast decrease in the rate of occurrence of incidents after the implementation of this strategy. However, there is a need for engagement to address the subordinate management dynamics that was observed to be a threat in the comprehensive implementation of this strategy.

Abbreviations: BBS, Behaviour Based Safety; GDP, Gross Domestic Product; HIRA, Hazard Identification and Risk Assessment; LTI, Lost Time Injury; LTIFR, Lost Time injury Frequency Rate; MLR, Multiple Logistic Regression; OHSAS, Occupational Health and Safety Assessment Series; OR, Odds Ratio; ISO, International Organization for Standardization.

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Introduction

Workplace injuries have dire consequences on employees who hurt and result in huge losses to the organisations [1,2]. Takala et al. (2014) estimate that globally there are 2.3 million deaths annually due to occupational accidents [3]. This further translates to between 1.8 to 6.0% of the total Gross Domestic Product (GDP) in different countries [3]. These losses result from employee compensation, medical and funeral costs, loss of production, and other costs that may relate to training of replacements if the workers die or are injured to a point where they are not fit for duty [3]. Many organisations are now compelled to implement different strategies by different regulatory authorities to promote workers' safety in their respective countries [1]. Different safety systems have been implemented by organisations the world over to enhance production but at the same time, maintain a safe and conducive work environment for workers [1]. These include Behaviour Based Safety Initiative Card System [4], Safety Score Permit [5], utilising skills to improve on Behaviour Based Safety [6], and other different workplace strategies [7,8] to mention a few.

It is documented that despite how good safety strategies are if they do not address workers behaviours, their implementation would not yield desired outcomes [3]. Various scholars report that over 80% of accidents are caused by unsafe acts at the workplaces [3,9,10]. This means that most accidents are avoidable if organisations implement strategies that target workers' knowledge, attitudes, behaviour and practices towards workplace safety [4]. Behaviour Based Safety strategies have become a key tool in accident reduction in various organisations symbolised by various contextual strategies that have been implemented worldwide to achieve zero harm [4]. According to the National Social Security Authority of Zimbabwe as reported on their "On Guard Magazine" published bi-annually, 2440 serious injuries, 22 fatalities, and Lost Time Injury Frequency Rate of 3.11 were experienced from January to July 2019 [11]. Most of these incidents were attributed to workers' unsafe acts and in some cases, failure to comply with safe working procedures [11].

The mining company selected for our study implemented, several strategies before implementing peer to peer strategy. The mine implemented other safety initiatives such as awareness campaigns, training or induction of employees, hazard identification and risk assessment (HIRA) system, stop and fix notes, audit-based safety, whistleblowing, and planned and unplanned job observations. This company is certified to ISO 9001, 14,001, 31,000 and 17,025 and it is also compliant to OHSAS 18,001. These systems seemed inadequate in propelling the mine towards reaching its safety target (zero tolerance to injuries and fatalities), hence introducing peer to peer strategy in 2008. The introduction of this strategy was expected to fast track the rate of moving towards achieving the zero harm target. This was a new strategy designed by the organisation under study and has not been used elsewhere. There was hope that if the organisation targets employees' behaviour, positive results could be yielded as reported in other studies that have targeted human behaviour [4].

Authors argue that to achieve positive safety outcomes at the workplace, and there is a need to target human behaviours cited to contribute to over 80% of accidents [9,12–14]. Employees' behaviours at the workplace are a predisposing factor that influences increase or decrease in the risk of being involved in accidents [15]. Organisations have different accident management systems employed to curb accident occurrence; however, these have to be complemented by behaviour centred programs to aid effectiveness [15]. Programs that do not focus on human behaviour are bound to fail [4,16,17]. Behaviour Based Safety (BBS) programs have been reported to increase safety awareness, resulting in decreased accident occurrence [18]. Employees and employers develop a good working relationship that results in developing programs that can be effectively and efficiently implemented and supported [19].

