Rising Cesarean Sections: Causes & Concerns.
Prasanta Mahapatra

A. The Problem:

The natural birth process is generally safe for mothers and babies. However, trial of natural labor in the presence of certain risk factors & medical conditions may be dangerous for the mother and/or the baby. A Cesarean section (C-section/CS) is an operation to deliver a baby through the abdominal route, instead of the natural vaginal route. When medically indicated, C-sections save lives and enhance perinatal outcome of high-risk pregnancies. C-sections reduce the risks of operative vaginal delivery for the mother. C-sections can be performed only in medical institutions and hospitals equipped for surgery. Specialists and healthcare workers skilled in comprehensive emergency obstetric care (CEmOC) ought to be available. Therefore, C-sections rates has been advocated, occasionally, as a process indicator of the quality (WHO 1994; Gichangi et al, 2001) and equitable access to maternal care (Stanton & Holtz, 2006; Thomas, 2006; Cavallaro et al, 2013; Irani & Shad, 2015). On the other hand, in the absence of medical indications, i.e. low-risk pregnancies, the operative and consequential risks of C-sections outweigh the benefits. Instances of rising cesareans without comensurate reduction of perinatal mortality has also been reported (Mukherjee et al, 1993).

In addition, excessive and unnecessary cesareans in some areas and by some people siphon off healthcare resources from underserved areas and the needy (Gibbons et al, 2010). Hence, overuse of C-section is cause for concern.

C-section rates (CSR) are rising all around the world. By about 2005, the average global CSR was estimated at 15% (Betran et al, 2007). The CSR for Africa was 3.5% indicating lack of adequate emergency obstetric care (EmOC) infrastructure in most countries of the region. On the other hand, CSR were very high in many developed countries, Latin America and Caribbean region. For example; 39.1% in Mexico, 36.3% in Brazil, 36% in Italy, 30.2% in Portugal. The CSR in China was estimated at about 40.5%. By 2009, CSR in the United States of America (US) had peaked at 33.9%. Professional & popular concerns and persistent debates, regarding overuse of C-sections, appear to have marginally reduced the US-CSR down to 32.8% in 2010, but remained unchanged in 2011 and 2012, for which latest statistics are available (Martin et al, 2013). Results from the global and multi-country, facility based surveys by the WHO, between 2004 and 2012, show that on average CSR increased at rates ranging from 1.0 to 16.8 percentage points per year, except for Japan where CSR reduced by 2.5% per year (Vogel et al, 2015).

Results from the three National Family Health Surveys (NHFS-1,2&3) show that the national average CSR in India increased from 2.9% in 1992-93 to 7.1% in 1998-99 and further to 10.2% in 2005-06 (Ghosh, 2010). Results from the third District Level Household and Facility Survey (DLHS-3) show that the national average CSR in India was about 9% during 2007-08 (Shabnam, 2014). But, these national averages of about 10% CSR around 2005-08 obscure the wide range of CSR prevalent in various areas of the country. CSR in Kerala was 30.1% in 2005-06 according to the NFHS-3 and 31.8% in 2007-08 according to the DLHS-3. Similarly, the CSR in undivided Andhra Pradesh (including Telangana) was

---

1 Dean, The Institute of Health Systems (IHS), ORCID:0000-0001-5320-470X
27.5% in 2005-06 and 29.3% in 2007-08. Very high CSR in several first referral hospitals in Telangana have incurred adverse notice (Sikdar, 2015). Tamil Nadu’s CSR was about 23.0% in both the surveys. Goa CSR was 25.5% during 2005-06 and 27.5% during 2007-08. Latest Mother & Child Tracking System (MCTS) data for 2013-14 suggests that the CSR was 42% in AP and 60% in Telangana State (TS). The CSR increased from 8.6% during 1980s to 20.3% by 2009 in a nonprofit maternity and child hospital in rural Telangana (Dangoria et al, 2013). The rising trend of cesareans in several parts of India is a recent phenomenon (Arjun, 2008). For example, the CSR at a maternity hospital in Mumbai rose from less than 2% in 1950s to just over 3% by mid-1970s, and 8% by end 1980s. From 1990s onwards CSR has increased faster, rising to 16% by 1998 (Mehta et al, 2001). The overall CSR at 30 Indian teaching hospitals increased from 21.8% in 1993-94 to 25.4% in 1998-99 (Kambo et al, 2002). The CSR at a private hospital in Pune catering to upper income groups, increased from 19% in 2000 to 50% in 2011 (Patil et al, 2012). A survey, in 1997, of middle/upper population in Chennai revealed CSR of 45% (Pai et al, 1999). This acceleration of CSR suggests increasing incidence of medically unnecessary cesareans, with its attendant risks and costs. NFHS time trend of CSR shows that the CSR in AP, Goa, Kerala, Tamilnadu, West Bengal and Punjab increased rapidly from 1992 to 2006 (Ghosh, 2010).

B. Medical Indications & Classification of C-sections:

Medical indications for C-section include: (a) mal-presentations (transverse, frontal & breech), (b) placental abnormalities such as placenta praevia, morbidly adherent placenta, abrupt separation of placenta (abruption) that carry the risk of severe antepartum hemorrhage, (c) absolute and relative cephalo-pelvic disproportion, (d) hypertensive disorders of pregnancy, (e) risk of mother-to-child transmission of multiple maternal infections, (f) older maternal age, (g) previous C-section, (h) dystocia and failure of normal labour to progress, (i) critical fetal distress during the course of normal labour, (j) prolapsed cord, etc (Penn & Ghaem-Maghami, 2001).

The unmet obstetric network (UON) considers (a) severe antepartum hemorrhages (placenta praevia, placental abruption), (b) transverse & frontal presentations, and (c) major cephalo-pelvic disproportion where the child is alive, as absolute maternal indications for cesarean section (Dubourg et al, 1999). Implicitly the remaining medical indications are referred to as relative medical indications. The UON definition of absolute maternal indications has been developed specifically as an indicator to track development of obstetric services. The Baltimore group on cesareans (Stanton and Ronsmans, 2008) recommended that absolute maternal indications include uterine rupture in addition to the ones in UON definition. Their definition of non absolute (relative) indications include; (a) previous cesarean, (b) failure to progress (prolonged labor, failed induction), (c) genitourinary fistula or third degree tears, (d) antepartum hemorrhage (excluding absolute causes), (e) maternal medical diseases, psychosocial factors, fetal compromise and breech presentation. There is a case, however, to treat breech presentation as an absolute indication, as the term breech trial (Hannah et al, 2000) has established the usefulness of planned C-section for all breech presentations.

When planned and performed before onset of labor (prepartum) the intervention is called elective C-section, otherwise emergency C-section (intrapartum). Graded urgency

---

2 In the context of C-section, the term “elective” generally means planned and hence prepartum. However, some authors have used the term “elective” to mean medically unnecessary cesareans. For example; the Consortium on Safe Labor study of contemporary cesarean delivery practice in the US defined elective cesarean delivery as, (a) those expressly labelled as ‘elective’, (b) cases where the mother declined a trial of labor, and (c) a
classifications consisting of more than two categories have been proposed. A group of obstetric anaesthetists proposed three categories, namely; (a) Elective, performed at a time convenient to patient, medical and midwifery staff, (b) Urgent, maternal or fetal compromise but not immediately life threatening, and (c) Emergency, life threatening maternal or fetal compromise (Lucas, Nel & Robinson, 1996). Another group of obstetricians and anaesthetists gathered professional opinion using case vignettes and proposed a four category urgency classification, namely; (a) Elective, at a time to suit the woman and maternity team, (b) Scheduled, needing early delivery but no maternal or fetal compromise, (c) Urgent, maternal or fetal compromise, and (d) Emergency, life threatening maternal or fetal compromise (Lucas et al, 2000). These four categories have been adopted by the Royal Colleges of Anaesthetists, Obstetricians & Gynaecologists (Brennand et al, 2010). However, the traditional binary classification, namely elective and emergency CS continues to be in vogue. While simplicity of urgency based classification is a plus, the amount of information provided by such stratification is limited. Hence, the need for more detailed classifications to facilitate, monitoring, auditing, analysis and comparison of CSR.

To understand the rising trend of cesareans, Anderson & Lomas (1984) adopted a five category classification, namely; (a) previous CS, (b) breech, (c) dystocia, (d) fetal distress, and (e) others. Similarly, Althabe & others (2004) identified seven categories of medical indication, namely; (a) dystocia, (b) intrapartum fetal distress, (c) previous cesarean, (d) breech, (e) maternal indications, (f) emergencies, and (g) other indications. However, overlapping categories and subjectivity of diagnoses mean that most indication based classifications, have low reliability. The possibility of accurately classifying a woman into one of the indication categories, before she is actually taken to the operating theatre (prospective identification) is limited for several cases.

The concept of a standard primipara, i.e. a subset of the obstetric population that has relatively low risk, has been proposed for making inter-unit comparisons of maternity care, as this simple stratification will control for the substantial difference in case mix. The approach may be combined with a separate study of the other groups in the case mix, such as multiparae and high risk primiparae, by defining additional nonoverlapping groups, homogeneous in terms of risk factors (Cleary et al, 1996). Classifications based on maternal & pregnancy characteristics, also referred to as women-based classifications, are more reliable, allow for mutually exclusive categories and prospective identification (Torloni et al, 2011). In the US, the concept of “no indicated risk” (NIR) cesarean is used to mean the lowest obstetric risk population identifiable from births data. The NIR subgroup consists of mothers who have full-term, singleton, vertex presentation, no prior cesarean and none of the 16 medical risk factors (eg. Diabetes, hypertension) or 15 labor & delivery complications (eg. fetal distress, prolonged labor) reported on birth certificates (MacDorman et al, 2008a).

In 2001 a ten group classification of cesarean (TGCS) framework, based on four obstetric dimensions, was proposed for monitoring, audit and analysis of cesarean sections at the health facility level (Robson, 2001). The TGCS is more commonly referred to as the Robson’s classification, after it’s author. The Society of Obstetricians and Gynecologists of Canada (SOGC) have advocated a modification of the Robson classification, which keeps Robson’s initial 10 groups as such and adds two or three sub categories under groups 2 to 10 (Farine & Shepherd, 2012). A systematic review (Betran et al, 2014) found increasing use of the Robson classification world wide, testifying the simplicity and usefulness of women-based based classification. The classification itself has been used as an intervention to reduce CSR. It allows self-validation since some groups can act as controls. It challenges variety of factors that are not considered accepted indications for cesarean delivery (Zhang et al, 2010).
traditional myths about alleged drivers of rising CSR, such as breeches or multiple pregnancies. However, quality of data may affect the real value of using the classification. Subjective assignment of core variables such as starting of labor, give scope for misclassification. To facilitate interpretation of results of the classification, Robson et al (2013) have proposed simplified set of rules. For example, standard nullipara (groups 1& 2, Table-1) usually constitute about 35-42% and standard multipara (groups 3&4) constitute about 30-40% of obstetric population. Group-9 usually represents about 0.2-0.6% of all women and cent percent cesarean is expected in this group.

