



BREAKDOWN TIME ANALYSIS IN THE EFFORT TO MAXIMIZE MEDICAL EQUIPMENT PRODUCTIVITY IN HOSPITAL

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ABSTRAK

Peralatan kesehatan di rumah sakit menentukan produktivitas penyelenggaraan pelayanan kesehatan. Peralatan kesehatan harus terus berfungsi dengan baik. Salah satu cara untuk mengukur keberhasilan pemeliharaan alat kesehatan adalah dengan standar *Breakdown Time*. Penelitian ini bertujuan untuk mengetahui penerapan standar *Breakdown Time* pada alat Kesehatan yang mengalami kerusakan. Metode penelitian yang digunakan adalah metode deskriptif kualitatif dengan wawancara mendalam. Narasumber ada yang berstatus swasta dan ASN. Dari kalangan swasta ada yang sebagai konsultan, manajer teknis, dan pengurus organisasi profesi dibidang peralatan kesehatan. Narasumber yang berstatus ASN adalah para praktisi pemeliharaan dan perbaikan peralatan kesehatan di rumah sakit pemerintah. Hasil wawancara dihimpun menjadi 6 kelompok berdasarkan pertanyaan pokok yang diajukan, kemudian dianalisis secara deskriptif. Hasil Penelitian, Standar *Breakdown Time* belum diterapkan secara menyeluruh di rumah sakit-rumah sakit. Beberapa narasumber menginformasikan, walaupun ada penerapan *breakdown time* standarnya belum jelas dan hanya diterapkan untuk alat berteknologi tinggi dan atau untuk jumlah alat yang minim, bahkan cuma ada satu-satunya di rumah sakit. Untuk peralatan lain waktu kerusakan tidak ada standar, sampai kapan alat yang rusak harus bisa difungsikan kembali. Kesimpulan, Standar *Breakdown Time* alat kesehatan penting diterapkan dan penerapannya harus didukung oleh peraturan setingkat Menteri.

Kata kunci: Alat Kesehatan, Breakdown Time, Downtime, Rumah Sakit

ABSTRACT

Health equipment in hospitals determines the productivity of health service delivery. Medical equipment must continue to function properly. One way to measure the success of maintaining medical devices is by standard Breakdown Time. This study aims to determine the application of standard Breakdown Time on damaged medical devices. The research method used is a descriptive qualitative method with in-depth interviews. There are interviewees with private status and ASN (government employees). From the private sector, there are consultants, technical managers, and administrators of professional organizations in the field of medical equipment. Interviewees with ASN status are practitioners of maintenance and repair of health equipment in government hospitals. The results of the interviews were compiled into 6 groups based on the main questions asked, then analyses descriptively. The results of the study, Standard Breakdown Time have not been applied comprehensively in hospitals. Several informants informed that although there is an application of breakdown time, the standard is not yet clear and is only applied to high-tech equipment and/or for a minimal number of equipment there is only one in the hospital. For other equipment, there is no standard when the damage occurs, until when the damaged equipment must be able to function again. In conclusion, the Standard Breakdown Time for medical devices is important and its application must be supported by Ministerial-level regulations.

Keywords: Medical Devices, Breakdown Time, Downtime, Hospital



INTRODUCTION

The use of health equipment in supporting the successful implementation of health services has become a necessity and has even become a production tool that can affect the quality of health services. According to WHO, a medical device is an instrument, apparatus, or machine used to prevent, diagnose or treat pain or disease, or to detect, measure, correct or modify the structure or function of the body for certain health purposes. Medical devices based on the potential risks that can befall patients are divided into 4 classes, namely class A medical devices that pose a low risk, class B poses a low to moderate risk, class C poses a moderate to high risk, and class D poses a high risk². According to the specifications, medical devices are grouped as Electromedical devices, non-Electromedical devices, and in vitro diagnostic products³. Health equipment is declared by WHO to be required for calibration, maintenance, repair, training in the use, and deactivation - activities that are normally managed by a competent engineer¹.

Medical equipment in hospitals has a large investment value compared to other investment values. Data in 2008 the investment value of medical equipment reached 37.73%, which is the largest investment component⁴. Health equipment will also determine the productivity value of health service delivery in hospitals. The investment value that has been invested will be calculated to be able to return and even for private hospitals it is hoped that investment in medical equipment can generate profits for hospitals. So, the guarantee that the medical equipment can continue to function should always be sought. In addition to ensuring that services to patients continue to run, it is also to ensure that the investments that have been made do not cause losses.

