

# Induction of Labor and Factors Associated with its Outcome in Ethiopia A Systemic Review and Meta-Analysis

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## Abstract

**Background:** Induction of labor is one of the most common procedures to prevent adverse birth outcomes of mother and the newborn yet if not performed under clear indication; it may result in devastating effects. Therefore, this systematic review and meta-analysis aimed to assess the prevalence of Induction of labor and factors associated with its outcome among pregnant women in Ethiopia.

**Methods:** The data bases used were: PUBMED, Google Scholar, HINARI, EMBASE, African Online Journals and on line repositories. This meta-analysis used twelve observational studies (cross-sectional and case control) which included 7401 participants. Different searching terms were applied based on the adapted PICO principles to achieve and access all the essential articles. Subgroup and sensitivity analysis were conducted with the evidence of heterogeneity. Egger test with funnel plot were used to investigate publication bias. The data were entered and analyzed using Microsoft Excel and Stata11 software respectively.

**Results:** Twelve studies were included in this systematic review and meta-analysis. The overall pooled prevalence of IOL was 16.43% (95% CI; 9.2, 23.67) in Ethiopia. Gestational age < 42 weeks (AOR: 4.3) and Bishop score > 5 (AOR:5) were associated with successful induction of labor while Nulliparity (AOR:2.9), Gestational age > 42 weeks (AOR:4.5) and Unfavorable Bishop score (AOR 5.2) showed significant association with failed induction.

**Conclusion:** Gestational age < 42 weeks and Bishop Score > 5 was associated with success of induction of labor while Nulliparity, Gestational age > 42 weeks and Unfavorable Bishop score showed significant association with failed induction. This finding is important to design strategic policies and to prevent emergency neonatal and women complications during the childbirth and postpartum periods.

**Keywords:** Induction of labor; Successful induction; Failed induction; Pregnant women; Systematic review; Meta-analysis; Ethiopia

## Abbreviations

CI: Confidence Interval

GC: Gregorian Calendar

IOL: Induction of Labor

OR: Odd Ratio

WHO: World Health Organization

## Introduction

Induction of Labor (IOL) is defined as the process of artificially stimulating the uterus to start labor. It is usually performed by administering oxytocin/prostaglandins or by manually rupturing the amniotic membranes [1]. IOL is one component of the comprehensive obstetrics care services aimed to decrease the risk of maternal and neonatal morbidity and mortality by ending the pregnancy in presence of many obstetrics and medical conditions [2]. IOL is one of the most common procedure in obstetrics and now a days it is one of the fastest growing procedures in the world specially in developed countries compared to the developing ones however its complications are still observed in countries like Ethiopia [3].

IOL may be indicated by medical or obstetrical complications of pregnancy or may be requested or chosen for non-medical or social reasons [4]. Some of the indications include post term pregnancy, hypertensive diseases of pregnancy, premature rupture of membrane, abruptio placentae, chorioamnionitis, fetal demise, Premature Rupture of Membranes (PROM), maternal medical conditions like diabetes mellitus, renal disease, chronic pulmonary disease, chronic

hypertension and fetal compromise as severe fetal growth restriction, iso-immunization [5]. IOL carries various risks including failed induction, low heart rate, infection, uterine rupture and bleeding after delivery [6].

Prevalence of IOL varied widely across the world. In United States of America it was 24.5% and from 6.8 to 33% in Europe but in Nigeria 6.5%, in D.R. Congo it was 3.2%, in Tanzania it was 21.63% and in Ethiopia, Addis Ababa it was 4% [7-12].

The outcome of labor induction will be either success or failure. The Bishop score at onset of induction parity of the woman, the indication for the induction and other factors mainly affect the success [3, 13]. On the contrary many factors lead to failed induction such as initial poor cervical Bishop's score at induction, fetal macrosomia, high body mass index and advanced maternal age [9-11]. When induction fails to end up in vaginal delivery increased rate of operative vaginal delivery, Caesarean birth, excessive uterine activity, abnormal fetal heart rate patterns, uterine rupture, maternal water intoxication, and possibly cord prolapse are expected as its complication [10, 14].