Table-1: Ten group or Robson’s classification and eight group New Jersey adaptation framework for monitoring, auditing and analysing CS rates at the facility level.

<table>
<thead>
<tr>
<th>Sl</th>
<th>Robson’s Classification</th>
<th>Cesarean</th>
<th>New Jersey Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nulliparous, single cephalic term (≥37weeks), spontaneous labour</td>
<td>Primary</td>
<td>Standard nullipara</td>
</tr>
<tr>
<td>2</td>
<td>Nulliparous, single cephalic term, induced or CS before labour</td>
<td>Primary</td>
<td>Standard nullipara</td>
</tr>
<tr>
<td>3</td>
<td>Multiparous no previous uterine scar, single cephalic term, spontaneous labor</td>
<td>Primary</td>
<td>Standard multipara</td>
</tr>
<tr>
<td>4</td>
<td>Multiparous no previous uterine scar, single cephalic term induced or CS before labour</td>
<td>Primary</td>
<td>Standard multipara</td>
</tr>
<tr>
<td>5</td>
<td>Multiparous, single cephalic term, with previous uterine scar</td>
<td>Repeat</td>
<td>Standard multipara with prior cesarean</td>
</tr>
<tr>
<td>6</td>
<td>All nulliparous single breech</td>
<td>Primary</td>
<td>Malpresentation nullipara</td>
</tr>
<tr>
<td>7</td>
<td>All multiparous single breech including those with previous uterine scars</td>
<td>Primary</td>
<td>Malpresentation multipara</td>
</tr>
<tr>
<td>8</td>
<td>All multiple pregnancies, including those with previous uterine scars</td>
<td>Primary</td>
<td>All other with prior cesarean</td>
</tr>
<tr>
<td>9</td>
<td>All singleton transverse or oblique lie including those with previous uterine scars</td>
<td>Primary nulli</td>
<td>Malpresentation nullipara</td>
</tr>
<tr>
<td>10</td>
<td>All single cephalic preterm, including those with previous uterine scars</td>
<td>Primary multi</td>
<td>Malpresentation multipara</td>
</tr>
</tbody>
</table>


The New Jersey Center for Health Statistics adapted the Robson classification into 8 categories (Denk et al, 2005, 2006). Table-1 shows the TGCS and New Jersey Eight Group (NJEG) adaptation for monitoring, auditing and analyzing CSR at the facility level. The TGCS does not allow for stratification into primary and repeat cesareans as some of its categories include both. The first level stratification in the NJEG adaptation is primary or repeat, with six categories under primary and two categories under repeat cesareans. These eight categories can expand into 24 sub categories. Thus the NJEG adaptation can collapse into two strata, and expand up to 24 sub categories. A systematic review of classifications for cesareans reports that both the TGCS and the NJEG adaptation (Denk’s 8 group) got the highest overall theoretical ratings and also performed very well on the practical case scenarios (Torloni et al, 2011). Considering the advantage of collapsing data into two simple
strata of primary and repeat cesareans, the NJEG adaptation i.e. Denk’s 8 group system, appears to be the most promising for future use.

The broad risk categorisation of women-based classifications does not capture specific indications or urgency that are required for finer risk rating of institutional obstetric populations. To assess the robustness of women-based classifications, Colais et al (2012) compared adjusted relative risk of C-section using Robson groups as the only adjustment factor (M1) with estimates from an expanded model (M2) including additional clinical and sociodemographic variables of the mother and the fetus. Although the percentage variations from crude to adjusted RR was similar in M1 and M2 models, residual confounding for clinical and demographic variables was present in first four groups, particularly in Robson groups 1&3. Hence, parity and type of labour should be taken into account in risk adjustment models for interhospital comparison.

C. Maternal Groups and Indications Contributing to High CS Rates:

Rising trends of CSR may be due to real increase in obstetric risk profile requiring cesareans (absolute indications) and/or increasing resort to cesarean for various relative indications. Study of changes in contribution of various maternal groups and indications of cesarean cited by obstetricians gives an idea about the extent to which the rising trend of CSR is influenced by nonmedical factors.

Robson’s-group wise comparison, between a high CSR (30%) hospital with a low CSR hospital in Ireland showed that; elective primary cesareans on standard nullipara, and repeat cesareans on standard multipara were the top contributors to high CSR (Burke et al, 2006). A similar study in Belgium of CSR in 2000 and 2008 found that maximum contribution to the increase in CSR was from Robson groups 1&5, both of which (standard primi- & multipara) are low obstetric risks (Delbaere et al, 2012). A study (Kelly et al, 2013) of hospital births from 2007 to 2011 in five Canadian provinces showed that, the overall CSR was 28.5%. The top contributing indications were, (a) repeat cesareans on standard multipara (Robson’s group-5, within group CSR:80.8%) accounting for 9.1% overall CSR, and (b) primary elective/emergency cesareans on standard nullipara (Robson’s group 1&2, within group CSR:23.8%), accounting for 8.8% overall CSR. Together, these three groups accounted for 17.9% overall CSR. The within group CSR for less than 37 week gestations (Robson’s group 10) was 27.3% accounting for 1.5% overall CSR. Although, within group CSR for breech and other mal-presentations (Robson’s 6,7&9) was 90.2%, their contribution to overall CSR was 4%. In any case, cesarean is medically justified in case of mal-presentations.

The US Consortium on Safe Labor study (Zhang et al, 2010) found that overall cesarean rate during 2002-2008, in American College of Obstetrics & Gynecology (ACOG) districts was about 30.5%. About 68% of these cesareans were in Robson’s group 1-5. The top contributing indications were, (a) repeat cesareans on standard multipara (Robson’s group-5, within group CSR: 82%) accounting for 30.9% overall CSR, (b) emergency primary cesareans following induction of labour on standard nullipara/multipara (Robson’s group 2a+4a, within group CSR:19%), accounting for 19.2% overall CSR, followed by (c) elective primary cesareans (Robson’s group-1) accounting for 8% of overall CSR and (d) elective cesareans on multipara (Robson’s groups 2b&4b) which accounted for 7.9% of overall CSR. Induction of labor was associated with twice as high a risk of cesarean compared with that for the spontaneous labour group.
In a chart review of 229 primary cesareans during 1996 in four Columbian hospitals 81.2% cases were assessed as unjustified. The diagnostic label of dystocia was most commonly cited as the indication for unustified cesareans. Of all cases in which dystocia was the indication for cesarean, 83.8% were assessed by chart reviewers as unjustified (Gomez & Carrasquilla, 1999). The CSR of a major teaching hospital in Connecticut, USA, increased from 26% in 2003 to 36.5%. Primary cesarean births accounted for 50% of the increasing cesarean rate. Among primary cesarean deliveries, more subjective indications (non reassuring fetal status and arrest of dilation) contributed larger proportions than more objective indications (mal-presentation, maternal-fetal, and obstetric conditions). The relative contributions of each indication to the total increase in primary cesarean rate were: non reassuring fetal status (32%), labor arrest disorders (18%), multiple gestation (16%), suspected macrosomia (10%), pre-eclampsia (10%), maternal request (8%), maternal-fetal conditions (5%), and other obstetric conditions (1%) (Barber et al, 2011).

The WHO global survey on maternal and perinatal health in Latin America estimated that the overall CSR was 35.4%. Although standard multipara with a previous cesarean (Robson’s group 5) represented only 11.4% of the obstetric population, this group was the largest contributor to the overall CSR (26.7% of all the cesarean sections). The second and third largest contributors to the overall CSR were: (a) emergency CS in standard nullipara (Robson’s group-1) responsible for 18.3%, and elective or emergency CS in standard nullipara (Robson’s group 2), responsible for 15.3% of all cesarean deliveries, respectively (Betran et al, 2009).

Study of contributing indications reported by the WHO global survey (WHOGS) during 2004-2008 and WHO multi-country survey (WHOMCS) during 2010-12 shows that primary cesareans in nulliparous women were the single largest contributor to the overall CSR accounting for about 33%, followed by repeat cesareans accounting for about 25% of the overall CSR. In countries with high human development index (HDI), the overall increase in CSR was attributable to significant increase in the absolute contribution of elective or induced (emergency) primary cesareans among nulliparous women. In moderate HDI countries, increases in almost all Robson groups contributed to the rising trend of CSR. In low HDI countries, repeat cesareans were the largest contributor to rising CSR followed by elective or emergency primary cesareans. The overall pattern of changes in CSR among maternity subgroups suggests that the threshold for medically indicated cesareans has become lower over time, and/or the use of elective cesarean has risen (Vogel et al, 2015).

D. What is the right number of cesarean sections?:

The optimal rate of CS deliveries is unknown. However, very low or very high C-section rates can be dangerous (WHO et al, 2009). We need a reference value to identify extremes of CSR. In 1985, an international consultation of experts from multiple disciplines concerned about appropriate technology for birth was organized at Fortaleza in Brazil, by the regional offices of WHO for Europe and the Americas. It was noted that several countries with low perinatal mortality, had CSR of less than 10%. Accordingly, the conference recommended that there is no justification for any geographic region to have more than 10-15% cesarean births (WHO, 1985). Subsequent reviews of empirical evidence reinforced that there is no apparent benefit of maternal/perinatal mortality reduction, for CSR above 15% (Chalmers, 1992, Joffe et al, 1994; Ye et al, 2014). A WHO Technical Working Group suggested that national average CSR should lie between 5% and 15% of births. CSR below 5%, indicates that a substantial proportion of women do not have access to surgical obstetric care and probably die as a result. A rate higher than 15% indicates over-utilization of the
procedure for other than life-saving reasons. The group cautioned about proper interpretation of national average CSR as it may mask subnational disparities and institutional level of care between public and private sector (WHO, 1994). Based on a recent review, the WHO has stated that, at population level, more than 10% CSR is not associated with reductions in maternal and newborn mortality rates (WHO et al, 2015).

The desirability of fixing a ceiling on CSR, without reference to case-mix, maternal preferences and practice environment has been questioned (Lancet, 1997; Groom & Brown, 2000; Cyr, 2006). Countries, faced with rising cesareans, have resorted to higher normative CSR to guide public health efforts at appropriateness of technological interventions for child birth. For example; the Mexican official standard for maternity care considers a 20% CSR as ideal (Gonzalez-Perez et al, 2001). The Italian National Health Plan 2002-04 targeted to minimise variation and reduce overall CSR to 20% (Meloni et al, 2012). The US Department of Health (USDH) expert group on CSR reasoned that the normative cesarean rate for standard primipara should be set at the 25th percentile and VBAC at 75th percentile of state averages for these two subgroups as prevalent in 1996. Accordingly they proposed a maximum of 15.5% cesareans for standard primipara and at least 37% VBAC (implying a maximum repeat CSR of 63%). The ACOG task force on cesarean delivery rates recommends case-mix adjusted CSR norms. Applying the CSR goals set by the USDH expert group for the two major obstetric subgroups, namely standard primipara and multipara with previous cesarean, to hospital case mix prevalent in 1987, the ACOG task force estimated a normative global CSR of 20.1%. Applying the normative subgroup rates to community case mix prevalent in 1987, yields a normative global CSR of 21.5% (ACOG, 2000).

