



International Research Journal of Public Health (ISSN:2573-380X)



Public Health aspects of Cesarean section including overuse and underuse of the procedure

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ABSTRACT

Caesarean section (CS) is lifesaving medical procedure that is able to avert both maternal and neonatal mortality. However, across the globe an estimated 3.2 million necessary CSs do not happen in low income countries and an estimate of 6.2 million unnecessary CSs happen in middle and high income countries.

The overuse and underuse of this procedure driven by both the supply-side (such as resources within the health system, healthcare policy and strategies, health financing systems and perceptions of the healthcare professional) and demand-side (such as socio-economic status, population preference and perceptions and trust in health system) determinants.

There are stark inequities in CS rates between and within regions and countries. Many regions across the globe (Eastern Asia, Northern Europe, Central America, Southern America, Northern America and Oceania) have over double recommended optimal rates, whereas several African regions (Eastern, Middle and Western) have dangerously low rates. Both of these have detrimental impacts on maternal and neonatal outcomes.

There is a need now for health policy and decision makers at both national and facility level to try and optimize the CS rates through facilitating strategies that promote positive human relations and encourage standardized evidence based care.

Keywords: Cesarean section, overuse, underuse, demand-side characteristics and supply-side characteristics

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How to cite this article:

Kranti Suresh Vora, Susanna Abraham Cottagiri, Shahin Saiyed and Parth Tailor. Public Health aspects of Cesarean section including overuse and underuse of the procedure. International Research Journal of Public Health, 2019; 3:30.



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Introduction

Cesarean section (CS), the surgical removal of a neonate through the maternal abdominal and uterine wall is a life-saving procedure for both the mother and child when medically indicated [1].

Globally, CS is both overused and underused leading to maternal and neonatal complications. Underuse contributes to maternal and neonatal mortality/morbidity and overuse contributes to increased risk of morbidities such as pelvic adhesions, small bowel obstruction, menorrhagia, dysmenorrhea, chronic pain, sexual dysfunction, subfertility, urinary/fecal incontinence and pelvic organ prolapse. After a mother has had a CS, she is also at a higher risk of bleeding, pelvic adhesions, intraoperative surgical injury, hysterectomy, uterine rupture, abnormal placentation, stillbirth and preterm birth in her subsequent pregnancies [2].

Of the 141 million live births that occur globally an estimate of 30 million (21%) of them were CS births in 2015. This proportion is a significant increase when compared to the numbers in 2000 – of the 132 million births that happened, only 16 million (12%) were CS births [3]. There is no consensus over what is the optimal rate of CS in the population, however an optimal range of 10 – 15% is used as a threshold for ideal maternal and neonatal outcomes. Studies have also shown a rate of over 20% to be detrimental and not useful in improving perinatal or neonatal outcomes [3–5].

From 2000 to 2015 the rate of annual average increase of CS is estimated to be about 3.7%. Majority of this increase (66.5%) was driven by the increase in the number of births happening in facilities and the rest driven by the increased use of CS within the facilities. The highest rate of increase was seen in South Asia with a 6.1% annual increase, followed by Eastern Europe and central Asia with a rate of 5.5% annually. African regions also had an increase of approximately 2% annually but fall below the optimal lower threshold of 10 % [3].

It is estimated that around 3.2 million necessary CSs do not happen in low income countries on the other hand an estimate of 6.2 million unnecessary CS births happens in middle and high income countries. An estimated of half of this excess is being performed in China and Brazil [6,7]. These large inequalities in access of C-section is a major public health concern and reflective of the disparities between countries and within countries [8].

Indications such as prolapsed umbilical cord, placenta previa, placenta abruption and persistent transverse lie are absolute medical indications for a CS and apply to only a small proportions of births [9]. Yet in many Low and middle income countries (LMICs) and High Income countries (HICs) there is a rise of CSs. The increase is without much justification and the drivers for this is not yet fully understood [8]. In LMICs underuse and overuse of CSs coexist in the same area, wherein women in higher wealth quintiles have unnecessary CSs while women in poorer quintiles are not getting CSs when medically indicated [3].

Inequities in CS rates between and within countries

Focus on intrapartum strategies that lead to an increase in the number of institutional birth is the largest contributor of CS increase. The rationale behind the focus on intrapartum strategies is that - most direct obstetric complications are unpredictable and strategies that ensure Skilled Birth Attendants (SBAs) who are trained and able to perform signal functions of Emergency Obstetric Care (EmOC) during the intrapartum period will reduce Maternal Mortality Rate (MMR). There has been reasonable success in many regions and now there is a general consensus that this is the best strategy to reducing MMR [10–13].