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Induction of labor is carried out in approximately 20% of pregnancies. It has been strongly associated with poor maternal and perinatal outcomes and Ethiopia, as most sub-Saharan countries, experience high maternal and perinatal mortality [11, 15] where some can be related to intra partum interventions as IOL. In areas with a high rate of maternal mortality and morbidity due to poor access to comprehensive emergency obstetric care, knowing the prevalence and factors commonly showing association with its outcome following IOL is crucial. Therefore, this systematic review aimed to estimate the pooled prevalence of induction of labor and associated factors of its outcome in Ethiopia.

## Methods

### Search strategy

A systemic review and meta-analysis were conducted using the published and unpublished studies to estimate the pooled prevalence of induction of labor and its associated factors in Ethiopia following preferred finding items for systematic reviews and meta-analysis guideline [16-20]. The databases used were; PubMed, HINARI, EMBASE, Google Scholar and African Journals Online. Prevalence of induction of labor OR induction of labor OR labor induction OR outcome of induction of labor OR associated factors of induction of labor AND Ethiopia and related search were used. Searching terms were based on adapted PICO principles to search through the above listed databases to access all the essential articles. The last date of searching was October 18, 2020.

### Eligibility criteria

This review included articles which were presented in all forms of observational study design that are reported in English language focused on induction off labor and factors associated with its outcome. Studies without full text and abstract, commentaries, letters, anonymous reports, and editorials than the English were excluded [21].

### Data extraction and quality assessment

After the search was conducted, data were extracted using a pre-piloted data extraction form developed by the authors. It included the name of the author, year of the study, the region in the country, study design, sample size, and overall prevalence. The first author conducted the primary data extraction and then second and third authors examined the data independently. All of the included articles scored (NOS) 7 and more can be considered a “good” study and have low risk of bias for cross-sectional studies and 9 or more scores for case-

control and cohort chosen to indicate a high standard for comparative observational studies.

### Outcome of measurement

The magnitude of Induction of labor was the primary outcome of the study where-as factors associated with its out-come (successful or failed) was secondary out-come. The odds ratio was calculated for the common risk factors of the reported studies. The most common associated factors included in this systematic review and meta-analysis were gestational age < 42 weeks and favorable bishop score for successful induction whereas nulliparity, unfavorable bishop score and gestational age > 42 for failed induction. Successful induction of labor means when a woman had achieved vaginal birth within 12 hr. after induction of labour was started. A failed induction is failure to achieve a vaginal delivery within 12 hr. after induction of labour was commenced.

### Statistical analysis

The extracted data were entered into the excel sheet and imported to STATA 11 for analysis. Heterogeneity among reported prevalence was assessed by using the inverse variance (I2) with Cochran Q statistic of 25%, 50% and 75% as low, moderate and considerable heterogeneity respectively with a p-value less than 0.05 (Rücker, Schwarzer, Carpenter, & Schumacher, 2008). The forest plot was also used to visualize the presence of heterogeneity. Possible variations between studies were evaluated by subgroup analyses and meta-regression. Findings were explained using forest plot with respective odds ratio and 95% confidence intervals. For the second outcomes, pooled odds ratios with 95% CI for each determinant was used to determine the association between induction of labor and its factors [22].

## Results

### Study selection

This review included published articles on induction of labor and its outcomes among women in Ethiopia. The electronic search was conducted on several databases, which include; PUBMED, Google Scholar, HINARI, EMBASE, African Online Journals and online repositories. The review found a total of 646 published articles. From this, 316 duplicate records were removed and 300 records were excluded after screening by title and abstracts [23]. A total of 30 full-

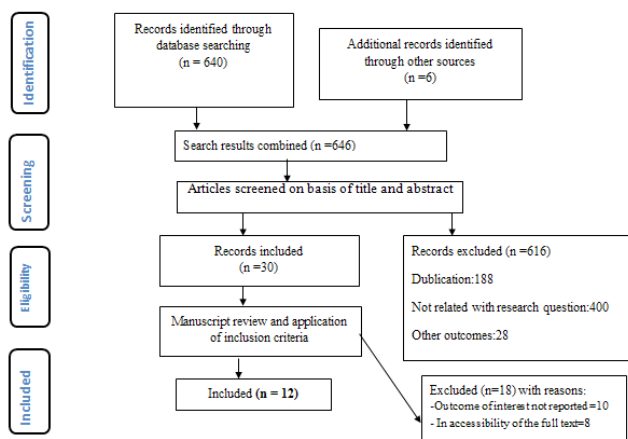


Figure 1: Flow chart of study selection for systematic review and meta-analysis of induction of labor and factors associated with its outcome in Ethiopia.

text articles were screened for eligibility. From this, 18 were excluded based on the exclusion criteria, stated below. Finally, 12 studies were included in the final quantitative meta-analysis (Figure 1).