Normative CSR targets and goals have also shifted over time, reflecting ambivalence in knowing the right rate for optimal maternal and infant outcomes and doubts about what strategies can safely reduce cesareans. For example; the US Government Healthy People 2000 goal was to reduce overall cesarean to 15%. Some obstetricians argued that the CSR target of 15% may result in shifting of cases from cesareans to operative vaginal deliveries that are associated with higher morbidities, eventually leading to a detrimental effect on maternal and infant health (Sachs et al, 1999 and Letters to the Editor NEJM, 1999). Subsequently the Healthy People 2010 target released in January 2000, was revised to 15% primary cesareans, and in Healthy People 2020, the new target is 23.9% (Hartmann et al, 2012). The professional debate engendered by Sachs et al (1999) appears to have contributed to the revision of the Healthy People 2010 target (Gregory, 2000). A survey for the National Sentinel Caesarean Section Audit in UK found that many consultants regard a CSR of 20% as being too high (Thomas & Paranjothy, 2001).

**E. Limits to health benefits of cesarean section:**

The primary rationale behind most of the medical indications is to improve perinatal outcome. Appropriate resort to this procedure does indeed improve maternal and perinatal outcomes. For example; the term breech trial has conclusively demonstrated the appropriateness of planned C-section for all breech presentations (Hannah et al, 2000). However, excessive resort to C-section would not be justified. Reductions in perinatal mortality was observed almost around the same time period as increases in CSR. This lead some to believe in a treatment effect between the two (Ott et al, 1977). However, closer examination shows that improvements in perinatal mortality does not necessarily rely upon an ever-increasing cesarean section rate. For example; a study (O'Driscoll and Foley, 1983) from Ireland found that the CSR at the National Maternity Hospital, Dublin remained between 4.2% in 1965 to 4.8% in 1980. Perinatal mortality, however, continued to fall from
42.1 to 16.8 per 1000 live births at 500gm or more. The CSR in Semmelweiss clinic in Vienna remained at 1-2% from 1974 to 1985, while the CSR in the rest of Vienna rose from 6.3% to 10.3%. Even then, neonatal mortality and stillbirth rates at the Semmelweiss clinic declined in exact parallel with rest of Vienna (Rockenschaub, 1990). During 1961-68, the perinatal mortality in a New York hospital dropped at an average rate of 1.24% per year, even though, the CSR remained stable. For the years 1972 through 1977, the CSR in this hospital increased markedly, but there was no decline in perinatal mortality. During 1961 to 1977, all women in this hospital with previous cesarean were delivered by cesareans. The perinatal mortality in this subgroup of women reduced by one third. As the effect of C-section would be minimal in this subgroup, other factors must have contributed to the decline in perinatal mortality (Minkoff & Schwarz, 1980). At a teaching hospital in Indianapolis, serving low-income women, the primary cesarean rate between 1976 and 1982 fluctuated between 5.8% and 8.2%, while the perinatal mortality rate for infants weighing more than 500 g was halved from 35/1000 to 18/10000 (Pearson, 1984). During 1968 to 1987, crude neonatal mortality rates in an Oklahoma community hospital declined, while CSR went up from 4.7% to 25.7%. However, birthweight-specific mortality bore little relationship to birthweight-specific CSR. Neonatal mortality for infants weighing over 2499gm and without congenital anomalies remained essentially the same (.91, 1.0, 1.02 per 1000 live births) for each of the five-year periods included in the study, despite marked increases in CSR (Sepkowitz, 1992). Several other studies have shown that higher CSR do not contribute to any reduction in perinatal mortality (Porreco, 1985; Notzon, 1990; Lidegaard et al, 1994, Sandmire and DeMott, 1994, Joffe et al, 1994; Eckerlund & Gerdtham, 1999, Mehta et al, 2001; Duarte et al, 2004; Jonsdottir et al, 2006). In Sweden the CSR decreased from 12.3% in 1983 to 10.84% in 1990 and the perinatal mortality reduced as well (Nielsen et al, 1994). An ecological study (Althabe et al, 2006) using data from 119 countries has shown that; for low-income countries where the baseline CSR is less than 10%, rising CSR is associated with reductions in maternal and neonatal mortality. On the other hand, in medium- and high-income countries, mostly with baseline CSR of more than 10%, increases in CSR is not associated with any significant changes in mortality rates. Another ecological study (Volpe, 2011) using data from 193 countries found that CSR has an inverse exponential relationship with IMR and neonatal mortality rate (NMR). For CSR below 10%-15%, rise in CSR was associated with a fall in IMR, but the curve lost its inclination for CSR above 10%-15%. Similarly higher CSR correlated to lower maternal mortality ratios when CSR was below 10%-15%, but the curve lost its inclination after that. Higher CSR beyond 15% had no effect on maternal or child mortality outcomes.

F. Health consequences of the increasing cesarean section rates:

The adverse consequences of high CSR are not fully understood. A systematic search for randomized trials to estimate the effect of cesareans due to nonmedical reasons, on perinatal and maternal morbidity and mortality did not find any study (Lavender et al, 2012). Potential consequences of elective cesarean sections in low-risk pregnancies have to be inferred from observational studies. As a major surgical procedure, C-section exposes the mother to risks of anesthesia and surgery. In case of elective C-sections, there is the risk of pre-term delivery due to errors in estimation of the expected date of delivery and/or errors in judgment regarding the intervention with respect to the period of gestation.

Several studies have reported that cesarean delivery is associated with an increased risk of maternal mortality. A study of deliveries in Cape Town during 1975-1986 found that the risk of maternal mortality for cesareans was five times higher than that for vaginal
deliveries (Lilford et al, 1990). In the United Kingdom (UK), maternal mortality in 1994-96 was estimated at 20.6, 58.5, and 182.0 per million, respectively for vaginal, elective and emergency cesarean deliveries. Maternal mortality of elective cesareans was 2.84 times and for emergency cesareans 8.84 times that of vaginal deliveries (Hall & Bewley, 1999). A case-control study of maternal mortality in North Carolina during 1992-98 estimated that the overall maternal mortality ratio (MMR) was 20.7 per 100000 live births. The adjusted odds ratio (OR) for pregnancy-related death associated with cesarean delivery was 3.9 (Harper et al, 2003). A case-control study (Deneux-Tharaux et al, 2006) in France of maternal deaths during 1996-2000 estimated the risk of maternal mortality for cesareans as 3.3 times higher than after vaginal delivery. The difference in odds of maternal death between elective and emergency C-section was not significant. Maternal deaths associated with C-section were mostly due to complication of anesthesia, puerperal infection or thromboembolism. The risk of postpartum hemorrhage did not differ significantly between vaginal and cesarean deliveries. In Netherlands, during 1983-92, the risk of maternal mortality after vaginal birth was 0.04/1000 compared with 0.53/1000 cesarean births. The risk of maternal mortality directly attributable to cesarean section was 0.13/1000 operations (Schuitemaker et al, 1997). A study (Clark et al, 2008) of about 1.5 million deliveries in the US between 2000 and 2006 found that the MMR attributable to C-section was 2.0 per 100000 live births compared with 0.2 per 100000 live births in case of vaginal delivery. Causes of maternal deaths attributable to C-section were pulmonary embolism, surgical injury and sepsis secondary to surgical injury. A retrospective cohort study of deliveries in RG Kar Hospital, Kolkata during 2003-2006 found that cesarean delivery was associated with a 3.01-fold increase in the risk of maternal mortality, compared with vaginal delivery, mostly on account of complications of anesthesia, puerperal infection and venous thromboembolism. The risk of death from postpartum hemorrhage did not differ significantly (Kamilya et al, 2010). However, occasionally studies did not find any significant difference in the level of maternal mortality for cesarean delivery versus normal vaginal delivery. For example; the WHO global survey of randomly selected secondary and tertiary facilities in Asia did not find any significant difference in risk of maternal mortality between cesarean delivery and spontaneous vaginal delivery (Lumbiganon et al, 2010). Emergency C-section is fraught with higher operative risks compared to elective cesarean. A retrospective cohort study of Canadian deliveries during 1991-2005 found that women undergoing emergency cesarean had the highest in-hospital maternal mortality at 9.7 / 100000 deliveries (Liu et al 2007). Another study in RG Kar Hospital, Kolkata, found that the odds of maternal mortality from emergency C-section was 2.8 times that from elective C-section (Kamilya et al, 2010).

A study of British Columbia Perinatal Data for low-risk obstetric population at term between 1994 to 2002, did not find any difference in maternal or neonatal morbidity between elective cesarean and planned vaginal delivery subgroups (Dahlgren et al, 2009). Review of discharge data for deliveries between 1995 to 2005 at university hospital in North Carolina, USA, found that planned cesarean was associated with lower risk of maternal morbidities, but longer hospital stay compared with planned vaginal deliveries (Geller et al, 2010). Another study in Sweden (Larsson et al, 2011) did not find any significant difference in medical complications between planned vaginal delivery and planned CS. General improvements in standard of care may mask risk of maternal morbidity attributable to rising cesareans. A study (Denk and Aveni, 2009) of maternal morbidities in New Jersey hospitals over 1997 to 2005, found parallel reductions in conditional probability of maternal morbidities in cesarean and normal delivery groups. Thus, the risk of maternal morbidity for an average woman decreased during the period. Even then the relative risk of systemic complications remained higher for cesarean group compared with vaginal delivery group. Many other studies have
found higher incidence of maternal morbidity for planned CS group compared with planned vaginal delivery (Villar et al, 2006; Borders 2006; van Dillen et al, 2010). A study of child births during 1988-2001 in Nova Scotia found that puerperal fever was the only maternal morbidity for which the risk was higher for elective cesarean deliveries compared to spontaneous labor. Maternal morbidity was highest for operative vaginal deliveries and emergency cesarean sections (Allen et al, 2003). A review of medical records of child births during 1995 to 2000 in a Women’s hospital in Pittsburgh, USA found that cesareans were associated with increased risk of endometritis (Burrows et al, 2004). A study discharge abstract database in Canada found that the overall maternal morbidity rate was 2.73% for planned cesareans deliveries during 1991-2005 compared with 0.9% in case of planned vaginal deliveries in the same period (Liu et al 2007). Another study deliveries between 1997 to 2001 extracted from the same Canadian dataset found that the risk of postpartum readmission was significantly at 2.7% higher for cesarean deliveries compared with 1.5% for spontaneous vaginal deliveries (Liu et al, 2005). A study (Ophir et al, 2008) from Israel reported that the rates of rehospitalization after cesarean was significantly higher at 1.41%, mainly due to infection, compared with 0.33% in case of spontaneous vaginal deliveries, due to late bleeding. A study (Koroukian, 2004) based on linked Medicaid and Ohio birth certificate data from 1991 to 1996 indicated that the incidence of major puerperal infection, thromboembolic events, anesthetic complications, and obstetrical surgical wound infection was higher among women undergoing a C-section as compared to those with vaginal delivery, even after limiting the analysis to elective cesarean deliveries and uncomplicated vaginal deliveries. On the other hand, women with C-sections were less likely to experience obstetrical trauma, and results on postpartum hemorrhage were inconclusive. Aside from obstetrical trauma, the relative risk of postpartum complications remains significantly higher among women undergoing C-section. Another study (Declercq et al, 2007a) of linked data for deliveries in Massachusetts, USA from 1998-2003 found that the rate of rehospitalization within one month of delivery, was higher at 19.2/1000 for planned primary cesareans compared with 7.5/1000 for planned vaginal births. Adjusting for age, race or ethnicity, and parity, a mother who had a planned primary cesarean was 2.3 times as likely as a woman who had a planned vaginal birth to be rehospitalized in the first month after the birth. Surgical wound complications were the leading cause of readmission in the planned primary cesarean group. Postpartum infections were a major cause of rehospitalization for both groups, although the rate of readmission was almost twice for planned cesarean group compared with the planned vaginal births group. A study (Bodner et al, 2011) of low-obstetric-risk cases in Viena found that the risk of puerperal fever and wound infections was higher in elective cesarean compared with the spontaneous vaginal delivery group. The WHO global survey in Asia found that cesarean delivery was associated with increased risk of admission to ICU and blood transfusion (Lumbiganon et al, 2010).