As a result, across the globe the number of births that happen in institutions has risen from 53.7 % in 2000 to 77.8% in 2015, this increase has translated to a rise in the number of CSs being (12.1% to 21.1%) performed as well (Table 1).

Table 1: Estimated % of CS births and % of Institutional Births of the total live births and MMR across the Globe

Regions	Institutional Births of the total live births [3]			Estimated CS births of the total live births [3]			MMR [14] per 100,000 live births	
	2000 (%)	2015 (%)	Average annual rate of change (%)	2000 (%)	2015 (%)	Average annual rate of change (%)	2000	2015
Global	53.7	77.8	2.5	12.1	21.1	3.7	341	216
West and central Africa	45.3	57.3	1.6	3.0	4.1	2.1	956	679
Eastern and southern Africa	38.2	55.8	2.5	4.6	6.2	2.0	755	417
Middle East and north Africa	65.8	87.2	1.9	19.0	29.6	3.0	170	110
South Asia	29.6	71.0	5.8	7.2	18.1	6.1	388	182
East Asia and Pacific	65.7	92.2	2.3	13.4	28.8	5.1	118	62
Latin America and Caribbean	86.8	94.2	0.5	32.3	44.3	2.1	99	68
North America	99.3	98.1	-0.1	24.3	32.0	1.8	12	13
Eastern Europe and central Asia	89.4	99.4	0.7	11.9	27.3	5.5	56	25
Western Europe	97.3	97.5	0	19.6	26.9	2.1		

In West, Central, East and Southern Africa there has been an increase in the proportion of births that happen in institutions but they still account for less than 60% of all the live births. CSs being performed in these regions have increased only slightly and the rates fall below 5% of all the live births - indicative of minimal required CSs for not being performed in these regions (Table 1).

In the Middle East and North African region as well there has been an increase in the proportion of births that happen in institutions and now account for over 87% of births. The rise in CS births is much faster here and account for approximately 30% of all live births. In South Asia, East Asia, Pacific, Eastern Europe and Central Asian regions the proportion of average

annual increase of CS rates was over 5% and at present the CS rates in these regions are 27 – 30% - indicative of overuse in some countries/regions. The average annual increase in the proportion of institutional births in South Asia was about 5.8% during this period. In East Asia and Pacific and Eastern Europe and Central Asia the average annual increase was much smaller 2.3 and 0.7 respectively (Table 1). Not all countries that have similar proportion of institutional births have similar CS rates. For instance, Turkmenistan, Kyrgyztan, Dominican Republic and Brazil all have above 95% of their births happening in facilities but their CS rates vary drastically between 6.3% to 59.3% [3].

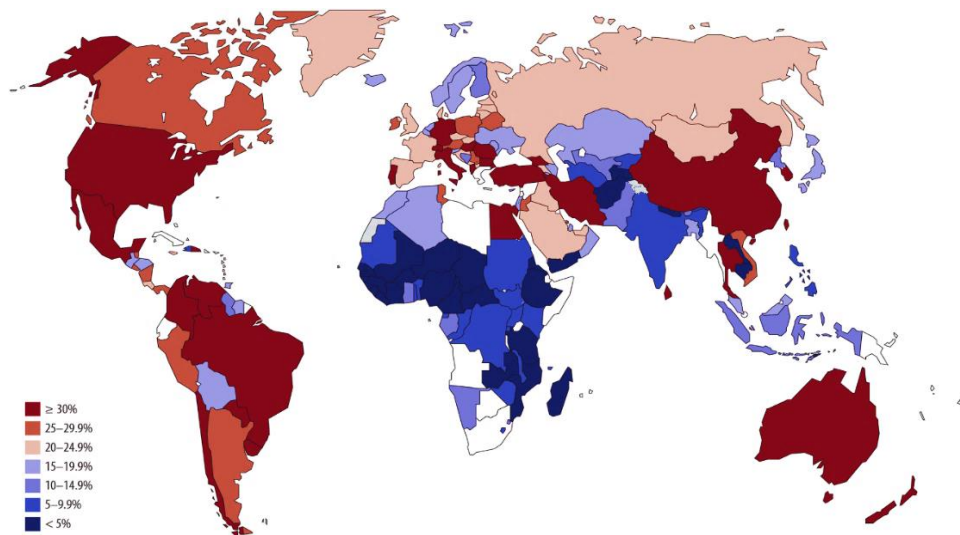


Figure 1: CS rates by country (Image taken from [4])

