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Risk Assessment in Discharge Process using PFMEA Tool in a Multi-Specialty Hospital

Shalini .

Kanakavalli K. Kundury

H. Basavana Gowdappa

ORIGINAL STUDY

Risk Assessment in Discharge Process Using PFMEA Tool in a Multi-specialty Hospital

Shalini [a], Kanakavalli K. Kundury [a,b,*], Basavana G. Hathur [b,c]

[a] Department of Health System Management Studies, JSS Academy of Higher Education & Research (JSS AHER), India
[b] Special Interest Group in Patient Care Management (SIG-PCM), JSS AHER, Mysore, 570015, Karnataka, India
[c] Department of General Medicine, JSS Medical College & Hospital, JSS Academy of Higher Education & Research, Mysuru, Karnataka, India

Abstract

Introduction: **'Quality' is an inseparable component of healthcare. It focuses not only on care parameters but also in identifying the potential failures/risks associated with the care process; thereby addressing them proactively before the occurrence of the loss. There are several quality tools available such as Process Failure Mode Effect Analysis (PFMEA) that helps in analyzing a process for identification of possible failures. This helps to find ways to avoid the occurrence of the failure or have a strategy to eliminate or minimize the risk. Thus, the current study was undertaken on identifying the risks involved in the discharge process using PFMEA tool.**

Objectives: **To identify the potential risks in patient discharge process and suggest measures to address the failures.**

Methodology: **The study was conducted for a period of 2 months in a multi-specialty hospital. In-patient discharge process was observed in detail and potential failures in the process were identified with the help of a multidisciplinary team constituted for the same purpose. Brainstorming sessions were conducted with the team members to identify possible failures, its causes and effects. Basing on the severity, occurrence and detectability, failure was ranked on a scale of 1−10 and Risk Priority Numbers (RPN) were assigned to each of the potential risks in the process.**

Results: **A total of 23 possible failures were identified which included inadequate explanation of discharge summary, missing diagnostic reports, delay in discharge medication initiation and unattended patient queries. RPN values have ranged from 60 to 320; depicting severity, occurrence and detectability of respective failures.**

Conclusion: **Identifying the potential failures in the patient care process is very crucial for patient, provider and healthcare facility as it helps in the optimization of resources, adds value to patient care, leads to patient satisfaction thereby enhancing quality.**

Keywords: Quality, Healthcare, PFMEA

1. Introduction

Quality of healthcare is the degree to which health services of the population and community would be yielding to better outcomes [1]. Quality is a continuous process, where gaps are identified and addressed in a systematic manner; setting up benchmarking practices [2,3]. The concept of 'Quality in Healthcare' for this reason had become very significant, as it enhances the care process and evolves with better practices. Out of several quality assessment tools, Proactive Failure Effect Analysis (PFMEA) aids in identifying the potential failures in the work process by examining the activities in detail [4]. PFMEA can be deployed at nursing home, pharmaceutical industry, diagnostic center, biomedical devices or in the process involved in different departments of the hospital [5,6].

Patient discharge in hospital is a significant process as it involves patient and team of individuals from various disciplines working in a coordinated fashion for transfer of patient from one environment

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* Corresponding author at: Department of Health System Management Studies, JSS Academy of Higher Education & Research, Mysore, 570015, Karnataka, India.
E-mail address: kanakavalli.dhsms@jssuni.edu.in (K.K. Kundury).

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to another [7,8]. Because of the nature of work in discharge process, failures such as time delays, inadequate communication, improper follow-up instructions and few such other lacune can hamper the quality of patient care. Research shows that application of PFMEA tool in patient discharge process helps in identifying the potential risks, possible failures thereby eliminating or minimizing the same. Often PFMEA tool also helps in re-engineering the work process leading to standardization of practices [3,9].

2. Objectives

The objective of the study is to identify the potential failures in patient discharge process using PFMEA tool and suggest measures to address the same.