Peer to peer strategies leverages on workers becoming stewards of their safety and be mindful of co-workers' safety. This is a BBS strategy that minimises accident occurrence by targeting and promoting safe work behaviours [4]. Each worker is given peer to peer forms to complete during working hours regarding their co-workers' performance. Peer to peer forms is used as instruments for commending individuals who perform their duties well or correct non-compliant individuals who violate the requirements of safe work procedures. These forms consist of four critical questions that are supposed to be answered by the person raising an issue on their co-worker. These questions were: i) what did you see? ii) What did you do to show you care? iii) How did your colleague respond or do? iv) what do you recommend about what you saw? The whole team gets rewarded with a 100% salary bonus each if they work for a combined 1 million hours without any incidents. Furthermore, they are given small gifts such as caps, t-shirts, and cups with zero harm as an additional token of appreciation. Non-compliant individuals are fined depending on the intensity of the offence, and the amount to be paid is determined by management. Action plans are drawn from the raised issues in the peer to peer forms if no compliance is reported. Long-term action plans, coupled with a follow-up strategy, would then be put in place to avoid the recurrence scenario. This strategy's performance has never been assessed in this organisation; therefore, our study sought to assess the effectiveness of peer to peer strategy in reducing accidents and injuries at this selected platinum mine. Our hypothesis assumes that there has been no significant difference in accident occurrence rates before and after the implementation of the peer to peer strategy.

Specific objectives

Our study sought to achieve the following specific objectives:

a) Analyse accident trends before and after implementation of the peer to peer strategy;
b) Assess knowledge levels of employees on the peer to peer strategy and its implementation;

c) Assess employees' practices in as far as implementation of the peer to peer strategy was concerned.

Material and methods

Study setting

Our study was conducted in a selected Zimbabwean platinum mine that began operations in April 2002 and employs approximately 200 workers. This organisation is a subsidiary of a bigger group of companies engaged in platinum mining and would remain anonymous in our study as per their request. This mine has two shifts: the day and night and most employees work underground mining platinum, except for the few administrators. This organisation coined the peer to peer strategy in 2008 to expedite their progress towards achieving zero incidents.

Study design

A mixed-method cross-sectional survey generating qualitative and quantitative data was conducted at this selected mine to collect data from the day shift miners. This survey method enabled collecting required data such as demographic characteristics, knowledge, and practices of employees on the peer to peer strategy, trends of incidents before and after implementing this strategy at a single point in time [20,21]. This design was appropriate for our study. The researchers did not want to follow up respondents but rather collect useful data to answer research questions at a single point and time [22].

Population and sampling

Our study targeted all employees working underground during the day shifts at the time of data collection. Of the 200 workers, 33 are administrators, and 14 are drivers. This left 153 respondents who were eligible to be part of the study. These 153 workers work in 14-day shifts then the other 14 days they are off. This meant that during data collection (which was done within seven days), only 32 eligible employees (who were on the day shift) who met the inclusion criteria were considered. Therefore, this was classified as a census type of sampling and recruitment of respondents as we took all those that were available on that particular shift [23].

Data collection tools

Data on incident trends were collected from registers using a checklist designed to capture critical information on incidence occurrence and classify it into different categories (unsafe acts, unsafe conditions, minor injuries, Lost Time Injuries (LTIs) Minor Incidents) from 2004 to 2017. A researcher administered pre-tested semi-structured questionnaire with both closed and open-ended questions was developed and used to collect data from the recruited respondents. The questionnaire was adapted from other scholars who had conducted similar studies and developed Likert scales [4,24,25]. The questionnaire had questions that sought to solicit information on demographic characteristics, followed by twelve questions that probed employees' knowledge about the peer to peer strategy and the open-ended questions to probe on employees' practices. The reported practices were further triangulated with covert observations where employees were observed conducting their tasks by researchers whose identities were masked and guided by a developed checklist [26,27]. The researchers were not employees of the organisation, therefore not known by employees during these covert observations. Researchers went underground to observe employees conducting their duties in the pretext that there were doing some repair work quotations. The workers were observed to determine whether they were completing the peer to peer forms and how they corrected the anomaly if one was found to be violating what is expected of them in as far as the strategy was concerned. The questionnaire took an average of 15–20 mins for researchers to collect data from each of the respondents. Responses to open-ended questions were recorded using a tape recorder. Covert observations were done during the daytime 8hr shift.