Many regions such as Eastern Asia, Northern Europe, Central America, Southern America, Northern America and Oceania have rates over double the UN recommended optimal rates whereas African regions (Eastern, Middle and Western) have dangerously low rates (Figure 1). Disparities in CS rates are also found within the same country. For example, in India the state of Telangana recorded a high of 57.7%, whereas the state of Mizoram recorded about 5.8%. Ethiopia is another example where there is stark

inequality, the overall national rate was about 2%, the province of Somalia recorded a very low rate of 0.4% whereas the province of Addis Ababa recorded 21.4%. Brazil is quite unique in that, the lowest rate recorded was a high of 33.9% (in the state of AP) and the highest recorded was 70.2% (in the state of GO). This disparity is seen in HICs as well, in USA the state of New Mexico recorded a rate of 17.9% while the state of New Jersey a high of 33.1% (Table 2).

Table 2: Disparities of CS rates within a country (Table adapted from [15])

Country	National rate (%)	Highest recorded rate within the country (%)	Lowest recorded rate within the country (%)
USA [15]	26.9	33.1 (New Jersey)	17.9 (New Mexico)
Brazil [15]	55.5	33.9 (Amapá)	70.2 (Goiás)
India [16]	17.2	57.7 (Telangana)	5.8 (Mizoram)
Cambodia [17]	6.3	14.3 (Phnom Penh)	2.2 (Kampong Speu & Pursat)
Bangladesh [18]	22.9	33.0 (Khulna)	10.9 (Sylhet)
Ethiopia [19]	1.9	21.4 (Addis Ababa)	0.4 (Somalia)

Some possible reasons for this inequalities often cited in the literature are urban/rural disparities, wealth inequalities and education of the mother. Most often urbanized areas will have higher CS rates than rural and remote. Studies have also

shown socio-economically wealthier mothers have more odds of getting a CS than a mother from a poorer background. Overuse of CS quite possibly is constraining resources that could be

diverted to address underuse especially in resource poor countries [7,20,21].

Exploration of CS rates through dimensions of utilization

Utilization of healthcare is traditionally defined as the ability of an individual to reach and obtain required healthcare services. More broadly utilization is an interface between characteristics of the demand side and the supply side. It is an outcome that results from the interaction between the characteristics of the user such as social, economic and physical environment as well as the provider characteristics such as health system organization, capacity and

capability [22–25]. Six facets of healthcare utilization – healthcare needs, perception of needs and desire to care, healthcare seeking, healthcare reaching, healthcare utilization and healthcare consequence/outcome will be explored below through demand side and supply side elements (Figure2) [22].

This review will explore public health aspects of CS including overuse and underuse of CSs through dimensions of utilization that look at both demand side and supply side determinants. The conceptual framework used here is an adaptation of an access to healthcare framework by Levesque 2013 [22].