3. Materials & methods

An observational study was conducted for a period of 2 months in a 100 bedded multi-specialty hospital accredited by NABH. Data for the study was obtained from various departments involved in the patient discharge process such as in-patient department, billing, insurance, laboratory, radiology, nursing and administrative departments of the hospital.

It was observed that during the study period, an average of 450 discharges per month. Discharge Turn Around Time according to hospital standard was 90 min for cash patients and 180 min for Insurance patients.

3.1. Materials

3.1.1. Processflow chart

There were 2 process flow charts prepared.

I. High line process flowchart depicting a brief of the entire discharge process, highlighting the vital activities (Annexure1 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas])
II. Detailed process flowchart (low line) describing specific details of the discharge process that included sub processes and cross functional areas (Annexure1 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas])

3.1.2. Proactive failure mode Effect Analysis (PFMEA) TOOL

PFMEA is a risk assessment tool that helps to identify potential failures in a process, it's causes, and effects (Annexure2 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]). Considering the severity and occurrence; criticality index of the respective risk can be computed. Risk priority number can be obtained by multiplying the criticality index with the risk detectability score (Annexure3 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]).

3.1.3. Thought processing questionnaire

Brain storming sessions were conducted with the multidisciplinary team members using a set of predefines questions (Annexure4 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]). The sessions focused on identifying the team members understanding of the existing discharge process, possible failures identified, areas that require refinement and suggestive plan of actions. The outcomes of these discussions gave inputs to identifying potential failure modes (Annexure4 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]).

3.1.4. S-O-D table

Severity-Occurrence-Detection table is a ranking scale used for the risk assessment.

S: Severity is a rating indicating the seriousness of the effect of the potential process failure mode. Severity always applies to the effect of a failure mode which is ranked on a scale of 1 (lowest being negligible) to 10 (highest being hazardous without warning).

O: Occurrence is the rating value corresponding to the estimated number of frequencies and/or cumulative number of failures that could occur for a given cause over a given period of time with the existing controls. It is ranked from 1 (lowest-unlikely failure) to 10 (highest-very high failure almost inevitable).

D: Detectability is a method (procedure), test, or an engineering analysis to detect or prevent a failure in the process or in subsequent operations. It can be easily identified with brainstorming sessions, observations, audits and evaluations; which helps in solution before the problem occurs.

It is ranked from 1 (lowest being always certain) to 10 (highest being absolute uncertainty that cannot

be detected) (Annexure 5 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]).

3.1.5. Risk assessment matrix

It is a 10 × 10 matrix that helps during risk assessment. It is a heat map that represents various levels of risks and their severity; highlighting the areas that require immediate action (Annexure 6 [https:rescon.jssuni.edu.in/cgi/editor.cgi?article=1055&window=additional_files&context=ijhas]).

3.2. Methods

The study was conducted in 3 phases.

Phases	Activity
Phase1: **Preparatory stage**	- Detailed understanding of the patient discharge process - Identifying stakeholders involved in the process - Identification of members in multidisciplinary team - Draw high level flowchart and detailed process flowchart - Developing thought processing questionnaire for risk assessment in patient discharge process
Phase2: **Study commencement**	- Formulation of a multidisciplinary team with 26 members from different speciality areas of hospital - Conducted brain storming sessions with team members using high level process flowchart and thought processing questionnaire - Inference has been draw by the sessions and observed for possible failures, its causes & effects in discharge process
Phase3: **Analysis, Results & Recommendation**	- A total of 23 possible failures were identified along with its cause and effects - Based on the observations of the team, Severity, Occurrence and Detectability of each identified failure was ranked on a scale of 1–10 to calculate Risk Priority Number (RPN) (R=S x O x D); where 1 being the lowest and 1000 being the highest. - Risk matrix of 10 × 10; was plotted based on severity and occurrence of every failure mode (S × O) - Suggesting strategies to management on addressing these potential failures.

4. Results & discussion

After going through detailed discussion with the multidisciplinary team using high line and detailed work flow charts, a total of 23 potential failure modes identified from 10 process steps of the discharge process.