### Characteristics of the included studies

This systematic review and Meta-analysis consist of 10 cross-sectional and 2 case-control studies with a total of 7401 participants in different regions in Ethiopia (Table 1).

### Pooled prevalence of induction of labor in Ethiopia

The overall pooled prevalence of this systematic review and meta-analysis of induction of labor in Ethiopia was 16.43% (95% CI; 9.2, 23.67; I<sup>2</sup>=96.0, P ≤ 0.001) presented with a forest plot (Figure 2).

### Outcomes of Induction of labor in Ethiopia

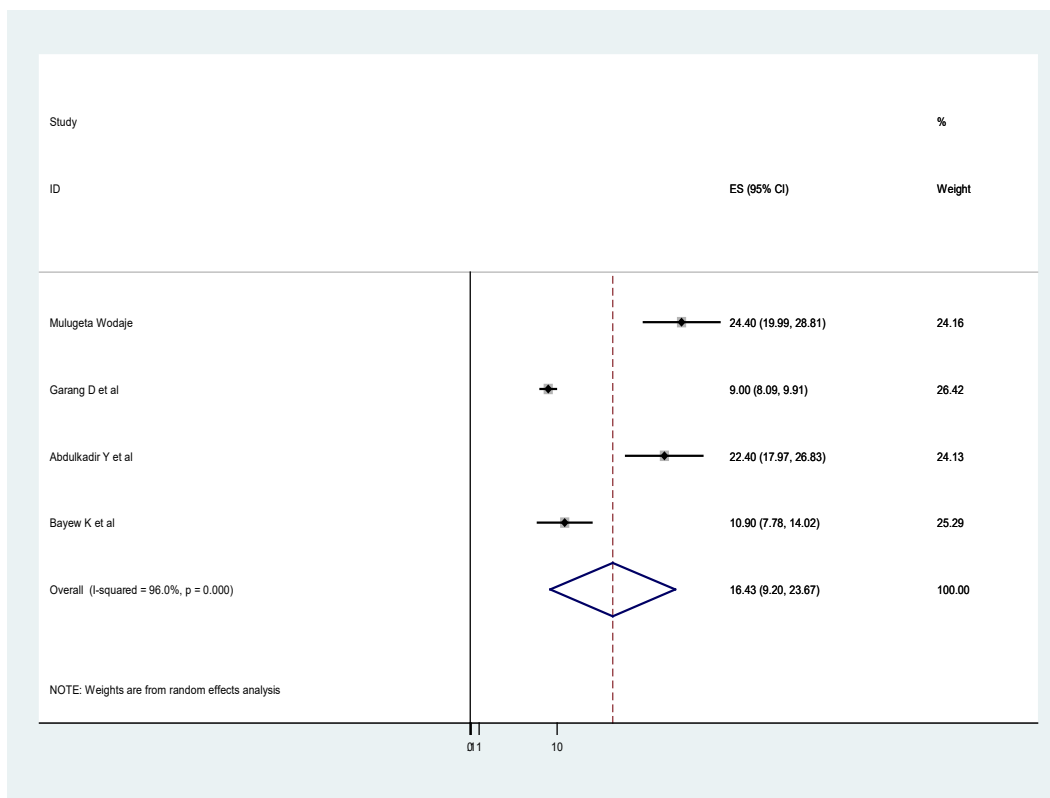
The two main outcomes of induction of labor, failed and successful induction of labor, are presented below. The overall pooled prevalence of failed and successful induction of labor in Ethiopia was 20.65% and 48.12% respectively (Table 2).