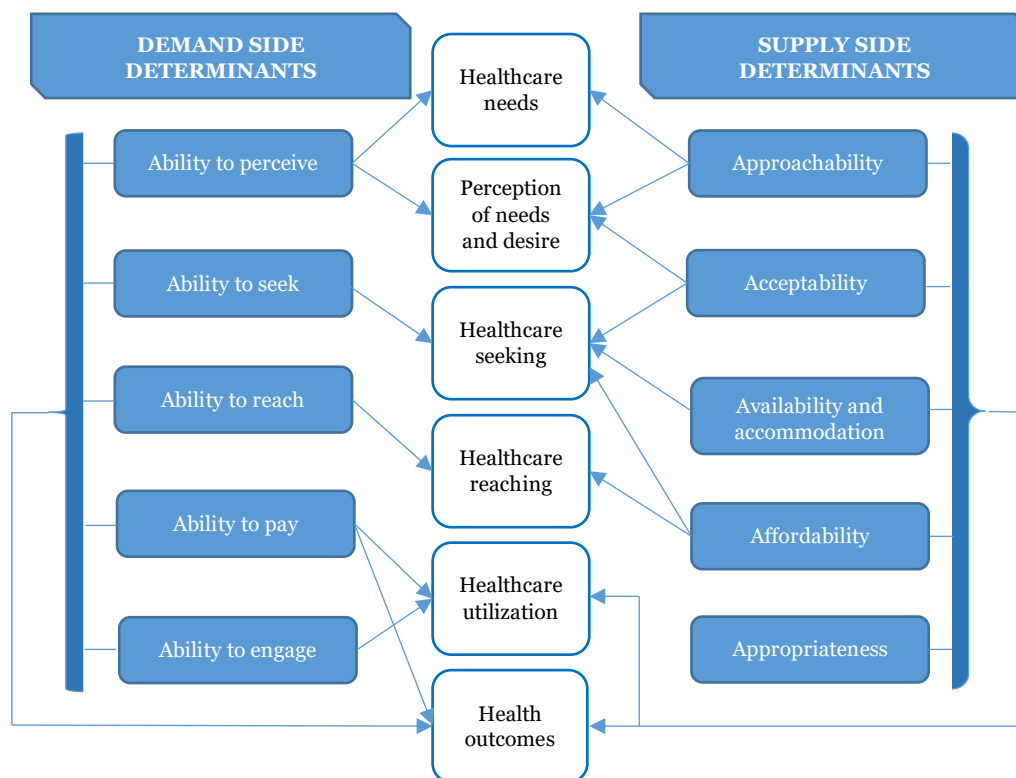


Figure 2: A conceptual framework to explore the use of CS through dimensions of utilization by looking at demand side and supply side determinants (adapted from [22])

Demand side determinants

In order to utilize and access quality care women, need the ability to perceive their needs, they also need the ability to seek, reach, pay and engage with the health services. The ability of women to perceive health care needs is determined by their health beliefs, knowledge,

trust in the health system and expectations. Women need healthcare systems that are gender sensitive and culturally appropriate. They also need the autonomy to seek care and an enabling socio-cultural environment. Other factors such as knowledge about health services, geographical boundaries, reputation of the hospital, mobility, self-efficacy to express

need and socio-economic status also determine access and utilization [22].

Preference for CS:

The large variations in CS rates across the globe is a reflection of cultural determinants rather than medical [1]. A mother's perception plays a significant part in the way she seeks and utilizes care. Mothers who prefer CS perceive it to be safer for mother and child [20]. Many women in high and middle income countries opt for CS when there is no medical indication. Caesarean section on maternal request (CSMR) has been on the rise in the recent years. Tocophobia (*intense fear of birthing*) has been reported as the main reason for this and an estimate of 6 – 10% of mothers suffer from this. Other reported influencing factors that might be contributing to this include social acceptability, trauma, abuse, high trait anxiety and psychological problems early in pregnancy, fear of pelvic floor damage, urinary incontinence, fear of negative effects on sexual relationships and lack of knowledge/support [1,20,26].

Secondary Tocophobia (*maternal request for CS among multiparous women*) influenced by previous negative experiences such as instrumental delivery or emergency CS also leads to maternal request for CS. The rate of negative perception especially fear among women vary widely between countries - from 5% in Switzerland (n=8000), 10% in Sweden (n=2662) to 25% in Canada (n=650) [27–30]. Rates of maternal request for CS also vary between countries, one Chinese study (n=66,226) reported 24.7% CS happened on maternal request whereas in a Nigerian study (n=843) only 6.6% were keen to request for CS and only 39.6% of mothers were aware they could ask for CS [31,32].

Some other reported reasons why mothers chose elective CS include perceived advantages of a child being born on an auspicious date, media's tendency to portray CS as controllable and modern and the partner's preference for a CS [20]. Low self-efficacy (*confidence in successfully executing an action*) of the mother

has also been associated with her request/inclination for CS [33]. It is a mammoth task to begin and optimise the high rates of CS. Monitoring CS rates and outcomes for the mother and child is key to ensure policies, guidelines, practice and action for optimization [4].

Aversion towards CS:

On the contrary, there have been reports from many countries especially West African countries where mothers have said they would refuse to undergo a CS even when medically indicated [34–37]. Informed refusals especially when the fetus's life is at risk is challenging. Factors that might influence these decisions include fear of postoperative pain, increased facility costs, cultural and religious beliefs, family/partner objection, lack of knowledge of the consequences and fear of death for both mother and child [37,38]. One Nigerian study (n=413) reported of mothers (12%) unwilling to accept the procedure under any circumstance [36]. Reports of refusals are mostly from low income countries [34,35,38], but a small proportion are also reported from high income countries [37].