Some morbidities that are not evident after primary cesareans, may manifest in future pregnancies (Gilliam 2006). A review of medical records of women who underwent two or more elective cesareans between 2000 and 2005 in an Israeli hospital, found that the proportion of women having any major complication was higher in the multiple-cesarean group, 8.7% versus 4.3%, and increased with the delivery index number: 4.3%, 7.5%, and 12.5% for second, third, and fourth or more cesarean delivery, respectively (Nisenblat et al, 2006). The incidence of abnormal placentation, risk of uterine rupture and the need for gravid hysterectomy increases with each cesarean delivery (ACOG, 2013). Clark et al (1985) estimated from delivery records between 1977 and 1983, that the risk of placenta praevia was 0.26% with an unscarred uterus and increased almost linearly with the number of prior cesarean sections to 10% in patients with four or more. The Evidence Report (Viswanathan et
al, 2006) for the US National Institutes of Health (NIH) State-of-the-Science Conference in 2006 identified 13 articles meeting its selection criteria for comparison of maternal morbidities after cesarean and vaginal deliveries. The adjusted odds of placenta praevia among women with one or more prior cesareans ranged from 1.32 to 4.7 compared with those who did not have any prior cesarean delivery. A study of elective cesareans in 19 teaching hospitals during 1999-2002, found that the risk of placenta accreta reached 2% in women having their fourth cesarean delivery and was over 6% in those with 6 or more cesareans (Silver et al, 2006). A study of births at three maternity hospitals in Dublin reports that the overall cesarean rate increased from 6% during 1966-75 to 19% during 1996-2005. However the proportion of peripartum hysterectomies (PH) on women with previous cesarean delivery increased from 27% during 1966-75 to 57% during 1996 to 2005. While uterine rupture as the indication for PH decreased during this period from 40.5% to 9.3%, placenta accreta as the indication increased significantly from 5.4% to 46.5% (Flood et al, 2009). A study (Clayton, 2010, Chapter-4) of low obstetric risk late preterm deliveries (gestational age:34 to 36 weeks) in Florida, USA during 1998 to 2006 estimated the risk of maternal morbidity by mode of delivery, (a) at birth hospitalization, (b) within the neonatal period, and (c) within first year of infancy, while adjusting for covariates. The risk of puerperal infection (attributable risk ratio, ARR =8.09) and unspecified febrile conditions (ARR=3.84) was found to be higher for the cesarean group compared with vaginal deliveries. Cesarean delivery was protective for postpartum hemorrhage at birth hospitalization (ARR=0.75), during neonatal period (ARR=0.63) and in the first year postpartum (ARR=0.69).

Several studies have found that cesarean delivery significantly increases the risk of neonatal mortality and morbidity. A study of US birth cohorts from 1999 to 2002 found that the neonatal mortality rate for elective cesarean deliveries was 1.73/1000 live births compared to 0.72 for planned vaginal deliveries. Thus the risk of neonatal mortality for cesarean deliveries was 2.4 times that of vaginal deliveries (MacDorman et al, 2008b). Elective cesareans may inadvertently cause iatrogenic prematurity, as methods of estimating gestational age are imprecise (Engle 2006; Fuchs & Wapner, 2006). Elective cesareans are associated with increased risk of respiratory morbidity (Kolas et al, 2006; Hansen et al, 2007, 2008). For example; a study (Clayton, 2010, Chapter-3) of low obstetric risk late preterm deliveries (gestational age:34 to 36 weeks) in Florida, USA during 1998 to 2006 found that cesarean deliveries were more likely to report a greater number of neonatal morbidity diagnoses compared to vaginal deliveries. With each additional morbidity diagnosis, the rate among infants via C-section was higher than the rate among infants delivered vaginally. This study estimated the risk of morbidity by mode of delivery, (a) at birth hospitalization, (b) within the neonatal period, and (c) within first year of infancy, while adjusting for covariates. At each of the three time periods, C-section deliveries had significantly higher morbidities; 29%, 26%, and 24% higher risk of morbidity for C-section deliveries compared with infants born vaginally.

A study of three Brazilian birth cohorts of 1982, 1993 and 2004 found that prevalence of premature births had increased along with a rise in CSR and ultrasound scanning (Barros et al, 2005). Review of nine articles for the NIH Evidence Report yielded moderate evidence that the risk of variable respiratory morbidity is higher for all cesarean births compared with vaginal deliveries (Viswanathan et al, 2006). Analysis of Australian National Perinatal Data from 1999 to 2002 showed that, babies born after any operative method of birth were at increased odds of being admitted to neonatal intensive care compared with those born after unassisted vaginal birth at 40 weeks' gestation. For elective cesareans among low-risk primipara, the adjusted odds of NICU admission at 37 weeks’ gestation were 12.08; at 38...
weeks, 7.49; and at 39 weeks, 2.80 (Tracy et al, 2007). A study of births at or after 37 weeks gestation, between 2005 and 2008, in an academic medical centre, compared neonatal morbidity for planned vaginal birth after cesarean (VBAC) group with elective repeat cesarean. The risk of respiratory morbidity requiring NICU care was higher at 9.3% for the intended cesarean group compared to 4.9% in case of the intended VBAC group (Kamath et al, 2009). A study (Wilmink et al 2010) of Netherlander birth cohorts from 2000 to 2006, found that C-sections performed before 39 completed weeks of gestation carried significantly higher risk of neonatal mortality and morbidity. The same study also found that more than 50% of the elective cesareans had been performed at <39 weeks, thus jeopardizing neonatal outcome. A study of repeat C-sections during 1999 to 2002, at 19 academic medical centres in the US, found that 35.8% of elective cesareans were performed before 39 weeks of gestation, the neonatal morbidities in this group were significantly higher (Tita et al, 2009, 2011; Chiossi et al, 2013). A medical audit of elective cesareans in a French region found that only 59.1% of inappropriate (unnecessary) cesareans were performed after 39 weeks gestation compared 80.2% in case of medically appropriate cesareans (Vendittelli et al, 2014).

G. Antecedent or Systemic Drivers of CS Rates:

Health system characteristics appear to have substantive impact on cesarean rates. For example; hospital level CSR in Massachusetts during 2004-06 showed a wide range from 14.0% to 38.3%, and most of the variation could not be explained by obstetric risk or case mix (Cáceres et al, 2013). This would imply that institutional characteristics, professional environment and practices, have a dominant effect on the risk of cesareans. Some of these characteristics might be amenable to control through policy instruments acting at the health system level (Lauer et al, 2010). Health system components that are critical for quality and efficacy of obstetric care are; (1) obstetric volume, (2) ownership profile of hospital stock, (3) teaching activity in the hospital, (4) financing of maternity services, (4) organization of obstetric care, and (5) professional environment shaping obstetricians’ practice styles. In addition, maternal requests for cesarean delivery are also responsible to some extent.

1. Obstetric volume and CSR:

The size and ownership of health facilities providing maternity care appear to affect CSR. Small size maternity units, solo obstetrician clinics and nursing-homes are usually associated with high cesarean rates (Berkowitz et al, 1989; Di et al, 1996; Lin & Xirasagar, 2004; Linton et al, 2005; Coonrod et al, 2008; Kolip, 2012). A study in Utah, found that higher obstetric volume of more than 1500 deliveries / year was associated with lower CSR (Clark et al, 1998). A study in Taiwan (Xirasagar et al, 2006) found that, solo and smaller group obstetrician practices have a significantly increased propensity to intervene with C-section. Compared to 4+ physician groups, the odds of a cesarean was higher at 5.38, and 3.87 for solo and two physician group practices. For women with no obstetric complication, solo practices were 35.5 times more likely and two physician groups were 49.53 times more likely to offer cesarean compared with 4+ physician group practices. The authors conjecture that ‘time pressure and convenience may play a significant role in obstetricians CS decisions, particularly in solo practice settings. Obstetricians in group practice clinics can share after hours call coverage, which increasingly resembles a hospital’s 24-hour, regular delivery service’. A study in Maine (Carpenter et al, 1997), found that dystocia specific CSR was inversely correlated with improved night coverage support, 24-hour blood bank availability,
and more adequate anesthesia services. The high prevalence of solo practices in India may escalate CSR (Arjun, 2008).

Low obstetric volume may affect quality of care. A retrospective cohort study of women admitted to acute care US hospitals for childbirth in 2007 found that the lowest-volume obstetric providers, who perform fewer than seven deliveries per year, have 50% higher odds of complications and a 5% higher adjusted rate of complication than providers who perform more than 90 deliveries annually (Janakiraman et al, 2011). A study of 2006 child births in Iowa showed that women who delivered at very low-volume hospitals had higher complication rates, as do women who deliver at exceedingly high-volume hospitals (Kyser et al, 2012). A study of California births in 2007-08 classified rural hospitals into three categories (R1: 50-599 births/year; R2: 600-1699 births/year; R3: 1700 births/year). The risk of postpartum hemorrhage and birth asphyxia was higher in the lowest-volume rural hospitals (Snowden et al, 2012, 2014). A study (Kozhimannil et al, 2014) assessed the relationship of obstetric volume with selected measures of quality using 2002 and 2010 birth data from rural areas of nine states in the US. Obstetric volume was categorized as low (10-110 births/year), medium (111-240 births/year), medium-high (241-260 births/year) and high (>460 births/year). The odds of labor induction without any medical indication was lower in medium volume hospitals compared with low or high volume hospitals. The odds of NIR cesareans was higher in low & medium volume hospitals compared with medium-high or high volume hospitals. In Norway, low volume maternity units with ≤100 births/year had the highest risk of neonatal mortality. The risk declined with increasing size of maternity unit until 2001-3000 births/year, and then increased for very large maternity hospitals (Dag et al, 1999). However, in Australia, no association was found between low obstetric volume and adverse outcomes for low risk women (Tracy et al, 2006).