Data analysis

Data on trends on incidents before and after the implementation were analysed using the Hotelling test and a time series plot. The Hotelling test was used to determine whether there was significance in the mean differences in unsafe acts, unsafe conditions, minor injuries, LTIs and Minor Incidents before and after implementing the peer to peer strategy. A Hotelling test is a test used to interrogate multivariate data to compare and determine the significance of mean differences from different variables or samples [28]. This test brings the advantage that it controls for type 1 errors (where a null hypothesis is falsely rejected) since the relationship between multiple variables is taken into account [28]. Our study assumed that the mean differences of incidents before and after the implementation of peer to peer strategy were zero. Therefore the Hotelling test was used to ascertain the significance of the differences observed before and after implementing this strategy. Furthermore, a Time Series Plot on all incidents was used to elaborate on the observed incidents before and after implementing the strategy. The 12 knowledge questions were scored; if the respondent gets the answer correctly, they were awarded one point, and if they got it wrong got zero. The total scores were populated, and if one scored between 0 and 6 questions correctly,

Table 1
Trends of Incidents before and after implementation of "Peer to Peer" strategy.

Variable	Before Implementation	After Implementation	Absolute Mean Difference	Hoteling *p*-Value
Minor Incidents	60	19	41	0.0260
Unsafe Acts	45	7	38	0.0170
Minor Injuries	35	12	23	0.0534
LTIs	26	7	19	0.0105
Unsafe Conditions	16	12	4	0.0023

*Hotelling p-value $\leq$ 0.05 considered significant.

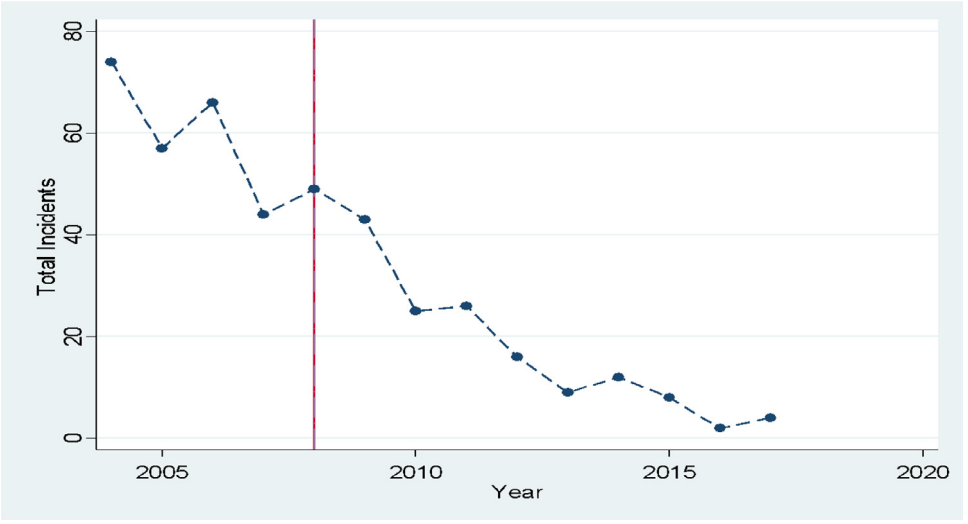

Fig 1. Time series assessment of Total Incidents.

they were deemed to be not knowledgeable while those scoring between 7 and 12 were considered knowledgeable. Chi-squared (χ^2) Tests and Multiple Logistic Regression (MLR) were then computed to determine whether or not the different categories in demographic characteristics influenced whether or not one was knowledgeable on peer-to-peer strategy its implementation. Qualitative data on practices and covert observations were transcribed verbatim, coded, and thematically analysed on MAXQDA version 14. Key emerging themes were then presented in tables.