- Verbal advice for discharge from consultant
- Nursing staff raising the discharge on HIS
- Discharge summary to get finalized by medical officer/consultant in charge
- Clearance from nursing in HIS
- Clearance from pharmacy and medical supplies
- Clearance from Laboratory & Radiology departments
- Billing settlements
- Clearance from Insurance claims
- Handover of discharge summary with reports and explanation of discharge medication
- Patient clears the bed

According to Table 1, initiating discharge process was found to get delayed due to reasons such as physician attending emergency duties/OP consultations, poor communication between care providers, deterioration in patient condition or patient's decision to get discharged against medical advice. These reasons contributed delay in discharge process leading to increased length of stay, low patient satisfaction and impacting hospital operations. RPN values (100–216) and Criticality index for these reasons ranged from 20 to 36; which is of moderately low risk; stating that these failures are definite to cause delay in the process but doesn't demand for immediate action. Re-aligning OP and IP services for better coordination of processes could aid in eliminating few of the causes that help in reducing time delay of discharges.

Table 1. Process Step - Verbal advice for discharge from consultant.

	Failure mode	S	O	D	CI=S*O	RPN=S*O*D
I.	Delay in discharge advice	5	4	5	20	100
II.	Planned discharge can postpone	5	5	4	25	100
III.	Discharge against medical advice	9	4	6	36	216

Table 2. Process Step- Nurse raises the discharge on HIS.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Nurses not alerted on discharge orders	6	4	6	24	144
II.	Discharge advice not communicated adequately	7	4	8	28	224
III.	Difficulty in traceability of discharge on HIS	5	5	5	25	125

Table 2 represents potential failure modes during discharge process initiation by a nursing staff. Few failure modes identified are lack of system alerts, improper communication and complex patient tracking systems. Reasons for these failures were identified as poor communication between doctor and nurse, nursing staff getting pre-occupied with patient care, staff shortages and failure of work allocations to other staff, lack of expertise in using hospital information system application. These reasons could delay the discharge process from the initial stages leading to congestion in the process. RPN values of these failure modes ranged from 125 to 244 with criticality index ranging from 24 to 28, which shows low risk as explained in Annexure 6. Maintaining nurses' notes, improving communication between doctor and nurse, effective scheduling of staff and improving utilization of hospital information system application would help in redefining the situation.

In the process of finalising the discharge summary by medical officer, there is a failure mode identified as advice being delayed by the physician. The possible reasons for this failure mode as mentioned in Table 3 are physicians attending emergency cases, OT schedules and long surgical procedures with unexpected delays; waiting for administering last dose of IV antibiotics, advice from referral doctor or patient kept on observation. This leads to high bed turnover intervals and increased admission queue. While RPN is 240 indicating low risk, Criticality index is 64 representing the highest score; which demands immediate action from the management to prevent further delays. Keeping discharge summary updated with the available information prior to the day of discharge; and also keeping track of the 'patients to be discharged' through hospital information system application

Table 3. Process Step- Discharge summary to be finalised by medical officer.

	Failure modE	S	O	D	CI =SXO	RPN =S*O*D
I.	Waiting for physician advice on discharge	6	8	5	48	240

Table 4. Process Step- Clearance from nursing in hospital information system.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Time consumed in issue return to pharmacy & medical supplies	4	5	6	20	120

could help in minimizing the delays and addressing the failure modes.

As per Table 4, delay in returning medication supplies to pharmacy was identified as failure mode while nursing staff initiate clearance from hospital information system application. This could be due to factors such as shortage of staff, work overload, call off from staff. This effects the bed clearance from the ward, delays billing process; finally affecting the discharge process. Enabling 'chute' system to transport returns to pharmacy and integrating that with hospital information system application would help to address potential failures. The criticality index was 20 which shows low risk and RPN 120 supports the same.