2. Teaching hospitals and CSR:

A study of hospital discharge abstracts for deliveries in Illinois hospitals during 1986, found that, controlling for various obstetric risks, cesareans were less likely in teaching hospitals. The adjusted odds of cesareans in teaching hospitals was 0.76 compared to other hospitals (Oleske, et al, 1991). Another study (Rock, 1993) found that by 1983, there was no difference in CSR for teaching and nonteaching hospitals in Illinois. Teaching hospitals in New York State had slightly higher CSR in 1983 than nonteaching hospitals. By 1988, Teaching hospital CSR in both Illinois and New York states was lower than the CSR for nonteaching hospitals. Yet another survey (Sanchez-Ramos et al, 1994) of accredited residency programs in obstetrics and gynecology estimated that in 1990 CSR in American teaching hospitals was lower at 20.3% compared with an overall national rate of 23.5%. Women delivering in teaching hospitals were less likely to have a cesarean section than those delivering in hospitals without residency programs (odds ratio = 0.77, 95% CI 0.77-0.78, p = 0.0001).

An analysis of data for all births in Maryland, USA during 1996, showed that CSR was lower among academic medical centers at 18.4% compared with 21.2% in community hospitals. On the other hand, community teaching hospitals had higher CSR at 24.3% compared with 21.2% in nonteaching community hospitals and 18.4% in academic medical centres. After adjustment for patient case-mix, the adjusted odds ratio (OR) for cesarean birth was 0.66 at academic medical centers and 1.23 at community teaching hospitals compared with community hospitals. Community hospitals in this study were defined as hospitals without a residency program in obstetrics. Community teaching hospitals were defined as hospitals with a residency program in obstetrics and with or without an affiliation to a school.

The Institute of Health Systems , HACA Bhavan, Hyderabad, TS 500004, India. Page 13 of 55
of medicine. Academic medical centers were defined as hospitals with a residency program in obstetrics, and a sole, primary affiliation to a school of medicine (Garcia et al, 2001).

On the other hand, some studies found that delivery at a hospital with obstetric and gynecology residency was associated with an increased risk of cesarean delivery (Linton et al, 2005; Coonrod et al, 2008).

Academic centres and teaching hospitals obviously influence the practice style of specialists trained by them. Hence, specialists trained in liberal cesarean practice environment may liberally intervene with cesarean in their practices. There is some evidence to suggest that physicians carry the imprint of their training beyond the residency period. For example, a study of deliveries in 1986 in New York State found that foreign medical graduates were significantly more likely to deliver by cesarean (Tussing and Wojtowycz 1993). Another study deliveries during 1989 performed by 441 physicians in 36 hospitals in Arizona found that the probability of c-section was associated with particular medical school attended (Burns et al, 1995).

3. Ownership profile of hospital stock and CSR:

Private hospitals tend to do more cesareans compared with nonprofit and public hospitals. A study of 1987-births in Washington state in US (McKenzie & Stephenson, 1993) private for-profit hospitals had significantly higher CSR, even though their obstetric populations were similar to those of nonprofit and public sector hospitals. A study of 1994-births in Belo-Horizonte, the state capital of Minas Gerais in Brazil (Chacham & Perpetuo, 1998), reports that the chances of a cesarean was 20% higher in fully private hospitals compared with public and semiprivate hospitals. Another study of 2000-births in Uberaba town of the same state in Brazil (Murta et al, 2006), found that the CSR in private hospitals was 81.2% compared with 28% in an university hospital in the same city. In addition, the odds of low birth weight babies was higher (OR:2.33, 95%CI:1.19,4.55) compared with cesarean babies born in the university hospital. A study of CSR in Latin American countries during 1995-1997, reported that CSR was much higher in private hospitals in all six countries (Argentina, Brazil, Chile, Colombia & Mexico) for which CSR data by hospital ownership was available (Belizan et al, 1999, Table-1). Another study (Potter et al 2001, 2008) in Brazil recruited a group of 1612 pregnant women in four cities between April 1998 and June 1999. Each woman was interviewed twice before the due date and once after the delivery. During the prepartum interviews women were asked about their preferred mode of delivery and in the postpartum interview about their satisfaction with the actual mode of delivery. A large proportion of women consistently declared, in first and second interviews, preference for a vaginal delivery. There was no difference in preference for cesarean between women scheduled for delivery in public hospitals and those scheduled to deliver in private hospitals. However, a much larger proportion of women delivering in the private sector subsequently had a cesarean section. For example; among the primiparous women intending vaginal delivery in private hospitals, the CSR was 66% compared to 30% in case of public hospitals. Difference in the timing of cesarean decision by hospital ownership is noteworthy. A much higher proportion (64%) of cesarean deliveries in private hospitals were decided in advance before admission compared to 23% for cesareans in public hospitals. Many cesareans were scheduled for an "unjustified" medical reason, especially among women who, during pregnancy, had declared a preference for a vaginal delivery. Among 96 women in this latter group, the reason reported for the procedure was unjustified in 33 cases. Doctors frequently persuaded their patients to accept a scheduled cesarean section for conditions that either did not exist or did not justify this procedure. The Birth in
Brazil study (Domingues et al, 2014) conducted during 2011-12 observed that, to some extent, primiparous women with a preference for cesarean section self-select into the private sector. About 27% of women resorting to private sector had initially preferred cesarean section compared to 5% in case of those resorting to public sector. In addition a greater number of women resorting to private sector tend to convert in favour of cesarean delivery. The decision for cesarean among women resorting to private sector, almost doubled during the course of engagement with the private sector. Eventually, the proportion actually undergoing cesarean delivery in the private sector was about three times the initial preference. In case of multiparous women, about 59% of women resorting to private sector had an initial preference for cesarean delivery. Among these women there was a 30% increase in the cesarean decision by late pregnancy, resulting in about 84% actually delivering by cesarean. On the other hand, changes in preference for cesarean was minimal among women resorting to the public sector.

A study of births during 1985 to 1987, in Lazio region of Italy, found that the adjusted odds of cesarean in semiprivate and private hospitals were 1.35 and 1.64 respectively, compared with public hospitals (Bertollini et al, 1992). A study of deliveries in January 2002 at two public hospitals and one private hospital in Athens, Greece found that the CS rate in the private hospital was 53% compared with 41.6% in the two public hospitals (Mossialos et al, 2005). Analysis of self-reported data on last delivery experience by females in Italian households shows that women admitted to a private hospital are more likely to receive a scheduled CS at any risk profile (Fabri and Monfardini, 2008). A population-based, retrospective cohort study of child births during 1998 to 2008, in Australia indicated that increases in elective cesareans for private patients in private hospitals had driven the increase in CSR for nulliparous women since 1996. The average annual percentage point change in this study of elective CSR was 5.2% for private patients delivering in private hospitals, four times higher in comparison to public patients in public hospitals (Einarsdottir et al, 2013). Another Australian study (Shorten & Shorten, 2004) compared time trend of obstetric outcomes in private and public hospitals in New South Wales during 1997-2001. Primary elective CSR in private hospitals increased from 6.6% in 1997 to 10.6% in 2001 compared with 2.6% to 3.3% in public hospitals, during the same period. For the year 2000, overall elective CSR for privately insured patients in private hospitals was 15.2%, compared with CSR of 10.1% for privately insured patients delivering in public hospitals, and CSR of 6.5% for publicly funded patients in public hospitals. Thus private ownership of hospitals as well as private health insurance contribute to higher CSR.

A study (Neuman et al, 2014) of selected clusters in Bangladesh, India and Nepal, lend support to the hypothesis that increased CSR in these South Asian countries may be driven in part by the private sector. They also suggest that preferences for cesarean delivery may be higher among highly educated women, and that individual-level and provider-level factors interact in driving cesarean rates higher. In Taiwan, clinics, often owned by obstetricians tend to provide more cesareans, compared with nonprofit hospitals (Lo, 2008). Analysis of the Indian National Family Health Survey (NFHS) 1992-93 data showed that the proportion of cesarean deliveries was higher in private compared with public sector institutions in several states, namely; Andhra Pradesh, Bihar, Goa, Karnataka, Kerala, Maharashtra and West Bengal (Mishra and Ramanathan, 2002). Results from NFHS-3 (2005-06) shows that the overall CSR in private health facilities was 29.9% compared with 18.1% for public healthcare facilities. The private public divergence in CSR was most visible in high CSR States. For example; Andhra Pradesh: 25.3% in public vs 42.8% CSR in private facilities. In West Bengal, CSR in public hospitals 20.8% compared with 50.3% in private
hospitals. In Goa, CSR in public hospitals was 18.1% compared with 36.6% in private hospitals (Ghosh, 2010). In Chennai, around 1998, total CSR in public, charitable, and private hospitals was 20%, 38% and 47%, respectively. After adjusting for parity, age at delivery and educational status, the odds of a primary cesarean section delivery in private sector was 2.4 times higher in comparison with the public sector (Sreevidya and Sathiyasekaran, 2003). Analysis of the 2008 district level household and facility survey (DLHS) data of Indian states with more than 10% CSR, shows that the odds of C-section was higher in private hospitals (Tiziana, 2014). This study actually estimated the odds of cesarean in public and other hospitals with reference to private hospitals. Public hospitals had a protective effect with the odds of cesarean in about one third to two thirds of that in private hospitals. The public private differential was higher in case of Andhra Pradesh and Tamil Nadu, where the odds of cesarean in public hospitals was one third that of private hospitals.

4. Effect of generous health insurance and physician compensation practices on CSR:

   Economic concerns do have some impact on doctors and hospitals, which in turn contributes to rising CSR (Keeler and Brodie, 1993; Gruber & Owings, 1996). Generous sources of payment has been associated with increased utilization of C-sections. A study of California deliveries in 1986 found that the CSR was highest (35%) for women covered by private insurance, intermediate (27%) for low income women covered by state Medicaid, and lowest (15.6%) for indigent women (Stafford, 1990a). Another study (Huesch, 2011) of births in New Jersey during 2004 to 2007, found that elective primary CSR were low for self-paying (10.8%) and Medicaid recipients (11.5%). On the other hand, elective primary CSR was highest at 16% for privately insured women. A study in Minhang district of Shanghai, China, found that the CSR was highest at 45% among women with government health insurance (most generous), followed by 40% for women with labor insurance and about 10% for women had partial or cooperative insurance (Cai et al, 1998). In Taiwan, the CSR was highest at 49% for women having most generous health insurance, compared to 29% for those with less generous insurance, 13.5% for self-payers, and 8.3% for those under government employees insurance (Tsai and Hu, 2002). Elective CSR among women with private coverage in Ireland delivering between 2005 and 2010 was 17.8%, almost twice the rate of 9.4% for other women (Lutomski et al, 2014). Among women who delivered in a private hospital in Athens, those with private insurance were 7.73 times more likely to undergo cesarean delivery than those who paid directly (Mossialos et al, 2005). A study (Cavaliere et al, 2014) in Italy suggest that providers respond strategically with more cesarean deliveries in regions with higher fee for C-section. The effect of tariff differential was higher in for-profit private hospitals compared to trust and public hospitals. The study in Athens, Greece found that having private health insurance was the strongest predictor of CS delivery in the private hospital (Mossialos et al, 2005). Although cesarean section rate differences in public and private hospitals in Brazil are well known, not all public hospital deliveries are publicly financed; likewise, some private hospital births are paid with public funds. Analysis of the 1998, 2003, and 2008 rounds of a nationally representative household survey (PNAD) in Brazil found that women who delivered publicly funded births in either public or private hospitals had lower cesarean section rates than those who delivered privately financed deliveries in public or private hospitals (Hopkins et al, 2014).