The Ministry of Health has compiled a Manual for the Management of Medical Equipment in Health Service Facilities⁵. This manual explains the management of medical equipment according to the cycle of medical equipment, namely pre-market and post-market. The pre-market cycle starts from planning and procurement, acceptance and installation, operation, maintenance, and repair, while the post-market cycle includes surveillance, decontamination, recall, and removal. The manual has been prepared well and is very useful, especially in the management of health equipment maintenance, which includes planning, calculating maintenance costs, and financing feasibility, but for the use of technical details of maintenance, it seems that it is still general and not enough to be used to measure the achievement of health equipment maintenance performance. There need to be technical guidelines that can ensure that the medical equipment can be used optimally, the damage to the

equipment can be minimized, and financial losses if the equipment does not function can be avoided.

Why should medical equipment as a hospital asset continue to function? Of course, the goal is that health services for patients do not stop. If the medical device is damaged so that it cannot be used, then the service for patients who need the medical device will stop and it means that there is a financial loss that must be borne by the hospital due to the cessation of services to patients. If medical devices are considered as production tools such as factory equipment, the longer the equipment is damaged, the greater the loss for the hospital and of course will also reduce the quality and productivity of hospital services as a product of the use of these medical devices. For this reason, the length of time the damage must be avoided or controlled.

The time of breakdown in equipment maintenance and repair is known as Breakdown Time. Breakdown time is downtime due to unplanned equipment failure. Calculated from the time the asset fails to function until the asset is successfully restarted⁶. The success of controlling the breakdown time can be used as a measure of the success of the equipment maintenance program. The smaller the breakdown time, the higher the productivity of the tool, on the other hand, the greater the breakdown time, the lower the productivity of the tool. The low productivity of medical devices due to high breakdown times will cause big losses for hospitals.

Based on the observations and experiences of researchers working in the health sector, currently, there is still medical equipment found in hospitals that are damaged and require a long waiting time for repairs. For this reason, it encourages researchers to find out whether the standard Breakdown Time has been applied to every medical device that is damaged in hospitals? especially in government hospitals.

METHODS

The method used in this research is descriptive qualitative. Data collection was carried out by in-depth individual interviews. Due to several limitations, such as social restrictions still in effect due to the Covid-19 pandemic, interviews were conducted using WhatsApp video calls and telephone calls, therefore document studies and on-site observations could not be carried out.

The interviewees are from various circles who work as practitioners in the field of medical equipment. They have private status and ASN (government employees). From the private sector, there are consultants, technical managers, and administrators of professional



organizations in the field of medical equipment. The interviewees with ASN status are practitioners of maintenance and repair of medical equipment in government hospitals.

As a guide, the researcher prepared 6 main questions as triggers and 4 follow-up questions for the informants, then the researchers conducted more in-depth interviews to obtain data. Before the interview, the researcher asked permission from the interviewees to be interviewed and to determine the time of the interview.

Of the 12 interviewees who were prepared by the researcher to be interviewed, 9 people were successfully interviewed. 1 person was not willing to be interviewed further and 2 more people could not be contacted. The duration of the interview for each interviewee ranged from 40 minutes to 60 minutes. Interviews were conducted on 22,23,24 and 25 May 2021.

RESULTS AND DISCUSSIONS

The characteristics of the interviewees all have a D3 Electromedical Engineering background. Two interviewees then continued to the applied bachelor's degree in D4 Electromedical Engineering. Two people with S2 educational background, the S1 level in Electrical Engineering. For the master's level, there is one person in the field of science and one person for the master's degree in hospital management. One person is a doctor or S3 in the field of Electrical Engineering. Among the interviewees are now active as hospital consultants and previously had complete experience in the field of medical equipment. The interviewees have served as the head of the Hospital Facility Maintenance Installation (IPSRS), the Head of the Health Facility Security Center (BPFK), one of the directors at a government hospital, and an official in the field of medical installations at the ministry of health. One resource person with a doctoral background in addition to being active as a marketing director in a private company in the field of health equipment maintenance, calibration, and testing services is also the Chairman of the Association of Health Facility Testing and Calibration Laboratory Companies (ALFAKES), a lecturer in Electrical Engineering and a technical consultant, especially in the field of health equipment.