Finalisation of bills and issue of discharge medications from pharmacy were observed as potential failure modes (Table 5). Duplicate entries, improper communications and wrong charges were identified as causes for the failures; which leads to discharge delay and patient dissatisfaction. RPN ranging from 100-210 indicating very low to low risk; criticality index ranging from 25 to 42 indicating low to moderate risk. Though RPN suggesting low risk, the criticality index 42 of delay in initiating discharge medication, demands management attention to address this moderate risk. To address these failures, pharmacy services are needed to be integrated with HIS services for eliminating duplicate works, encourage transparency in documentation and quicker bill finalisations.

Delay in discharge process was also found to get delayed due to clearance from diagnostics such as duplicate entry of tests, wrong test charges, samples received but not processed for investigation, advice test kept on hold by consultant, unable to collect the sample, sample received not adequate and mislabeling of samples (Table 6). Wrong charges and re-

Table 5. Process Step- Clearance from pharmacy and medical supplies.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Delay in giving clearance	5	5	4	25	100
II.	Waiting for implant charges confirmation	7	4	7	28	196
III.	Delay in discharge medication initiation	6	7	5	42	210

Table 6. Process Step- Clearance from laboratory & radiology.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Delay in laboratory clearance	6	5	5	30	150
II.	Advised Test Not Done	7	3	6	21	126
III.	Delay in radiology clearance	7	4	5	28	140

investigations lead to patient dissatisfaction and can mask the image of hospital. RPN ranges between 126 and 150; and CI ranging from 21 to 30 suggests low risk. Training of technicians in proper sample collection, finalization of bills a day prior to the patient discharge would help to address the situation.

Cash bills settlement from patients prolonged due to reasons such as delay in finalizing & clearance of bills from other departments, new charge entries communicated to patient/patent's attenders after final bills are prepared, patient attender waiting for negotiation of bill. Often patient's affordability to pay for their hospital bills and inadequate financial counselling also were found to be few reasons (Table 7). These factors result in prolonged bed clearance time, more waiting time for new admissions, unsatisfied patient's/attenders and low quality of service. Though the RPN was found to be the highest among the observed failure modes, the range from 280 to 320 suggest low risk. But considering the CI of 45–64, which shows moderate to high risk, requires management actions that include updating patient bills on daily basis, prior settlement of bills for planned discharges and monitoring the billing activity through HIS application help in eliminating the delays and address the potential failures.

As per Table 8, delay in insurance claim clearance was due to delay in submitting insurance bills, unanswered queries on time and denial of insurance. Also submitting wrong medical codes. Causes for these failures are due to delays in finalizing bills from respective departments, delay in arranging information as per TPA standards and medical codes, shortage

Table 7. Process Step- Cash bills settlement from patients.

	Failure mode	S	O	D	CI =SXO	RPN =S*O*D
I.	Delay in billing finalisation	8	8	5	64	320
II.	New charge entries communicated to patient/patent's attenders after final bills are prepared	9	5	7	40	315
III.	Patient attender waiting for negotiation of bill	8	7	5	56	280

Table 8. Process Step- Insurance claim clearance.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Delay in sending bill to insurance	6	7	5	42	210
II.	Queries unanswered on time	7	7	5	49	245
III.	Denial of insurance	10	2	5	20	100

of manpower in IP and OP billing and unavailability of physicians to address specific queries. RPN values ranging from 100 to 245 indicates very low risk to low risk. CI score for 'answered insurance queries' is 49 and 'delaying in submitting insurance bills' is 42 suggested moderate risks to be addressed by the management. Proper procedures have to be in place to execute bills through TPA which includes pre-authorization, frequent follow-up and continuous monitoring to deal with these failure situations. Bill settlement through insurance services has to be handled by a designated team and proper PR services to be deployed for patient counseling.

There was found that inadequate communication with patient while delivering discharge summary reports and post discharge care were potential failure modes as per Table 9. Reasons for these were identified as inadequate explanation of discharge advice due to missing reports from radiology/ECHO/ECG images of patients, misplacing of preliminary information and health history of patients in OP/ER services and unavailability of medicines in hospital pharmacy. This leads to lack of clarity in post discharge care, re-investigations, poor quality of patient care and extended patient recovery period. This also might lead to various legal obligations and low patient satisfaction. RPN range140–288 indicates very low to low risk. CI 20–36 suggested moderately low risk seeking planned action. As patient documentation and report handling services were outsourced, proper guidelines of report management to be issued to the third party. Report generation can be automated and maintained with HIS application for easy and quick retrieval of information.