Physician compensation practices appear to influence the cesarean decisions. Fee differentials between cesareans and normal deliveries and fee-for-service physician payments have been found to be associated with higher CSR. A review of deliveries in four Brooklyn (New York) hospitals between 1977 and 1982, found that private physicians performed significantly more cesareans than hospital house officers and attending physicians (de Regt et
al, 1986). A study of child births during 1988-92, covered by state Medicaid programs in US found that larger fee differentials between cesarean and normal childbirth lead to higher CSR (Gruber et al, 1999). A subsequent analysis of the same data set including several child births that had been inadvertently excluded, confirmed the positive relationship of fee differential with CSR, although the estimated effect size was one fourth of the original estimate (Grant, 2009). A similar study (Alexander, 2013) of Medicaid reimbursement data for 1990 to 2008 found that increasing relative reimbursement rates cause fee-for-service doctors to shift patients into C-sections, while salaried doctors are unresponsive. This study found that the increase in C-sections by fee-for-service doctors was associated with lower infant mortality. However this differential in infant survival can not be attributed to the mode of delivery. Many factors operate during the course of one year, affecting infant mortality. Rather, the socioeconomic status of mothers may simultaneously drive resort to fee-for-service physicians and lower infant mortality. This study did not have access to neonatal mortality/morbidity data, which would have been the appropriate outcome variables to test the hypothesis of better neonatal outcomes, associated with higher CSR. In fact, several studies have shown that neonatal survival and health benefits of cesareans taper off as the CSR increases between 10 to 15%, and are nonexistent thereafter (ibid. ‘Limits to health benefits of cesarean section’).

5. Organization of Obstetric Care and C-sections:

Various organizations of obstetric care are feasible. Midwives, general practice physicians, and specialist obstetricians all provide obstetric care through a variety of institutional arrangements, ranging from solo community practices delivering home birthing services to hospital based obstetric care. In midwife-led continuity models of care, the midwife is the woman’s lead professional, but one or more consultations with medical staff are often part of routine practice. Freestanding midwifery units do not have access to obstetrician services within the same healthcare facility. Alongside midwifery units are midwife lead units located within hospitals having parallel obstetrician lead units. Both freestanding and alongside midwifery units are based in healthcare institutions. Other models of obstetric care include; (a) physician-led, (b) physician-provided obstetric units, and (c) shared models of care. In physician-led models, admitting physician/obstetrician is the lead professional, while nurses and midwives provide intrapartum and in-hospital postpartum care under medical supervision. In physician-provided models, the admitting physician/obstetrician provides majority of care. In shared care models, the lead professional changes depending on the stage of pregnancy (antepartum, intrapartum or postpartum) and whether the care is given in the hospital, birth centre or in community settings.

It has been observed that, for low obstetric risk women, there is no difference in risk of perinatal and maternal outcomes between midwifery and obstetric units (Birthplace in England Collaborative Group, 2011; Overgaard et al, 2011 & 2012). Rather, the Midwifery care has been found to be associated with lower incidence of cesareans compared to obstetric care by physicians (Butler et al, 1993; Hueston & Rudy, 1993; Rosenblatt et al, 1997; Janssen et al, 2007). A randomised trial in Ireland (Begley et al, 2011) found that Midwife-led care, in an alongside midwifery unit, is as safe as obstetrician-led care and is associated with less intervention during labour and delivery. Physician-midwife joint practices have been found to have significantly lower CSR compared with physician-only practices (Schimmel et al, 1994, 1997). For women with similar demographics and medical history, midwife-staffed maternity hospitals with physician backup tend to have lower CSR compared with hospitals staffed by obstetricians (Baruffi et al, 1984, 1990).
The US Agency for Healthcare Research and Quality (AHRQ) comparative effectiveness review (CER) on strategies to reduce cesarean birth in low-risk women (Hartmann et al, 2012), included five trials comparing midwife-led continuity of care models with standard hospital care models. The review concluded that most of these studies did not provide sufficient evidence that midwife-led continuity of care models contribute to reduction in cesarean rates. One study (Homer et al, 2001) demonstrated a modest 4.5% reduction cesarean births. On the other hand, the Cochrane collaboration review (Sandall et al, 2013) synthesized results from these five and another eight trials to compare midwife-led continuity models with other models of obstetric care. All 13 trials had taken place outside the US and involved low or mixed risk pregnancies. All trials included licensed midwives, and none included lay or traditional dais. No trial included models of care that offered out of hospital birth. Women randomized to midwife-led continuity models of care were on average more likely (RR=1.05) to experience a spontaneous vaginal birth. The relative risk of cesareans was lower at 0.93, but statistically not significant (95% CI: 0.84 to 1.02). The risk of regional analgesia, instrumental vaginal birth, and preterm birth were significantly lower among women assigned to the midwife-led continuity model.

The Advanced Practice Nurses (APN) systematic review (Johantgen, et al, 2012) summarized 21 studies in US from 1990 to 2008, which compared process of care and birth-outcomes by certified nurse midwives (CNMs) and physicians. The review found moderate to high evidence that CNMs rely less on technology during labor and delivery than do physicians and achieve similar or better outcomes. The majority of studies reported differences between CNMs and physicians that favored CNMs. CNMs tend to use fewer pharmacological interventions, fewer cesareans, fewer operative vaginal deliveries and more vaginal births after cesareans. A meta-analysis (Brown & Grimes, 1995) of 15 somewhat similar studies from US before 1990 had found that CNMs used less technology and analgesia than did physicians in intrapartum care, while neonatal outcomes were equivalent to those of physicians.

Prior to 1992, deliveries in the 450 bedded Lancaster General Hospital, in Pennsylvania, were supervised by obstetricians. In 1992, the hospital changed its policy, so that deliveries were supervised by family practice residents only. Cesarean rates declined from 16.7% between 1986-91 to 11.1% between 1992 to 1995. he observed decline in the cesarean rate could not be accounted for by any change in patient demographics or secular trends in cesarean delivery rates (Coco et al, 2000).

6. Professional Environment, Practice Style And C-sections:

Many of the medical indications for cesarean are relative in nature involving subjective assessment by obstetricians. This allows for a wide range of practice variations in maternity care. Increasing CSR has triggered several opinions and debates among obstetricians on the appropriateness of resorting to and/or complying with maternal requests, in the absence of clear medical indication for cesareans (Steer 1998, BMJ Debate, 1998; Upadhyay & Buist, 1999; Sachs et al, 1999; Bewley & Cockburn, 2002; Minkoff & Chervenak, 2003; Minkoff et al, 2004; Singer & Hannah 2004; Anderson et al 2004; Lippman 2004; Ecker & Frigoletto 2007; Tore et al, 2008; Blanchette, 2011; Duperron and Demers 2011; Ecker 2013). Overall, two schools of obstetrics practice have emerged. While one school prefers liberal cesarean policies, the other favours natural birth and strict compliance with medical indications for cesareans. Liberal ‘operatives’ rationale for no-indicated-risk cesareans would include; (a) an elective cesarean eliminates the rare chance of emergency cesarean with it’s attendant risks to mother and baby, (b) a number of elective
cesareans are needed to avoid risks that are no longer acceptable in the present world, and (c) respect for maternal autonomy. In addition they argue that, with advances in anesthesia, preoperative antibiotics, and surgical technique, the absolute risk of procedure related mortality and morbidity has comedown considerably. On the other hand professional and societal risk aversion has increased. Obstetricians in the strict medical indication school argue that NIR cesareans still carry comparatively higher risks of maternal & neonatal mortality/morbidity. For example, Bewley & Cockburn (2002) pointed out that the real risk-benefit calculation is between labour (which might end in cesarean section) and elective cesarean section, and thus becomes critically dependent on the emergency cesarean section rate. The only hard data on this comes from a meta-analysis of all randomized breech trials which found an increased risk of maternal death or severe early morbidity, and this despite a high emergency cesarean section rate of 45% in the labour (control) arm. This increase of nearly 30% is likely to be an underestimate for cephalic presentation with its higher vaginal delivery rate. A laissez faire attitude to elective cesarean section sends a mistaken signal to the public and professionals alike that all cesarean sections are safe and the request debate can be misinterpreted as such. Ethical principle of beneficence favors vaginal delivery for low obstetric risk groups. Hence, arguments of patient autonomy ought to be moderated by ethical considerations beneficence (Minkoff et al, 2004). Hence, natural birth should be the default mode of delivery and cesarean would be justified only if medically indicated. Individual obstetricians are spread along a broad continuum of practice styles between the liberal cesarean policy and natural birth schools. There appears to have been a lowering in the overall threshold concerning the decision to carry out a cesarean section rather than changes in risk profile or obstetric management (Leitch and Walker, 1999).

Professional attitude is a two way process, affecting and affected by the cesarean decisions. Several studies have reported variations in CSR among obstetricians and maternity units, that cannot be explained by differences in obstetric risk profile, source of payment, or medicolegal environment. For example, a study (Goyert et al, 1989) of child births over a 12 month period during 1986-87 in a community hospital serving very-low-risk private patients with insurance in an affluent suburb of Detroit found that individual practitioner’s primary cesarean rate ranged from 9.6% to 31.8% (average 17.2%). This study indicates that next to nulliparity, identity of the physician explained a large part of the variation in CSR. The observed variation in CSR among physicians was not attributable to practice setting, the patient population, the degree of obstetric risk, or the physician’s recent medicolegal experience. A study (Sandmire & DeMott, 1990) of deliveries from 1986 to 1988, at two community hospitals in US, reports that individual physician cesarean rates ranged from 5.6% to 19.7%. CSR for physician groups ranged from 9.8% to 18%. The variances in CSR among individual and groups of physicians were not attributable to obstetric risk factors, maternal socioeconomic status, or duration of the physician's practice. Higher cesarean rates did not result in better neonatal outcome. Individual physician practice style was the only apparent determinant of cesarean rates for the 11 obstetricians. Analysis (Kozhimannil et al, 2013) of the 2009 US Inpatient Sample showed that the overall CSR at 1050 hospitals in 44 states ranged 7.1% to 69.9%, a 10 fold difference between the lower and upper levels. The CSR among lower-risk mothers at each hospital ranged from 2.4% to 36.4%, a 15 fold difference. The larger range for lower-risk cesareans suggests the effect of differences in practice styles, hospital specific professional environment, and organizational settings. A comparison of two groups of obstetricians in an institution showed that the cesareanists (individual CS rate >15%) differed from others in their practice styles. The cesareanists differed by way of lower thresholds in diagnosis of fetal distress, cephalopelvic disproportion, and repeat cesareans (Lagrew & Adashek, 1998). A medical audit of 192
elective cesareans performed during 2011 in a French region found that 22.4% of cesareans were inappropriate and contributed by provider (obstetrician) preference. Principal reasons cited in these cases by the obstetricians were presumed cephalo-pelvic disproportion, and a previous cesarean. Another 12.0% were inappropriate on account of maternal preference (Vendittelli et al, 2014).