Table 1: Interviewees Profile

No.	Interviewees	Age (years)	Work place	Education	Length of work	Last post
1	Interviewees 1	60	ASN at General Hospital Center X Type A Education Private (Medical Equipment repair and maintenance service company)	D4	35 years	Head of Sub-Maintenance and Repair of ALKES
2	Interviewees 2	61	Equipment repair and maintenance service company)	D4	35 years	Technical director



3	Interviewees 3	51	ASN at General Hospital Center Y Type A Education Private (health equipment provider company)	S2	27 years	Fasmed Installation Staff
4	Interviewees 4	47	Private (Private Hospital in Riau Province)	D3	23 years	Technical manager
5	Interviewees 5	32	Hospital Consultant Private (calibration service company and provider of Health equipment)	D3	8 years	Medical Equipment Technician Consultant
6	Interviewees 6	64	Hospital Consultant Private (calibration service company and provider of Health equipment)	S2	38 years	Manager and General Chair of ALFAKES
7	Interviewees 7	45	Hospital Consultant Private (calibration service company and provider of Health equipment)	S3	20 years	Head of Hospital Facility Maintenance Installation
8	Interviewees 8	40	ASN at the Special Hospital for Mothers and Children	S1	19 years	Head of Hospital Facility Maintenance Installation
9	Interviewees 9	40	ASN at Regional general hospital outside Java	D3	19 years	Head of Hospital Facility Maintenance Installation

Source: Results of interviews with Interviewees on 22,23,24 and 25 May 2021.

From the results of in-depth interviews with interviewees, the following picture is obtained:

Opinions about knowledge and understanding of the term Breakdown Time

Of the total interviewees, 66.7% of the interviewees knew about the term breakdown time and 33.3% did not know, but after explaining the definition of breakdown time to those who answered they did not know, they understood it, and those who answered they knew they could be declared to have understood about breakdown time term. Some of the informants thought that the breakdown time in question was response time. Whereas response time is the time required to respond to a complaint of damage until the complaint is followed up. Some argue that breakdown time is the same as downtime. Though the two are different. Breakdown time is the length of time the medical device does not function due to unplanned damage, while downtime is the length of time the medical device does not function because it is planned plus breakdown time in the event of unplanned damage to the medical device.

Opinions about the application of standard breakdown time

The standard breakdown time has been applied by 22.2% of interviewees who work for private companies providing medical equipment and service companies for maintenance, calibration, and testing of medical devices. 55.6% have not implemented and 22.2% of

respondents from government hospitals type A education apply for some equipment, especially for high-tech medical devices.

The responses from interviewees who have applied the standard breakdown time are as follows:

Interviewees 4 explained that, in his company, which is a company that is part of a large private company group, TBK has implemented a standard breakdown time. The standard breakdown time set for each tool is 2x24 hours starting from receiving on call. Standards are applied based on previous surveys. For certain tools such as Lab equipment, spare parts can be loaned/used for backup. Standard 2x24 hours without taking into account administrative processes such as offers, POs, and so on. There is enough commitment from the hospital regarding costs and other things to be carried out immediately, and about the payment for maintenance and repair services, there have been no significant problems so far.

Interviewees 9 explained that, in his company, the standard breakdown time is 1 x 24 hours provided that there is a service contract and if there is the availability of replacement parts for damaged tools. For the first nonservice contract damage history, the breakdown time can be up to 3 months, and because the history already exists, it can be faster. The solution for customers to reduce breakdown time is to use a backup unit, but often customers don't want to use a backup unit of a different brand.

Responses from interviewees who have not applied the standard breakdown time are as follows:

Interviewees 2 explained that the breakdown time has not been applied. Interviewees have difficulty determining the standard of Breakdown Time because before making corrections or corrective actions there is a process that precedes and the length of time cannot be predicted. This process is an administrative process and can also involve the procurement of spare parts. for the repair process after the process that precedes it is complete, it can only be estimated the length of time the repair will take to complete. For damage that suddenly appears, it will depend on the results of the damage found. Solutions to minimize losses can be minimized by using backup units, but usually, the number of backup units that are owned is very limited.