As per Table 10, patient clearance of the bed is getting delayed due to patients waiting for

Table 9. Process Step- Handing over of discharge summary reports & explanation on discharge medication to patient.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Inadequate explanation of discharge advice	10	2	7	20	140
II.	Improper handling of reports	6	6	8	36	288

Table 10. Process Step- Patient clears the bed.

	Failure mode	S	O	D	CI =SX O	RPN =S*O*D
I.	Delay in clearing the bed	5	6	2	30	60

transportation from attenders, late evening approval of insurance claim and patients travelling long distances waits until day light, patient kept for observation till evening for last dose of IV antibiotic, or waiting for reconfirmation of any report. This leads to prolonged waiting time for new admissions, impacts revenue cycle management of the hospital and extended usage of hospital resources by patients; extra cost to hospital. Failures modes in this process step represented lowest RPN with CI of 30.

4.1. Risk assessment matrix

As the risk in PFMEA process was rated on a scale of 1–10, risk assessment matrix of 10 × 10 was considered for easy assessment. As Severity(S), Occurrence (O) and Detectability (D) range from 1 to 10; the minimum value of RPN is 1 where as the maximum value is 1000.

Considering the criticality index (CI) and Risk Priority Number (RPN), various failure modes were represented in the matrix based on their severity and occurrence.

Failure mode, delay in billing finalisation was identified as the most potential failure (CI = 64 & RPN = 320) demands for immediate action to prevent further damage.

Patient attender waiting for negotiation of bills, mishandling of reports, patient waiting for discharge advise were found to be on next priority with CI = 56 and RPN = 280 values respectively.

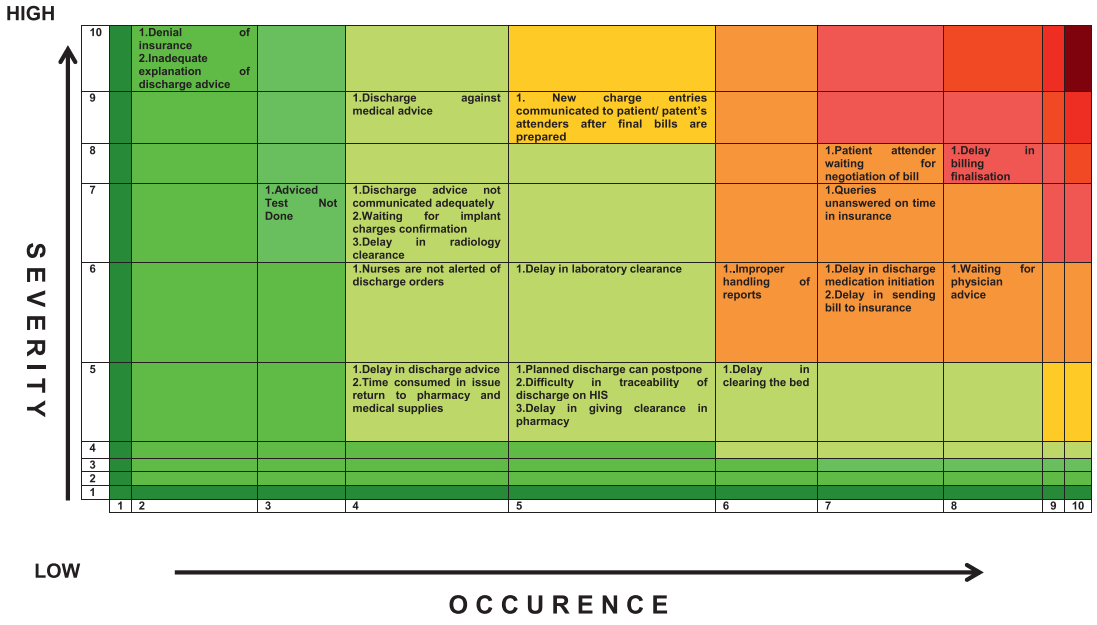
Inadequate explanation of discharge advice with CI 20 with RPN 140 suggest low risk. But with high severity scores, it requires proper plan of action to prevent further impact on patient care.