Several studies find that a lot of regional differences in CSR cannot be explained by differences in risk profile and are most likely a result of difference in practice style. For example; the CSR for births from 2004-06 was 30 % in former West-German regions and 22% in former East-German regions. Proportions of pregnancies with strong and moderate indications for cesarean were similar in both regions. For strong indications the probability of cesarean were similar in both regions. But the probability of cesarean for moderate indications was substantially higher in West-German regions (Rafael et al, 2013). Another study (Kolip, 2012) in Germany observed that, most of the regional variations in the CS rate are attributable to variance in risk assessments prevalent among obstetricians in respective regions. Cesarean sections are more frequently planned by office-based practices than deliveries in main hospital wards. A study of births during 2004-07, in British Columbia reports that obstetric risk adjusted CSR ranged from 14.7% to 27.6%. Dystocia was the most common indication, accounting for 30% of all cesarean deliveries and varied more than five fold across regions. This variation likely reflects differences in practitioners' approaches to medical decision-making (Hanley et al, 2010). The cesarean rates in 2008, of 146 NHS trusts, ranged from 13.6% to 31.9%. Controlling for maternal characteristics and clinical risk factors did not greatly reduce the variation with adjusted rates ranging from 14.9% to 32.1% (Bragg et al, 2010). Analysis of Florida hospital discharge data on deliveries during 2000-01 showed that small area variations in practice style are contributed by (a) individual-level variations among physicians, and (b) inter hospital variations. The inter hospital variations are a result of substantial matching effect such that hospitals attract doctors with complementary practice styles, and to some extent quick learning of the institutional practice style by newly recruited doctors (Dranove et al, 2006).

Professional practice environment, appear to influence compliance by obstetricians with maternal request for C-section. For example, a study (Habiba et al, 2006) of obstetrician attitudes in eight European countries found that compliance with a hypothetical woman's request for elective cesarean section simply because it was 'her choice' was lowest in Spain (15%), France (19%) & Netherlands (22%); highest in Germany (75%) & UK (79%) and intermediate in Italy, Sweden and Luxembourg. In UK, the proportion of cesareans on maternal request, at the maternity unit level, varied from 2% to 27% (Thomas & Paranjothy, 2001). In Maine, USA, 84.5% obstetricians responding to a questionnaire, were willing to perform a cesarean on maternal request, although only 21.1% would prefer it for themselves or their partners (Wax et al, 2005). On the other hand, most practitioners in Oregon, USA would not perform cesarean without a clear medical indication. Male physicians were more likely to agree to a patient's request for cesarean delivery than female physicians (Ghetti et al, 2004). A study in Israel found that about 50% obstetricians will agree to maternal request for cesarean delivery, even though only 9% of the respondents said they would prefer cesarean delivery for themselves (if female) or for their partners (Gonen et al, 2002). Another study in Australia found that about 77% obstetricians will agree to a woman’s request for elective cesarean in the absence of any indications (Robson et al, 2009).

A qualitative study (Hopkins, 2000) of the cesarean decision process in Brazil found that majority of first-time mothers in public and private hospitals wanted to deliver vaginally. Among primiparous women who delivered by cesarean, about 75% said they had wanted a
vaginal delivery. Some doctors, in private hospitals, may use a pro-vaginal birth rhetoric but do not wait for labor to progress naturally. Participant observations and in-depth interviews of postpartum-women showed that obstetricians can portray the birthing situation in such a way that women feel relieved when a cesarean is considered. Doctors often frame their decisions to perform cesareans in terms of women’s demands. This would explain why 60% of women who had originally intended vaginal delivery, but ended up with cesarean, expressed satisfaction with the later, in the Brazilian study reported by Potter et al (2001, 2008).

7. Physician convenience & provider induced demand:

The term "obstetrician" is derived from the Latin word obstetricius meaning one who stands by the woman giving birth. However, the contemporary and dominant role perception of obstetricians is that of a professional with operative delivery skills. Cesareans may be an easy way out for physicians faced with longer waits and unpredictability of time to vaginal delivery. Professional authority and information asymmetry between physicians and expectant mothers gives rise to the potential for physicians to shift the mode of delivery decision according to their convenience. Gans and Leigh (2012) sought to test the relative bargaining power of physicians and expectant mothers over birth timing. They identified days of the year for which patient preference might be strong for nonmedical reasons. For example, avoiding child births on February 29 and April 1st, considered as inauspicious dates of birth. Then they identified situations where patient preferences for avoiding inauspicious dates and physician preferences for avoiding weekends coincide. When these inauspicious dates occur on a Monday or Friday, patients may have a stronger preference for a weekend birth. Using Australian birth data from 1975 to 2005, the authors estimate that, when the preferences of doctors conflict with the preference of patients, the issue is resolved in favor of the doctor approximately three-quarters of the time.

Evidence of widespread shifting of deliveries away from Sundays and holidays to weekdays, particularly in institutional settings where physicians have dominant role, has been reported from many areas. For example; Rindfuss et al (1979) found that substantially fewer births occur on Sundays and holidays in US and Canada. The shifting of births away from Sundays and holidays was attributable to induction of labor, after controlling for socioeconomic status and other risk factors. A study in Germany (Lerchl,2005) compared distribution of births by day of week in a large state for 1988-2003 and historical control for 1900-1950. Births during 1900-1950 were distributed evenly on all days of the week. For the recent period, numbers of births on weekends, especially on Sundays, were decreasing, while births on weekdays were more frequent. The increasing avoidance of births during weekends appeared to have been contributed by elective labor induction on weekdays. A follow up study by the same author (Lerchl, 2008), showed that weekend birth avoidance rates for 2003 ranged from 11.6% to 30.5% in various states of Germany. Correlation of weekend birth avoidance rates with state wise cesarean rates was statistically significant. Another study of births in Switzerland from 1969 to 2005 showed that births on weekends were decreasing as a consequence of rising cesareans and induction of labor. Both primary and secondary caesareans were significantly correlated with weekend birth avoidance rates (Lerchl and Reinhard, 2008). A study (Morita et al, 2002) of Japanese births in 1998, found that, in maternity homes staffed by midwives, there was no difference in average number of births on weekdays and weekends or national holidays. But in case of hospitals (20+ beds), daily average births, was significantly lower on weekends and national holidays. The results in clinics, with no bed or less than 20 beds, were similar to those in hospitals except on Saturdays. The difference in the daily average of live births between Saturdays and weekdays
was smaller in clinics than that found in hospitals. Obstetric intervention like cesareans and induction of labor facilitated in the timing of delivery and contributed to avoidance of births on weekends and national holidays.

Brown (1996) estimated that, after controlling for relevant clinical variables, time-dependent dummy variables related to physician leisure are significant predictors of both total and unplanned c-sections. Gomes et al, (1999) report that physicians in southeast Brazilian town, appeared to proactively schedule cesarean deliveries to minimize their unsocial hours, while citing a biological indication for purposes of medical record. Chart review of cesareans during 1996 in four Colombian hospitals found that primary cesareans were more frequent on Mondays (18%) and Fridays (24.4%) than on other days of the week. Among patients whose cesarean was found justified by the chart review, there was no difference in the distribution among six working days of the week. But unjustified cesareans were more frequently performed on Fridays than on other days of the week (Gomez and Carrasquilla, 1999). Mossialos et al (2005), based on their study of three hospitals in Athens, found support to the hypothesis that physicians are motivated to perform CS for convenience. A study of deliveries in 1986 in New York City found that, while additional fee income from C-sections was not a significant motivator, occasionally physicians may perform C-sections to manage their time (Tussing & Wojtowycz, 1992). A similar study (Burns et al, 1995) of deliveries performed by 441 physicians in 36 hospitals in Arizona, US during 1989 showed that the log odds of performing a c-section increase with the physician's rate of c-sections in the prior year, delivery on a Friday, and delivery between 6 AM and 6 PM, and decrease with the concentration of the physician's hospital practice. These findings suggest that some physicians have a greater tendency to advise cesareans and to some extent scheduling convenience is a likely motivator. A regional study from Italy reported that CS rates were consistently lower on Sundays in all types of hospitals (15.7%) compared with weekdays (24.1%). Sunday CSR was lowest in private (8.8%), intermediate in semiprivate (10%) and highest in public (12.2%) hospitals (Bertollini et al, 1992). Spetz et al (2001) examined the likelihood of cesarean at particular times of day, in California, controlling for maternal characteristics and mother’s insurance coverage. For mothers covered by a group-model HMO, the probability of cesarean during the course of a day was more stable compared with mothers covered by all other insurance plans. Group-model HMOs are organised such that physicians do not have a convenience incentive linked to scheduling of cesareans at different times of a day. Hence, the authors concluded that physician convenience was indeed a factor contributing to performance and scheduling of cesareans.

Fraser et al (1987) sought to test the hypothesis that convenience for the physician plays a role in the rate of cesarean section performed because of dystocia. Three time periods were defined (night, 12 midnight to 7:59 AM; day, 8 AM to 5:59 PM; evening, 6 PM to 11:59 PM) based on the work commitments and daily routines of the obstetrician. Rates of cesarean section for dystocia were determined for each of the three time periods. An evening peak in the cesarean section rate is partially but not entirely explained by an evening increase in the proportion of patients in prolonged labor. When patients were stratified according to labor duration (less than 12, 12 to 15, and greater than 16 hours), a persistent evening excess in the rate of cesarean section for dystocia was observed for patients whose labor duration was less than 16 hours. Although this is interpreted as being consistent with the hypothesis of physician convenience, the magnitude of this effect on the overall rate of cesarean section for dystocia is small.