Interviewees 5 only answered briefly, there is no SOP yet.

Interviewees 6 explained that the procurement of spare parts and the administration process at his place of work could not support the speed of completion of repairs to equipment damage.

Interviewees 8 explained that to determine the Breakdown Time, it is still constrained by time, spare parts, human resources.

Interviewees 7 as a consultant was not asked about the application of the standard breakdown, but the interviewee argued, based on his active experience as one of the directors of a hospital in Jakarta, some of it had been implemented. Even technicians are given achievement standards and if they exceed achievements, achievement incentives are given. The opinion of the informants 7 needs to be re-validated by studying documents and making visits.

Responses from interviewees who apply standard breakdown time for some tools are as follows:

Interviewees 1 gave a response, that the hospital has implemented a standard breakdown time for certain equipment such as Linac, by entering into a service contract with the vendor by providing conditions for achievement or utility usage/use of tools up to 95% within 1 year, which means providing a breakdown tolerance limit. time not more than 5% over 1 year. 5% in one year for high-tech tools. For other equipment, in general, there is no standard "breakdown time" or downtime.

Interviewees 3 gave a response, already for high-tech medical equipment. There is a service contract with a vendor and in one clause there is something related to "breakdown time". The considerations are that the tools are high technology, make a lot of money and the number of tools is limited. (Need to see the contract?). For other tools, it has not been implemented, because if there is a damaged tool, it is considered that other tools can still be backed up and can ask the vendor for help to back up. Have never calculated/reported losses due to tool breakdown time.

Opinions answer the question, is it important to apply the Breakdown Time standard.

All respondents answered importantly and their opinions were as follows:

Interviewees 1 argues that standard breakdown time is important to be used as a reference, guideline, and record.

Interviewees 2 thinks that. Important, but determining the application of "Breakdown Time" to a minimum will depend on the maintenance planning of the equipment and the trust of the hospital management because it will involve several costs.

Interviewees 3 thinks that it is important. However, its implementation is still constrained by limited human resources, multifunctional workloads, and time constraints so that it has not become a priority. Even though it is also aware that if it is implemented it will affect

the quality of service, optimization of equipment, and efficiency of maintenance and repair costs.

Interviewees 4 Important. To measure performance. In his company, management requires the Maintenance and Service Support section to be able to handle 95% of errors or equipment damage in 1 day to be resolved. So, if there are 100 damage reports, 95 reports must be completed within 1 day per complaint.

Interviewees 5 believes that it is important to minimize financial losses or hospital services, especially for equipment that is minimal in number, even for example there is only one device. The technicians for low or medium technology medical devices are repaired by themselves and the equipment must be completed within 1 (one) day.

Interviewees 6 thinks that it is very important, affecting the reproducibility of equipment, services, and financial losses.

Interviewees 7 believes it is very important. WHO and ECRI have provided a standard for Breakdown Time, WHO ranges from 2 to 5% per period, in Malaysia, the Standard Breakdown Time has been adapted from 5 to 14%, Indonesia has not yet adopted this.

Interviewees 8 thinks that it is important, especially if there is only one tool.

Interviewees 9 thinks that it is important but also relative, because there are many types of medical devices, according to the latest data, there are 193 types of medical devices with distribution permits, while for each type there are many. When compared with industrial production machines, the variations are usually less and usually the main type of production machine is only 1 type and many spare parts can be found in the local market. The breakdown time of medical equipment may not be the same for each type of device.

Opinion if the regulator / Ministry of Health regulates the standard Breakdown Time. And it is expanded as a regulation on the maintenance and repair of health equipment.

All sources agree and their opinions are as follows:

Interviewees 1 argues Agree. For improvements related to effectiveness, efficiency, and the principle of benefit. If it is true, it needs to be properly socialized so that it can be followed as a reference. When applied, there is no problem it has been applied to several tools that are service contracts. For other tools, it is necessary to know how to calculate or determine breakdown time. When asked for their opinion on possible obstacles that will arise during the policy or regulation-making process, according to the informant, there should be no obstacles. Because it will affect the value of the service but during the process, there needs to be communication with the hospital or the hospital involved.