### Publication bias

A funnel plot was assessed for the asymmetry distribution of induction of Labor in Ethiopia by visual inspection (Figure 3). Egger's regression test showed with a p-value of 0.004 indicated the evidence for publication bias. Hence, trim and fill analysis was conducted to overcome the publication bias. 1 study filled with a total of 4 studies and overall, 5 studies were enrolled and computed through the trim

**Table 1:** Study characteristics included in this systematic review and meta-analysis of induction of labor and its outcome in Ethiopia (n=12).

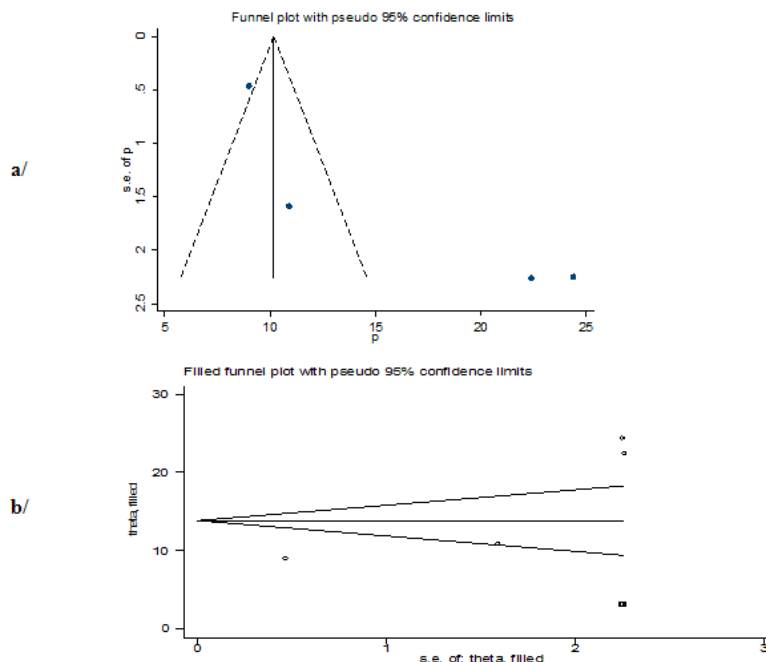
Authors	Year of publication	Study region	Study design	Sample size	P (%) of failed induction	P (%) of successful induction
Sara Hiluf	Online	Addis Ababa	cross-sectional	347	40.30	59.70
Mulugeta Wodaje	Online	Amhara	cross-sectional	365	9.04	15.34
Eyasu M	2020	Addis Ababa	cross-sectional	339	25.40	74.60
Abenezer M	Preprint	Amhara	case-control	336		----
Tenagnework D	2019	Amhara	cross-sectional	319	19.70	53.30
Bekana F	2015	SNNPR	cross-sectional	294	17.30	72.70
Woubishet G	2016	Oromia	cross-sectional	280	21.40	65.70
Garang D	2020	Tigray	cross-sectional	3834	0.88	6.68
EyasuT	2018	SNNPR	cross-sectional	347	26.50	59.70
Abdulkadir Y	2017	Oromia	cross-sectional	340	9.40	12.94
Bayew K	2018	Tigray	cross-sectional	384		---
Melese G	2020	Oromia	comparative cross-sectional	216	38.10	61.10



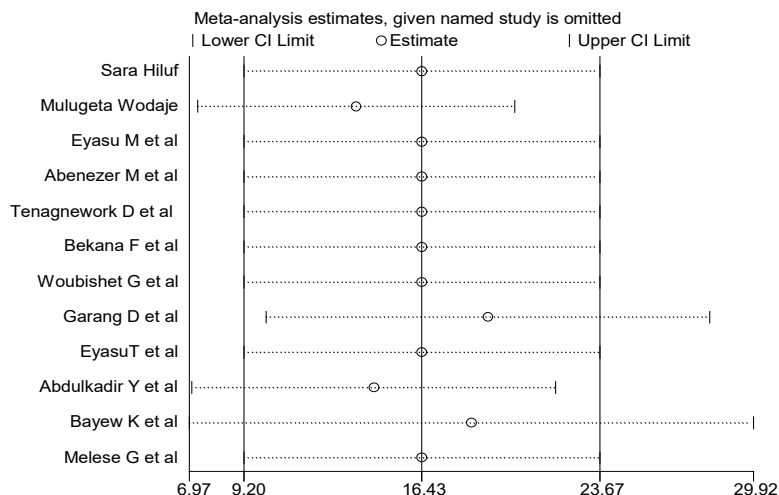
**Figure 2:** Forest funnel plot of the pooled prevalence of induction of labor in Ethiopia.