Results

Of the 32 targeted respondents, 4 declined to participate in our study. This then meant that 28 were recruited, giving a response rate of 88%, which was sufficient to make meaningful conclusions.

Trends of incidents and conditions before and after implementation of the peer to peer strategy

The study's findings pointed out that there was a huge difference in the mean occurrence of incidents before and after the implementation of the peer to peer strategy. This was confirmed by the Hotelling p-values, where all p-values that were equal or less than 0.05 for all categories symbolising that the mean differences were significant. This was also confirmed by the Time series Plot that showed a steep decline after implementing the "Peer to Peer" strategy. These findings are presented in Table 1 and Fig 1.

Relationship between demographic characteristics and level of knowledge

About 89% (25) of the respondents were knowledgeable of the "Peer to Peer" strategy and its implementation. These findings are presented in Fig 2. There were no associations found between all tested demographic characteristics and the levels of employees' knowledge towards the peer to peer strategy, both using the χ^2 tests and MLR. The p –values for both tests were greater than 0.05. These findings are presented in Table 2.

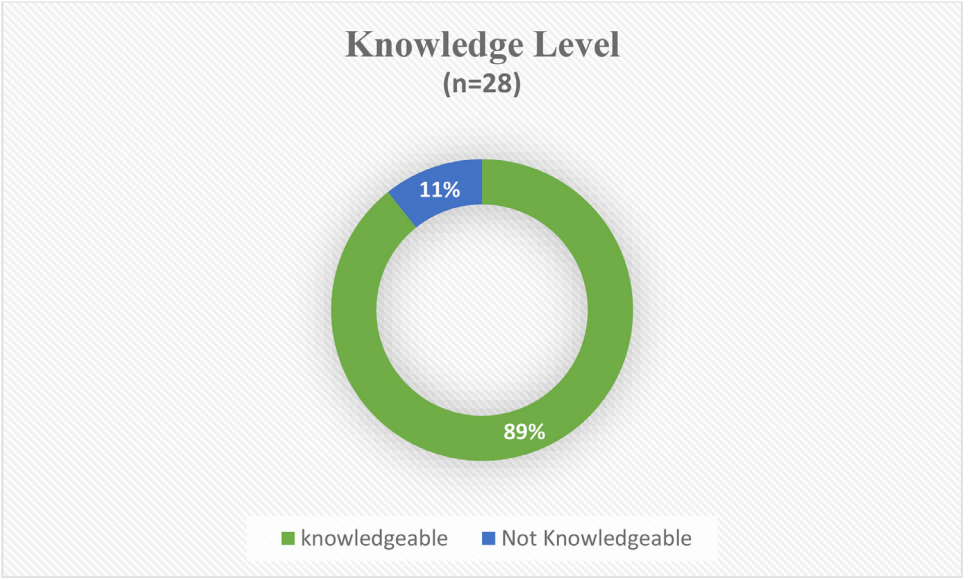

Fig 2. Respondents' Knowledge Levels on the "peer to peer" strategy.

Table 2
Relationship between level of Knowledge and Demographic Characteristics.

Demographic Characteristics and Knowledge ($n = 28$)						
Variable	Not Knowledgeable	Knowledgeable	χ^2 p-Value	MLR-OR	MLR-95% CI	MLRP-value
Age						
16–30	0	6	0.464	***		
31–45	2	8		0.8	0.57–11.298	0.869
46–60	1	5		***		
61+	0	6		***		
Gender						
Male	2	18	0.847	***		
Female	1	7		0.777	0.060–10.004	0.847
Completed level of Education						
Primary	2	5	0.358	***		
Secondary	1	16		6.4	0.474–86.343	0.162
Tertiary	0	3		***		
Never went to School	0	1		***		
Length of Service in years						
<1	0	2	0.626	***		
1–5	1	7		1.556	0.116–20.854	0.739
6–10	2	9				
>10	0	7				

* p-values $\leq$ 0.05 considered significant.