Interviewees 2 agrees, and it is necessary to comply with strict regulations relating to the maintenance/repair of medical devices. As has been issued by the Minister of Health concerning testing and calibration, as well as Nuclear Energy Regulatory Agency (BAPETEN) Regulations concerning Conformity Tests. If applied, it is a good idea to stimulate hospital technicians to be able to complete repairs of damaged equipment according to the standards set, and the performance of the maintenance and repair department can be measured. In his opinion about the obstacles that may arise during the policy-making process, the informants stated that there should be no obstacles. Regulations are needed for reference and performance measurement.

Interviewees 3 agrees because it is by the competence of the medical equipment maintenance and repair section so that the performance of maintenance and repair can be measured and converted into value for money and/or part of the number of hospital services as a whole. If applied, the opinion is very good, it can measure the reliability, effectiveness of the tool, and the leakage of funds due to breakdown time that cannot be controlled. In his opinion about the obstacles that may arise during the policy-making process, the informant stated, the main obstacle is the data and the other is the support from the hospital management. Regulators need to invite all stakeholders in the process of making these regulations.

Interviewees 4 agrees, but the regulations must be comprehensive, including the issue of funding/repair costs and others. If applied, it's a good idea. everything has a legal footing. The hospital's doubts in preparing repair funds and others can be eliminated. Can be used for evaluation and continuous improvement. In his opinion about the obstacles that may arise during the policy-making process, the informants stated that the obstacles that may arise are data problems. Policymakers need to conduct a thorough data survey to stakeholders. Including small and large medical device companies.

Interviewees 5 agrees, can help as a reference. If applied, the opinion is good, but it needs support from management. In his opinion about the obstacles that might arise during the policy-making process, the informant stated that there was only 1 person in the hospital where the interviewee worked as an electromedical technician, whereas for AC/electrical technicians there were 6 people.

Interviewees 6 thinks Agree when viewed from a management point of view to be used as a reference, from a technical implementation point of view, disagree if there are no solutions to the obstacles to supporting the implementation of the regulations. If applied, it's a good idea. Electromedical implementers will be encouraged to improve their competence. In the future,

electromedical implementers will have special competence in handling medical equipment. In his opinion about the obstacles that may arise during the policy-making process, the informants stated that the competence of technical implementers must be measured. There must be hospital budget and policy support.

Interviewees 7 agrees, and it must be at the level of regulations, not just guidelines. Regulations can be forced and if the guidelines are not firm. The term is sissy. Some things are important requirements for the continuity of maintenance and repairs that can be ignored for reasons of cost and others. If applied, the opinion is that the reproducibility or readiness of the tool will continue to be maintained, if there is the damage it will be resolved quickly as well as for routine maintenance it can be fast. In his opinion about the obstacles that might arise during the policy-making process, the interviewees stated that there might be a need to synchronize KARS with the Ministry of Health, regulatory problems in Health Facilities, and resistance from GAKESLAB. For example, when negotiating for an e-catalog, matters relating to equipment maintenance and repair can be defeated.

Interviewees 8 argue that they agree, it can be used as a reference, be used as a work standard, and measure performance. When applied, the interviewees do not provide an opinion. Regarding the obstacles that may arise when formulating policies, the interviewees emphasized the availability of spare parts in the future.

Interviewees 9 agrees, even Malaysia already has the Malaysian Standard for the maintenance of health equipment. Utilities in Malaysia already require 98%, meaning the breakdown time is 0%, while 2% is tolerance for downtime for planned equipment maintenance purposes. Other countries such as India also have standards. In Indonesia, there is no such thing, there are even regulations downstream from the maintenance process such as calibration and testing of medical devices. In Malaysia, if the utility is below 98% of the health facility, the permit can be revoked, because less than 98% means that the service has stopped. If it is implemented, the informants argue that the maintenance program can be more measurable. Breakdown time or Unwanted Events (KTD) related to repairs or repairs is no longer a mindset. The improvement mindset has changed with the trend of replacing tools with new versions. So, the conversation has revolved around utility downtime and uptime, not repairs anymore. In his opinion about the obstacles that may arise during the policy-making process, the informant stated that the Minister of Health regulations for maintenance had been initiated several years ago, the draft for the Minister of Health regulations (PERMENKES) on maintenance was made in 2019. However, the regulator still considers that the maintenance of medical equipment does

not require legal protection. From the private sector, it is not an obstacle and even supports so that there is a strong legal basis relating to the maintenance of medical equipment. The private sector hopes that curative actions can be minimized or eliminated because the costs are large, preventive is a better choice. Regulators are less involved in electromedical engineering experts in drafting regulations concerning medical equipment