**Table 2:** Summary of failed and successful induction of labor in Ethiopia.

Outcomes of induction	Pooled P (95%CI)	No. of studies	I <sup>2</sup> (%)	P-value
Failed	20.65	10	98.9	≤ 0.001
Success	48.12	10	99.7	≤ 0.001



**Figure 3:** Assessment of publication bias of researches on induction of labor and its outcome in Ethiopia, **a)** (before an adjustment) and **b)** (after trim-fill analysis were computed).



**Figure 4:** Sensitivity analysis of the pooled prevalence of induction of labor in Ethiopia.

and fill analysis with a pooled prevalence of 13.83% (95% CI; 7.64-20.0.3) using a random effect model [24].

**Sensitivity analysis**

This systematic review and meta-analysis showed the point estimate of its omitted analysis lies within the confidence interval of the combined analysis (Figure 4).

**Factors associated with successful induction of labor in Ethiopia**

For this systematic review and meta-analysis, the most associated

risk factors with successful induction of labor included gestational age < 42 weeks and Bishop score > 5 (Table 3).

**Factors for failed induction of labor in Ethiopia**

For this systematic review and meta-analysis, the most commonly associated risk factors for failed induction of labor included nulliparity, gestational age > 42 weeks and unfavorable Bishop score (Table 4).

**Discussion**

In this systematic review and meta-analysis, pooled prevalence of induction of labor in Ethiopia was 16.43% (95% CI; 9.2, 23.67). This

**Table 3:** Summary of factors associated with success of induction of labor in Ethiopia.

Variables	Model	Egger test (P-value)	Status of heterogeneity	AOR (95%CI)	I <sup>2</sup> (%)
Gestational age < 42 weeks	Fixed	0.655	No heterogeneity	4.3 (1.63,11.36)	0.0
Bishop score > 5	Random	0.742	Low heterogeneity	5 (3.59,6.97)	42.3

**Table 4:** Summary of factors associated with failed induction of labor in Ethiopia.

Variables	Model	Egger test (P-value)	Status of heterogeneity	AOR (95%CI)	I <sup>2</sup> (%)
Nulliparity	Random	0.546	Moderate heterogeneity	2.9(1.95,4.31)	53.5
Gestational age ≥ 42 weeks	Fixed	0.655	No heterogeneity	4.5(2.47,8.05)	0.0
Unfavorable Bishop score	Random	0.742	Low heterogeneity	5.2(3.65,7.31)	21.0

is in line with findings from Nepal [9.72%] [25], SouthWest Nigeria [12.9%] [26] and Tanzania [21.63%] [12]. In the mean time this prevalence was higher than findings of Nigera (11.5%) [11], DR congo (3.2%) [10] another study from Tanzania (2.3%) [27]. This may be due to the variance in study design, sample size, time gap and difrence in sociodemographic charecterstics of participants. In the study from Congo pregnancies lower than 37 weeks gestation were excluded and in the study from Tanzania fetouses with congenital anomalies and intrauterine dath were excluded. However the pooled prevalence of this study was lower than findings from The United States of America (24.5%) and Sri Lanka (35.5%) [28]. The reason behind might be deference in socio demographic characteristics of participants, expanded obstatric care available at the developed countries and Africa as whole is considered to have the lowest number of induction of labor compared to western counreies [14].

The overall pooled prevalence of successful induction of labor in Ethiopia was 48.12%. This figure is lower than findings from Nigeria [75.9%] [11] Kenya [62%] [29] and Nepal [58.33%] [30]. The reason behind might be due to the difference in method where in the study from Nigeria induction was primary done by using Misoprostol. Misoprostol ripens the cervex at the same time causes utrin contractions which makes it more effective. In the study from Kenya the difference may due to variation in defination of failed induction of labor which extended to 24 hr.

According to this systematic review and meta-analysis, successful induction of labor was associated with Gestational age < 42 weeks (AOR:4.3, 95% CI:1.63, 11.36) and Bishop score > 5 (AOR: 5 95% CI:3.59, 6.97).