Practices of employees with regards to peer to peer strategy

Four themes emerged from respondents concerning employees' practices. These were identified with peer-to-peer forms, response to an unsafe act condition, and employees' response when corrected and interim action is taken when deviating workmate fails to accept correction. These obtained themes are presented in-depth in Table 3.

Findings from covert observations

It was observed that most employees file peer to peer complains against each other. However, some did not issue these forms to their supervisors or any member of management even if they deviate from the peer-to-peer strategy requirements. All employees were observed to be taking part in the implementation of the strategy. The findings are presented in Table 4.

Table 3
Practices of employees.

Theme	Responses
1. Issuance of peer to peer forms	Some respondents highlighted that they correct each other first and then raise a peer to peer form. One employee noted, "*When my colleague is working without adequate PPE/C for example, I tell him/her to wear adequately then I write a peer to peer card*". Some respondents indicated that it is a challenge to correct management or their supervisors when they commit an unsafe act. Another employee said, "*Even if I see a member in management committing an unsafe act, it is difficult to correct them*".
2. Response to an unsafe condition	One of the emerging themes showed that respondents evacuate an unsafe condition unless there are mitigation measures. A quote from one of the respondents said *"I address the unsafe condition by either barricading so that the place is not accessible to everyone, stacking materials to get rid of falling and tripping hazards or evacuating the place if it is beyond my capabilities."*
3. Response of employees when being corrected	Most employees cited that they issued a peer to peer form accordingly as soon as possible (they stop the task and correct the act or condition). One respondent said; "*Employees stop whatever they will be doing and correct, (Stop and Fix rule) because individuals are ashamed of being issued peer to peer forms. It also puts concerned individuals on the spotlight for unsafe practices*".
4.Interim action when a deviating workmate fails to accept correction	Respondents highlighted that workmates remind each other on the benefits of complying with standard operating procedures. This is indicated by one participant's response who mentioned that; *"Whenever a colleague deviates and fails to accept correction. I remind them of the benefits that come along with following safe work procedures and the consequences of breaching standard operation procedures."*

Table 4
Covert observation results.

Peer to Peer forms issuance	Observation
Do employees raise peer to peer forms after identifying an unsafe act?	Employees do raise Peer to peer forms against each other; however, they were afraid to raise peer to peer forms against management personnel. One employee was observed reminding the SHEQ Officer to wear glasses at a PPE/C compulsory zone; however, he did not raise a peer to peer form.
How do they issue or raise the peer to peer forms to each other?	Employees were observed correcting each other first before writing a peer to peer form.
Who raises or issues a peer to peer form?	Employees across all sections or departments were involved in peer to peer issuance system.
What is the reaction of those who have peer to peer forms raised in their name?	Employees deny having committed the unsafe act at first hand. However, when trained or corrected, they take note and adhere to standard operating procedures.

Discussion

In general, the findings of this study highlight that Behaviour Based Safety initiatives play a major role in motivating employees to adopt behaviours that minimise the risks of them from being exposed to hazards at the workplace. Employees become motivated to be responsible for their safety and their co-workers at the workplaces. It has been widely reported targeting employees' behaviours at the workplaces go a long way in ensuring that they adopt safe attitudes and practices towards safety in general and understand the impact of their actions on the safety of oneself and the other workers [4,29]. Therefore, targeting the behaviour of employees goes a long way in complementing the already available safety systems implemented by the different organisations [29].

Respondents exhibited high levels of knowledge about the peer to peer strategy. This could have been a result that some incentives and consequences came with the implementation of this strategy. This could also have been because this strategy was introduced very well by those responsible. If these strategies are comprehensively introduced, they are bound to be grasped well by the employees [29]. Furthermore, studies suggest that if a strategy impacts one's income and livelihood the concerned individuals are bound to take that strategy seriously and acquire as much knowledge about it as possible and ensure they maximise on the befits and minimise negative consequences that could impact on their livelihoods [30,31,32].