Many studies from LMICs have reported mothers avoiding giving birth in hospitals due to “fear of cutting”, some mothers also perceived the procedure was used indiscriminately without consideration of personal circumstance. This can be detrimental in cases where a mother has medical indications but does not seek care due to perceptions such as these. It is key that mothers are equipped with knowledge during the antenatal period so that she can make informed choices regarding her birth [39].

Knowledge, belief and trust in the health system:

All pregnant mothers need to be able to perceive danger signs so as to seek medical help. They must be able to identify the services /interventions /procedures that exist. Many studies from African countries show poor knowledge even among mothers who attend

antenatal care (ANC) clinics there are reports of mothers who have never heard of CS. One Nigerian study reported a rate 17.7% (n=209) and a study done in Ghana reported 4% (n=317) of mothers who were unaware/have never heard of the procedure [34,35].

African studies also report of some women who perceive CS as a cultural taboo and a procedure normally conducted for lazy women. Many of them have inadequate information on danger signs and complications that might lead to CS. There were also reported misconceptions regarding the procedure where many women perceived that most women who undergo CS die [40]. It is vital that during ANC visits health care professionals incorporate information that makes mothers prepared for possible complications and procedures during childbirth [41].



Personal autonomy and cultural norms:

In many traditional societies, it is common for women to have very little autonomy over their health choices often men or elder members of the family decide for women and they would require permission to seek care.

In Afghanistan, a country with very poor maternal health indicators, a high of 50.5% ever married women reported not being able to access a facility because they did not get permission to go and 66.7% were not able to access treatment because they were not able to get money. The overall CS rate in Afghanistan is about 3%, mothers in the wealthiest quintile in the country had CS rate of about 7% whereas

mothers in the poorest quintile a shocking low rate of 1%. Some societies also have norms that dictate that women are to be only seen by female healthcare professionals [43]. In remote and rural areas where women health workers are fewer it becomes challenging for women who have complications to receive life-saving interventions in time.

In certain communities' religious ideologies and beliefs are also suggested to have an impact on the likelihood of a mother having necessary CS [44]. It is key that health systems and professionals are sensitive to the cultural and social sensitivities that exist within communities.

Socio-economic status:

After reaching the health institution, there is no medical reason for variation of CS rates among mothers in different wealth quintiles. Yet on an average women in the wealthiest quintile are 2.4 times more likely to give birth by a CS than mothers in the poorest quintile (8.9% vs 21.3%) [3]. Disparities in some LMICs such as Bangladesh, India and Pakistan are stark where poor women receive fewer CS than indicated and the rich more than required [45]. Some speculated/reported reasons for this disparity includes financial barrier, lack of capacity and resource to provide CS especially in rural and low-resource setting and wealthier women more willing to adopt interventions - possibly due to increase exposure and normalization of the procedure [3].

Many studies have shown the level of education a mother has to be an important factor that determines if she undergoes a CS [21,46,47]. One study conducted in China among primiparous women showed that the adjusted odds ratio of CS for college or university educated mother to be 4.46 times higher than for an illiterate mother [21]. Racial and ethnic disparities have also been cited as factors that influence CS rates. Few studies from America have suggested African American women to be more likely to undergo CS than Caucasian white mothers [48,49].

In low resource settings it is essential to monitor and train healthcare professionals in emergency obstetric services [50]. In settings where CS is much higher than required there is a need to review policy and guidelines within the healthcare system.

Supply side determinants

Health systems that enable access to care must be approachable, acceptable, available, accommodating, affordable and appropriate. Approachability and acceptability is determined by transparency of the treatment, effectiveness in reaching information to target audience, professional values, preferences and social and cultural norms. Care also needs to be available, accommodating, affordable and appropriate. Some determinants of this are capacity and resources available in the facility, healthcare professional's demographic characteristics, behaviors/convenience, type of facility and payment mode [22].