Risk assessment matrix aids to the PFMEA tool to analyse the risk at a glance.

5. Discussion

The present study was conducted to proactively assess potential failures in patient discharge process using PFMEA tool.

Literature showed similar studies conducted on patient re-hospitalization, turnaround time (TAT) of discharge process and identification of delays in discharge process. A study conducted by Pollack et al. considered a similar approach on assessing discharge process of high-risk patients with diabetes [10]. The study reported highest RPN of 630 accounting to diabetes education provided to patient and patient's inability to distinguish between insulin pens and improper communication on discharge instructions for patient follow-up. Also, RPN was reported high with 560 for incomplete discharge instructions on medication instructions and dosage. Low RPN values are reported on incorrect verification of medication



coverage by patient's insurance [10]. In the current study, had reported an RPN of 210 for delay in discharge medication initiation, RPN of 245 for insurance queries unanswered on time, RPN of 288 for inappropriate handling of reports and 140 RPN for inadequate explanation of discharge summary. Relatively low RPN values in the current study showed the efficiency of discharge process; which still requires minor refinements.

Research has highlighted several reasons which would delay the discharge process namely poor communications between care providers, delays in finalizing of patient bills, re-investigations and clearance from various departments [11]. Also, insurance clearance was found to consume considerable time for approvals and finalization of bills during patient discharge from the hospital [11]. Proper documentation of patient care services and maintenance of patient documents was found to save time and helps in lean management of discharge process [12]. Many of the reasons stated above were also observed in the current study at various levels during the discharge process.

Another Study conducted by Gijs Hesselink et al. [13] aimed to improve patient discharge process using intervention mapping to reduce readmission produced similar results; except that the current study aimed at assessing the risks in patient discharge process using the PFMEA tool by drawing detailed discharge process flow chart.

Another study by Kelly A. Nealon et al. [14] on using Failure Mode and Effects Analysis to Evaluate Risk in the Clinical Adoption of Automated Contouring and Treatment Planning Tools showed 290 possible failure modes; with a maximum RPN of 486. It has considered a complex process (RPA) with moderately high risk (tightly coupled) involved.

A Study conducted by Molly K. [15] on opportunities for quality improvement in cystic fibrosis new born screening showed a total of 96 failure modes with 20 high risk categories.

The current study had considered evaluation of in-patient discharge process, a complex process with moderately low risk (loosely coupled). When compared to the minimum and maximum values of RPN, a total of 23 potential failures were identified in the current study, with maximum RPN as 320 and minimum as 60; which demonstrates that the discharge process is effective yet, but still to attend very few low to moderate risks.

A study by Xuxia Yu et al. [16] aimed to assess potential failure mode, implement countermeasures against risks and improve disinfection quality monitoring using healthcare failure mode and effect analysis (HFMEA). In this study only hazard index has been identified and used for quality improvement through risk mitigation but in the current study both criticality index (CI) and RPN has been calculated to identify the potential failures. Also, the following failures were observed like i) inadequate sample ii) wrong selection of sampling materials iii) nonstandard labelling of samples iv) improper interpretation of reports with Hazard index (Severity*Occurrence = CI) of 24, 16, 30 and 15 respectively.

In the current study, few similar failure modes were observed like delay in laboratory clearance, advised test not done (because of inadequate sample, mislabelling etc), improper handling of reports with criticality index of 30, 21 and 36 respectively.

6. Conclusion

Quality is the mantra of the present healthcare scenario. Whether it is inherent to patient care or requirement for accreditation, quality has significant role in the functioning of health care services. Identifying potential failures in a work process would help to address the failures before their occurrence thus minimizing the process errors. Thus, quality can be achieved as a continuous process.

Conflict of interest

No conflict of interest.

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