Our study's findings showed that the rate of occurrence of incidents decreased after implementation of peer to peer symbolised by fewer incidents experienced after implementation compared to before implementation of this strategy. This meant that this behaviour-based safety program was effective as workers could have been very worried about their behaviours that predisposed them to injuries and were well aware of what they needed to alter in their behaviours to stay safe and aim to receive incentives for complying and exhibiting desired behaviours. Commercial mines invest significantly in accident minimisation strategies which in turn yield fruit [33]. This has resulted in a significant reduction of accident occurrence. These findings are consistent with a study conducted by Giuffrida and Torgerson in 1997 who reported a high

compliance rate on homeless TB patients after being given a $5 USD incentive to comply [34]. This works well particularly on people from lower-income quintile [35]. In our case, mine workers in Zimbabwe do not earn much; therefore, they always appreciate any additional income leading them to go the extra mile to ensure compliance if they have extra income [36]. This strategy, in turn, could have also improved the working conditions as workers would report any anomaly that was bound to jeopardise their chances of getting these incentives leading to the improvement of other conditions and eliminating other negative factors that could predispose employees to accidents and injuries as well [37]

The study did not find any association between demographic characteristics and workers' level of knowledge towards peer to peer strategy. This contradicts findings by some authors who found a positive correlation between the level of knowledge and educational qualifications, i.e. the higher the level of qualification a worker has the higher the likelihood that they will be more knowledgeable about safety-related issues [38,39]. The difference between these studies' findings and our study could be explained by incentives given to workers for complying and attaining a combined 1 million work hours incident-free. When one is motivated by monetary rewards for conducting their tasks safely, they make it a point to abide by safe work procedures and know them to comply [39]. However, what needs to be fostered in employees is the change of mindset towards being motivated ones safety rather than the drive to be rewarded financially [39,40].

Our study reported that all workers were actively involved in the implementation of peer to peer safety strategy though management was treated differently by other workers. Workers feared members of management, and if these members were non-compliant to safe work procedures workers did not raise a peer to peer form. Power dynamics are usually complicated to manage in workplaces, particularly in mines as subordinates always feel inferior to their managers [41]. O'dea and Flin (2001) argue that there is a need to address this gap to ensure safety programs' effectiveness [40]. Management plays an important role in ensuring the success and comprehensiveness of safety programs if they are also made to be fully accountable for their actions [41].

Employees will complete peer to peer forms, but it was observed that the majority do not submit these to management (during covert observations). This however, was seen as working against the progress in general in as far as implementing this strategy was concerned. It is reported in the literature that majority of times employees who work together find it difficult to report negative issues about their co-workers as this is seen as a potential to strain working relations especially when those that are reported suffer some consequences [4].

Limitations

There was a possibility that some accidents were not reported since there were some financial incentives associated with zero occurrences of accidents for a million worked hours. Employees could have been tempted not to report Minor incidents in fear of jeopardising the chances of getting a 100% salary bonus. This strategy was added into a cocktail of strategies which could have influenced the outcome. The observations were only done on the day shift employees and were not extended to the night shift. There could be a possibility that there could have been different outcomes regarding these observations between the day and the night shifts.

Conclusion

The peer-to-peer strategy effectively reduced workplace incidents as evidenced by the significant decline in incidents of incidents after its implementation. However, manager-subordinate dynamics undermines the comprehensive implementation of this strategy. Incentives given to workers motivates them to be compliant. Financial consequences force workers to comply with safe work procedures as they fear losing earnings when fined. There is a need to motivate employees without forking out financial incentives as these are not sustainable for a small mine located in a low-income country. Employees' mindsets should be targeted such that they are motivated by the by valuing their safety and wellbeing.

Ethical considerations

Written permission to carry out the study was sought from the selected Platinum Mine. Researchers also sought permission to conduct our study from the Department of Environmental Science and Health at the National University of Science and Technology. After being made aware of their rights to withdraw from the study at any point when they felt so, written consent was sought from the participants. The Helsinki declaration on principles to be observed when conducting studies that deals with human subjects were observed throughout the study.

Consent for publication

Not Applicable.

Availability of data and material

Not Applicable.

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Declaration of Competing Interest

The authors declare that they have no competing interests.

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Not Applicable.

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