Professional values, philosophies and preferences:

Healthcare professionals within the health system play a key role in determining the rates of CSs. In a recent systematic review by Panda and colleagues that aggregated clinician's views of determinants that influence CS rates, clinicians' personal beliefs (*including professional values/philosophies*) was the most important deciding factor after health care system determinants (*such as fear of malpractice lawsuits and resources*) and clinicians' characteristics (*such as personal convenience, clinician's demography and confidence and skills*) [51]. Many obstetricians perceive CS to be a safer option that reduces risks and prevent complications [52,53]. Studies have reported that obstetricians tend to choose CS in unclear situations [54], and when they perceive risks such as urinary and fecal incontinence and pelvic floor prolapse [55]. One research from Argentina where the national CS rate is quite high (35.2%), reported only 6-12% of mothers who wish to birth via a CS, but in reality among healthy nulliparous women 34% -

45% actually birth via a CS [6,56,57]. These rates indicate the significance of judgement and perception of the clinician who attends the birth.

Although caesarean section on maternal request (CSMR) is increasing slowly in all parts of the world, for the most part the doctor decides if a mother undergoes CS. In the American "Listening to mother III" survey (n=2400) 32% of mothers reported planning for a CS, most commonly reported reasons were repeat CS or medical indication for primary CS. For primary CS mothers, 63% of them indicated doctor to be the decision maker. Among repeat CS mothers, 47% reported that the doctor made the decision and 30% reported that the mother made the decision. Among mothers who had a primary CS only 1% of them had made a request without medical indication. 13% of mothers reported pressure from a healthcare professional to accept a CS although not all underwent the intervention, those who were pressured were 3 times more likely to undergo a CS than those who were not pressured [58]. Tendencies to use CS when not required is seen in low resource settings as well. For example, a 2013 Tanzanian study found a simultaneous rise in number of CSs and maternal mortality for mothers who had low-risk births [59,60].

In many countries where malpractice lawsuits are common some healthcare professionals see CS as a protective mechanism. They are more likely to be sued for complications during a vaginal delivery than for a non-medically indicated CS. In situations where the clinician's reputation and career might be at stake they might choose a CS for professional protection than for reasons that benefit the mother and child [20].

Other health professional determinants reported to influence CS rates include the attending clinician/obstetrician's convenience and demographic characteristics. In few settings studies have shown clinicians to perform higher number of CSs during working hours and weekdays especially on Fridays. Some clinicians also perceive scheduling CS as being

a procedure that can be controlled and organized especially for repeat CS. Few demographic characteristics also seem to play a role in whether a clinician decides to perform a CS. Male obstetricians, younger obstetricians and more senior/experienced doctors are more willing as well as likely to perform CS [51]. Healthcare systems must be able to regulate and optimize CS rates through implementation of policy, strategies, guidelines and actions that encourage evidence based practice which will prioritize the best outcome for the mother and child.



Type of healthcare professional attending birth:

The type of healthcare professional that attend birth has an influence on CS rates. In few countries such as Sweden, Finland and the United Kingdom where midwives are the primary care providers CS rates have not risen drastically as they have in other high income countries. A midwife led care model is based on the rationale that childbirth is a natural woman-centered process that requires very little to no medical intervention. The midwife is the primary care professional that decides the course of care for entirety of the childbearing cycle [61,62].

The rate of CS birth in Sweden is about 17%, much lower than the European median average of 25.2% [64]. Sweden has been able to maintain an optimal rate as both the midwives and obstetricians in the country agree and share the belief that birthing is a normal process, they also work as team with a common goal of achieving a normal birth. Moreover, the private

healthcare sector is very small in Sweden, mostly all mothers seek care in public hospitals with midwives, this removes the financial incentives to perform CSs. Obstetricians and midwives also reported no fear of litigation or fear of being blamed in case of adverse outcomes. Only complicated cases and mothers who express fear of birthing are referred to senior obstetricians [65].

Many obstetricians/ doctors on the other hand are more likely to take a scalpel even with lower risk complications. An American study reported subjective indications (*such as non-reassuring fetal status, maternal request and labour arrest disorders*) to contribute much more than objective indications (*such as malpresentation, maternal-fetal, and obstetric conditions*) to the proportion of primary CSs [66].

Contributing to the trend of overuse is a form of obstetric violence where mothers are being forced and coerced to undergo CS. This violence is mostly imposed upon women who wish to have VBAC (Vaginal birth after CS) [67]. These cases rarely go to court and even if they do they are not published frequently, which makes it difficult to determine statistics. These coercion tendencies happen due to set legal and organizational standards. Medical-legal conferences and court proceedings tell clinicians that they are less likely to be sued for malpractice if the mother underwent a CS than a vaginal birth. This lowers the threshold of a doctor's decision to perform a CS [68]. Policies and guidelines to protect and encourage obstetricians to follow evidence based practice might be able to curb the overuse that happens due to fear of legal consequences.