In the industrial sector, especially factories, the continuity of production is something that must be pursued. The cessation of production means some losses must be calculated. The longer production stops, the greater the loss. The main cause of the cessation of production at the factory, one of which is the cessation of production machines with unplanned or breakdown. The length of time the tool is damaged until it can function again is stated by the breakdown time. The production stoppage can also be caused by the planned maintenance of production machines. The total downtime of production machines due to planned or unplanned is called downtime,

$$\text{Downtime} = \text{Breakdown Time} + \text{Preventive Maintenance} + \text{Predictive Maintenance}^6.$$

Preventive Maintenance and Predictive Maintenance include planned production machine shutdowns.

From that formula, the machine availability will be known.

$\text{Availability} = \text{Uptime} - \text{Machine downtime}^6$. Availability is the state of readiness of a machine/equipment both in quantity (quantity) and by the needs used to carry out the operation process. Readiness (availability) can be used to assess the success or effectiveness of the maintenance activities that have been carried out.

Machine downtime including Breakdown Time can ideally be achieved up to 2% or less⁸. This means the goal of minimizing breakdown time is quite clear. If the machine is often damaged, it will take a long time to produce. The longer the engine breaks down, the more problems it will cause and make things worse. It will eventually cause losses of millions of rupiah, even tens or up to hundreds of millions of rupiah.

What about the medical equipment in the hospital?

The latest data on statistics on the state of medical equipment that record damage and are not suitable for use, in quantity may be known in the Application for Facilities, Infrastructure, and Medical Devices or ASPAK⁹. ASPAK is a web-based application that collects data and presents information about Medical Facilities, Infrastructure, and Devices at Health Service Facilities. ASPAK contains information including identity data of Health Service Facilities; Facility data; Infrastructure data; Medical Device data; and other data related



to health services. ASPAK in the future should also be able to provide information on the condition or the latest historical data on the state of medical devices by expanding its recording of the history of maintenance and repair of medical equipment at the Health Facilities.

Regarding the condition of medical equipment, research data may be presented which may be quite old. In 2005 research conducted by Trijuni Angkasawati, Wahyudin Astuti, and Andryansyah Arifin¹⁰, at Syaiful Anwar Hospital in Malang, East Java, presented data on the results of research on the utilization of medical equipment, found 3.33% of the equipment was damaged before being used, 60% of 90% of the equipment studied was damaged. Previous research by Janahar Murad (1991) on the Monitoring System for the Safety Effects of Medical Devices as quoted from the journal Hamdan Syah Alam et.al (2016) ¹¹ explained that 63% of medical devices had problems while 10% of damaged medical devices were not explained, but the population comparison was not explained. However, the above data was confirmed when the researcher conducted interviews with the informants. Although the number should be investigated more deeply, from interviews some informants said that there were still damaged medical equipment and could not be used again. The damage has been around for a long time and there is even equipment that has been damaged for more than a year and has not been repaired. It was even confirmed from interviews that hospitals were planning to finance the maintenance and repair of medical devices for the next two years. Of course, it is not guaranteed to be renewed at the time of implementation in the next two years.

From the interview, it was also known as stated in the research report. Even though there is a standard breakdown time set, the consideration is because it relates to a limited number of tools or even the only one. For tools that are considered large in number, breakdown time for the equipment is not a priority to be addressed immediately.

CONCLUSION AND SUGGESTIONS

The term Breakdown Time has been understood by all Interviewees, but it can be stated that it has not been applied to the maintenance and repair of medical devices, especially in hospitals, both government hospitals, and private hospitals. All informants stated that breakdown time is important to implement. Standard breakdown time can be used as a reference, guideline, recording, measuring performance, minimizing financial losses, and maintaining tool reproduction. The application of standard breakdown time can also affect the quality of service, optimization of equipment, and the efficiency of maintenance and repair costs. The interviewees also all agreed that the regulator, in this case, the Ministry of Health,

made regulations on the maintenance and repair of medical equipment, which among others regulates the standard breakdown time and the factors that influence it.

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