Pregnancies where gestational age was < 42weeks had the odds of 4 time to have successful inducion of labor than their counter parts. Even though some literatures sugesst that induction prior to post-term leads to a substantially increased possible additional complications related to the intervention, initiating induction of labor specially at or beyond 37 weeks is associated with a succsful vaginal delivery and clear reduction of both fetal and maternal morbidities. It also lowers caesarean rates without increasing rates of operative vaginal births and fewer NICU admissions due to induction [31].

Mothers that had a Bishop score > 5 were 5 times more likely to have a successful outcome of labor induction. Successful induction of labor is clearly related to the state of the cervix that is, the length, thickness, and particularly the consistency of the cervix were important parameters to consider before induction of labor [32].

The pooled prevalence of failed induction was 20.65%. This finding is comparable with the cohort study from Tanzania which is 19% [31]. However this finding was lower than the report from different countries which is 25% in Pakistan [33], 36.5% in South West Nigera [26] and

50.5% in India [34]. Justification for this variance could be difference in methdology, sociodemographic variation of participants and time gap. In the study from pakistan the diffrence could be due to the deference in methodology where only nulliparous woman were involved when being nuliparous is a known risk factor to develop a failed induction and in the study from India failed induction was defined based on mode of delivery which is caesarean section.

According to this systematic review and meta-analysis failed induction was significantly associated with Null parity (AOR:2.9, 95%CI:1.95, 4.31), Gestational age > 42 (AOR:4.595% CI:2.47, 8.05) and Unfavorable Bishop score (AOR 5.2:95% CI:3.65, 7.31).

Participants that are nulliparous were nearly 3 times more likely to have a risk of failed IOL than multiparous mothers. This finding is also mentioned on a number of literatures [3, 33, 35]

Being nulliparous is high-risk pregnancy with several associated obstetric complications like prolonged duration of labor and it is also associated with a higher rate of assisted vaginal delivery. Previous other studies in different parts of the word have show increasing rates of cesarean delivery in general and especially among nulliparous women due to failed induction [35].

Having a gestational age > 42 weeks had the odds of 4 times to develop failed IOL. This association is also supported by other studies [36, 37]. According to different literatures pregnancies that go beyond 42 weeks of gestation are associated with increased fetal and neonatal mortality and morbidity as well as maternal morbidity on the contrary when gestational age of a fetus is advanced induction of labor is justified to reduce the risk of perinatal mortality in post term pregnancies due to ageing of placenta [38]. Literatures suggest that fetal, neonatal and maternal complications associated with this condition have always been underestimated [39] and the finding from meta-analysis indicated that advanced gestational age is associated with failed induction due to intrapartum complications as fetal distress and prolonged duration of labor.

Mothers that had unfavorable Bishop score were 5 times more likely to encounter failed IOL. Which is also supported by studies done accross the world [30, 40, 41]. Women with unfavorable cervix, who have not experienced cervical ripening phase prior to labor, present the greatest challenge with regard to labor induction. Many investigators have identified the importance of assessing cervical status prior to induction of labor [40]. Cervical ripening is required to increase the chances of successful induction of labor when the Bishop score is low [41].

### Limitation

As many of the studies included were cross-sectional, the outcome



variables might be affected by other confounding variables in nature and temporal cause and effect relationship may not be well addressed.

## 9. Conclusion

The overall pooled prevalence Induction of labor among pregnant women was higher than other African countries. Gestational age < 42 weeks and Bishop score > 5 were associated with success of induction of labor while Null parity, Gestational age > 42 weeks and Unfavorable Bishop score showed significant association with failed induction. This finding is important to design strategic policies and to prevent emergency neonatal and maternal complications during the childbirth and postpartum periods.

## Declarations

## Ethics Approval and Consent to Participate

Not applicable.

## Consent for Publication

Not applicable.

## Availability of Data and Materials

All related data has been presented within the manuscript. The dataset supporting the conclusions of this article is available from the authors on request.

## Competing Interests

The authors declare they have no competing interests.

## Funding

No funding was obtained for this study.

## Author's Contributions

EA and FW took part in the design, selection of articles, data extraction and drafted the manuscript. FW performed statistical analysis. TW and BA critically reviewed the manuscript. All authors read and approved the final version of the paper.

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Not applicable

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