Capacity and resources within the health system:

Capacity and resources within the health system has been associated with the rate of CS being performed. Number of hospitals, hospital beds and supplies in hospital per capita are some of the determinants of this. Regardless of medical need there is an observed effect wherein the greater the capacity of the system the greater

the surgical obstetric procedures performed. In one study that looked at CS in developed countries found doubling of hospital beds corresponded to a 26.8% rise in C section and doubling in medical supplies in a hospital to contribute to 15% in the rates [69].

In some settings lack of experience and skills among younger doctors in performing vaginal births have been associated with higher rates of CS. Younger doctors are probably more likely to perform a CS when they have little training and supervision and are afraid to show signs of incompetency [70]. In many facilities younger obstetricians are gaining confidence and expertise to perform CS but lacking skills to conducted assisted vaginal births [71–73].

Many settings in LMICs and remote areas do not have the capacity or resources to perform CS. In a 2010 WHO study of 137 countries, 54 countries had CSs rate below 10%, indicating a disproportionate distribution of wealth and usage. Of the additionally needed 3.18 million CS, 50% of them need to happen in 6 countries – Nigeria, India, Ethiopia, Congo Democratic Republic, Pakistan and Indonesia). The disproportionate use of CS among and within countries reflects socio-economic disparities that need commitment and willingness from governments and health systems [6].



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Health system financing:

The way health systems are financed and designed can promote or obstruct CS procedure. In some countries especially where

majority of the care is provided by the private sector it is common for organizations and professionals to benefit financially from a CS than a vaginal birth. For instance, in Brazil majority of babies, 80 – 90% born in the private facilities are through a CS when compared 30 – 40% born in the public [20]. Similarly, in a country-wise analysis of 34 Sub-Saharan African countries, the average overall CS rate in public institutions was 7.9% and in private 12.3%. CS rates in public ranged from 3% to 15.6% (Burkino Faso and Ghana respectively) whereas in the private, the CS rates varied from 0% to 64.2% (Sao Tome and Principe and Rwanda respectively) [50].

Previous studies on maternal health improvement schemes from LMICs have shown that the design of the package or the scheme can have an impact on the rates of CS, through financially incentives and disincentives. For instance, policies of two widely known safe motherhood schemes run in two different states of India the Janani Sahayogi Yojana (Madhya Pradesh) and the Chiranjeevi Yojana (Gujarat) have been associated with CS rates. Under the Janani Sahayogi Yojana obstetricians were reimbursed higher for CS than for vaginal births which drove the CS rates from 26.6% (2007 – 08) to 40.7% (2010 – 11) during the four years of the program. The Chiranjeevi Yojana was setup in way that the obstetrician would be paid a fixed amount of money for 100 births regardless of the type of birth the mother had. In the latter scheme the CS rates decreased from 6.7% (2007 – 08) to 4.3% (2010 – 11). Both of these states had an overall CS rate of less than 10% and the eligibility of the schemes were based on poverty status of the mother [75].

Policies of the Chinese New Cooperative Medical scheme (NCMS) has also been associated to dramatic rise in CS rates in certain counties of China. In a study done on five counties, four of them showed an increased rate between 36% - 131%. One of the reasons the authors speculate that contributes to the rise is

the direct link of the clinician's pay/ bonus to the facility revenue [76].

Insurance schemes is another reported influencing factor of the clinician's judgement. Certain policies and regulations that insurance companies set such as no reimbursement for epidural and allocating lower price rate for vaginal births and high for CS can indirectly contribute to the clinician's decision making [51].

In an American nationwide study conducted (on 2009 data) among 593 hospitals – an overall variation of 10-fold was observed between hospitals, the CS rates varied from 7.1% to 69.9%. For women who had low-risk pregnancies (*where expected variations are minimal*) as well the CS rates varied from 2.4% to 36.5%, a 15-fold difference. Difference in practice patterns across hospitals was identified as the main driver of variance in CS rates. The variation also signals potential quality concerns. In 2009 Medicare paid almost half the births in the US, the authors argue that governments efforts to standardize practice through financial (*rigorous policy of purchase, tax for undesirable actions/outcomes, financial incentive for desired actions/outcomes*) and non-financial (*transparency, public reporting, educational campaigns, stringent license approval*) methods could optimize CS rates [77].

Financial incentives play a significant role in deciding the type of birth a mother has, this requires policies, procedures and guidelines at the facility and national level which will enable evidence based practice implemented in the best interest of the mother and child.

Health Risk and Outcomes:

An estimate average of 37% of maternal and neonatal morbidity/mortality can be avoided through universal access to essential obstetric surgery [78]. However, recent evidence from LMICs show that the increase in surgeries maybe contributing to preventable mortality. Performing CS in LMICs can be riskier for the mother and child due to non-availability of skilled resources and lack of functioning equipment in

some facilities. Often safety and quality standards are not met [56,79]. “*We as a community have been promoting institutional delivery as a means to improving health outcomes. We are now realizing that just providing access to care doesn't necessarily improve outcomes.*” - Ana Langer from Women and Health Initiative [56].

Overuse of CS can be a direct threat to safety in LMICs, the overall national rate of CS in India is about 17.2%, however in a state called Telangana the rate is now 57.7% [16]. This high rate of CS also brings about increased risk for placental disorders, hemorrhages and uterine rupture in subsequent pregnancies [56]. A recent analysis of data from 719 health facilities across 26 LMICs showed majority of the facilities i.e, 73.8% (n=531) conducted CSs. However, a good proportion of these facilities that conducted CS showed lack of resources. A worrying 47.3% reported absence of an anesthesia provider, 26.4% of no access to oxygen supply, 60.8% had no access to anesthesia machine and 65.9% no access to a blood bank [79].

A recent technical consultation response identified many health system issues of quality and safety in LMICs. Lack of anesthesia support, lack and gaps in data quality (*such as who performs surgery and the extend of adverse outcomes*), lack of humans resources (*that often lead to delays in surgery, anesthetic complications, postoperative infections and long term consequences*), gaps in training and supervision (*which lead to unequal human resource distribution*), lack of standardized protocol and influence of obstetrician's preferences to be some of the health system determinants that impact on quality and safety of CSs in low-resource setting [56].

In resource poor settings there is a need to now establish a minimum quality standard which facilities must adhere to in order to perform CS. It is also important to increase investment in facility equipment, strengthen health information systems and employ apt recruitment and retention strategies along with training and

supervision for surgical, anesthesia and obstetric workforce in order to reduce risk of CS in LMICs.

Sometimes due to clinical reasons attempting at normal vaginal birth might be risky or not possible. In a recent Lancet review series that discusses optimization of CSs, Sandall and colleagues estimate that - if a mother were to have an emergency intrapartum CS the risk of mortality for her is 4 times more if she had a vaginal birth [2,80,81].

A few review papers have explored the long and short term impacts of CS on mothers [2,82,83]. Most reported short term and immediate risks that come with a CS include risk of post and preoperative complications such as surgical/anesthetic complications, wound infections, hematomas, cardiac arrest and urinary catheterization [82,83]. Emerging evidence also shows possible short-term risks such as altered immune development higher risk for allergy, atopy and asthma and lesser diversity of gut microbes for babies born by CS [2,84].

Some reported long term risks of having a CS identified are pelvic adhesions, small bowel obstruction, menorrhagia, dysmenorrhea, chronic pain, sexual dysfunction, subfertility, urinary/fecal incontinence and pelvic organ prolapse. And as the number of CSs a mother has increases her risk for bleeding, adhesions, hysterectomy, abnormal placentation and uterine rupture, still birth and preterm birth also increases [2,82].

Optimal outcome for both the mother and child is a result of various determinants that involve the health system, health professional and the user. There is need to facilitate strategies that involve positive human relations (*such as labour companion, continuity of care through mid-wife led units and antenatal education*) and collaborative multi-disciplinary teamwork. There is also a need to adhere to and implement strategies that will provide all mothers standardized evidence based care. Interventions to optimize CS rates would also

have to take into account healthcare professionals views/preferences/beliefs as well as the mother's fears and concerns [20].

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- Title: International Research Journal of Public Health
 - ISSN: 2573-380X
 - DOI: 10.28933/IRJPH
 - IF: 1.36 (citefactor)
 - Email: IRJPH@escipub.com
 - TEL: +1-281-656-1158
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