The hour of delivery is determined by the time the process of labor begins, a phenomenon that is supposed to be distributed randomly along the day. That would imply
uniform distribution of obstetric procedures during the day. In practice, however, circadian rhythms of operative deliveries are observed in hospitals, all of which can not be attributed to physician convenience alone. Other contributing factors include, availability of full complement of staff in morning shifts, differences in experience of staff available in night shifts, health worker fatigue, etceteras (Goldstick et al, 2003). Lefevre (2014) argues that part of the circadian rhythm can be attributed to genuine scheduling effect, and the other to physician convenience. The fact that C-sections are less likely on leisure than on non-leisure periods is necessary but not sufficient to assert that physicians induce demand for a convenience motive. She used a commercial claims and clinical encounters database in the US for years 2008 to 2011 and differences in probability of cesarean on a long weekend Monday compared with other week days, to identify the relative contribution of scheduling effect and physician induced demand. The database contained inpatient and outpatient claims of almost 40 million employees and their dependents covered under a variety of health plans. She found evidence of a statistically significant but small convenience effect of 0.5 percentage point increased probability of cesarean section on weekdays around long weekend Mondays, in case of primary cesarean sections. The estimated convenience effect was higher in case of repeat cesareans. She concluded that, “the higher probability of C-section in non-leisure periods is due to rescheduling. Having a preference for working on weekdays doctors are able to advance or postpone medically justified C-sections. However, they do not increase the number of C-sections they perform in order to advance the date of delivery.” However, the dataset used by her concerns patients covered by more generous private insurance, a subgroup known to have higher CSR. The practice environment & styles would have settled indications for cesareans in this subgroup. The need for physicians to further induce cesareans for their convenience would be limited. Given this inherent dataset bias, it is noteworthy that she found some statistically significant evidence of physician convenience.

8. Fear of malpractice litigation and CS Rates:

A study (Yang et al, 2009) of state wise childbirth data in US from 1991-2003, found that higher malpractice premiums for obstetricians were associated with greater use of cesareans. It was estimated that a $10000 decrease in malpractice premiums would result in 0.16 percentage point reduction in primary CSR. Cap on non economic damages imposed by some states was associated with reduced CSR. A cap of $250000 or less on non economic damages, was associated with 0.48 percentage point reduction in primary CSR. Pretrial screening panels were associated with lower primary and total CSR. Zwcker et al (2011) estimated the effect of medical liability insurance premium paid by obstetricians on CSR using a sample of 2006 inpatient data in US. Average state malpractice premium of over $100,000 was associated with higher incidences of total cesarean deliveries (OR 1.17, 95% CI: 1.02, 1.35) compared with when the average state malpractice premium was less than $50,000. A study (Murthy et al, 2007) of county wise childbirth data from Illinois state in US for the period 1998 to 2003, showed that for $10000 increase in malpractice insurance premiums CSR increased by 0.15%.

9. Maternal Request for Cesarean Delivery:

Many obstetricians conjecture that increasing maternal requests may be driving the rapid rise in cesareans (Ash & Okoh, 1997; Marx et al, 2001). Mothers may be open to the idea of cesarean delivery for apprehensions & fear of vaginal delivery (tocophobia), perceived benefits such as protection of pelvic floor, lowered risk of incontinence, preservation of sexual function and their scheduling preferences.
The conjecture that maternal requests are behind the rising cesareans gained ground with the observation that CSR is often positively correlated with socioeconomic status. A study of 1982-83 births in Los Angeles county, California reported that primary CSR among the highest-income group was 24% compared with 13% for the lowest-income group. Controlling for maternal age and parity, socioeconomic status had an independent effect on the rate of primary CS (Gould, 1989). In Brazil, C-sections are much more common among wealthy and educated women (Chacham & Perpetuo, 1998; Behague et al, 2002; Barros et al, 2011). Women with more socioeconomic power in the home tend to have more cesareans. On the other hand, socioeconomically poor women, may seek C-sections because they consider it good quality care and to beat poor quality of regular maternity services. The underlying fear of vaginal birth may be aggravated by realities of class based differences in the quality of care. Poor women may adopt various medicalised practices to justify the need for medical intervention during birth (Behague et al, 2002). A study of maternity discharge data from three periods in Scotland, shows that, in 1980-81 & 1990-91 emergency cesareans were more likely among women at the bottom of the social class residing in most deprived areas compared to the most affluent upper class. By 1999-00, the difference in emergency CSR by area deprivation and social class had disappeared. The temporal change for elective cesareans was different. In 1980-81, women from most deprived areas were more likely to have an elective CS. But there was no such association by 1990-91. In 1999-00, the odds of elective CS was higher among women from higher socioeconomic status and/or residing in better areas. Socioeconomic status and area deprivation had independent effects on elective and emergency CSR (Fairley et al, 2011). A study (Leeb, 2005) of Canadian Child births during 2002-03 found that after adjustment for age of mother, women living highest-income areas were significantly less likely to have cesarean deliveries (23.3%) than those in the lowest-income areas (24.9%). Univariate analysis of the US birth data for 2006 showed that CSR increase as educational level of the mother increases. However, the relationship reversed after controlling for maternal and pregnancy characteristics. In the multivariate model, level of education was negatively related to primary cesarean delivery. Combining the main effects of race-ethnicity and education with interaction effects revealed that each additional level of education reduces the odds of a primary cesarean by 0.97 times for non-Hispanic black women and Asian women, 0.94 times for Native American women, and 0.89 time for non-Hispanic white women. In case of Latinas, each increasing level of education increases the odds of a primary cesarean by 1.03 times. Education appears to have opposite effect for Hispanic/Latina mothers than for other soical-ethnic groups, mainly because latinas with less than a high school education have lower CSR than other women with same level of education (Roth and Henley, 2012). These studies show that the correlation of socioeconomic status with c-section is contextual, and can go in either direction. Contemporary beliefs about the desirability of cesareans prevalent among the educated classes and ethnic groups appear to influence, decisions regarding mode of delivery. The complex dynamics of socioeconomic status, racial-ethnic world views, and medical technology are not fully mapped out. However, one can look at empirical data about the actual prevalence of cesarean sections without any medical indication, and expressed maternal preferences for various modes of delivery, to assess the contribution of maternal request to the overall increases in CSR.

Cesareans on maternal requests are by definition the ones where there is no medical indication and the mother has requested for the same. Other factors may also contribute to the cesarean decision in the absence of medical indication. Hence, prevalence of no indicated risk (NIR) cesareans gives an upper boundary estimate of maternal requests. A study of the US birth data for 1991 to 2001 showed that the primary cesarean rate for mothers at NIR rose
from 3.1% in 1991 to 5.5% in 2001 and 6.9% by 2003 (Declercq et al, 2005; Menacker et al, 2006). All of the NIR cesareans can not be equated with mother’s request. The proportion of elective primary cesarean delivery on maternal request (CDMR), in a major academic hospital in US, increased from 1.4% in 2003 to 7.0% in 2009 (Barber, et al 2011). About 7.6% of cesareans in Norway during 1998-99 were on maternal request (Kolås et al, 2003). In 2000 doctors in UK reported that, about 7% of cesareans had been performed on maternal request (Thomas & Paranjothy, 2001). Taiwan’s National Health Insurance (NHI) assigns separate codes medically unindicated C-sections. Between 1996 to 2004, the CDMR in was 1.82%, which was 5.87% of all cesareans in Taiwan during this period (Ma et al, 2010). A medical audit of 192 elective cesareans performed during 2011 in a French region found that 12.0% of cesareans were inappropriate on account of maternal preference, while another 22.4% were contributed by provider preference (Vendittelli et al, 2014).

Several studies have directly asked pregnant women about their preference for the mode of delivery. A meta-analysis (Mazzoni et al, 2011) of such studies estimates that overall about 16% women request for cesarean delivery. Maternal preference for cesarean is highest in Latin America (24.4%), followed by US & Canada (16.8%). The estimated preference for CS in other regions, namely Asia, Australia, Europe and Africa range from 11 to 14%. Maternal preference for CS is higher at 22% in middle-income and compared to 12% in high-income countries. Women with previous cesarean prefer CS much more (29.4%) compared to 10% for no previous CS. These synthetic estimates are based on studies that included women whose preference might have been rooted in medical indications and those with no indicated risk. Maternal request for cesarean (CDMR) is usually defined to mean the subset of maternal preferences where there is no medical indication for cesarean. The “Listening to Mothers” survey of women’s childbearing experiences in US reported that the proportion of women explicitly requesting for cesarean was insignificant at less than 0.5%. However, compared to mothers with vaginal birth, those with cesarean had different personality traits. The cesarean mothers were less confident as they approached labor, more frightened and overwhelmed, and felt less powerful (Declercq et al, 2007b). In a postpartum survey, 8.1% Canadian mothers informed that they had requested for cesarean and 6.1% succeeded with their request. Among those who had a previous cesarean, 5.3% requested a repeat cesarean. Maternal request for cesarean was lower at 1.5% among primiparous women (Chalmers et al, 2008). A survey of pregnant women from 40 randomly selected maternity centres in the UK revealed overall 5.3% preference for cesarean delivery. The preference for cesarean was higher among women who had a cesarean (19.9%), or an operative vaginal delivery (7%) in the past. Among primigravida, preference for cesarean was lower at 3.2% (Thomas & Paranjothy, 2001). Another prospective patient interview and case note review over a one year period at a District Hospital in England, found that about 18.42% of cesareans were on maternal request. Thus the rate of cesarean delivery on maternal request in this study was 3.47% (Jackson and Irvine, 1998).

A Swedish study (Hildingsson et al, 2002) reports that 8.2% of the women would prefer to have a cesarean section. A wish for cesarean section was associated with a previous cesarean section, fear of giving birth and a previous negative birth experience. Another study of a regional cohort of women in Sweden, from 2007-08, found that, at midpregnancy 7.6% of them preferred a cesarean. By late pregnancy the preference for cesarean was almost same at 7%. One year postpartum, 9.85 would prefer cesarean if they were to have another baby. More multiparous women preferred cesareans. Fear of giving birth, previous elective cesarean and previous negative birth experience were strong predictors of preference for cesarean (Wiklund et al, 2008; Karlström et al, 2011). A survey of 36-40 week pregnant
women while waiting at antenatal clinics in Brisbane, Australia showed that 6.4% preferred a cesarean section. Most of them had a current obstetric complication or experienced a previously complicated delivery. Only 0.3% preferred a cesarean section in the absence of any known current or previous obstetric complication. Women who preferred a cesarean were more anxious, were generally poorly informed of the risks of this procedure, and/or overestimated the safety of the procedure (Gamble and Creedy, 2001). At 30 weeks of pregnancy, 10% women in a sample of Norwegian women would choose a cesarean section. Negative experiences from previous pregnancies and fear of giving birth are two of the strongest factors associated with a wish for a cesarean section (Kringeland et al, 2009). A German study (Kolip, 2012) reports that only 2% of pregnant women request a cesarean delivery in the absence of medical indications. The study attributed the regional variations in the CSR to differences in risk assessments and interpretations by obstetricians. A Polish survey asked nulliparas between 38 and 40 week of pregnancy who requested cesarean and found that request for cesarean in 12% of cases resulted from fear of labor pain. After they were informed about methods of reducing labor pain and guaranteed that those methods would be available, as many as 52% of pregnant women who had previously requested cesarean section changed their mind and wanted to give birth in a natural way (Pawlec et al, 2012).

The Birth in Brazil study (Domíngues et al, 2014) conducted during 2011-12 found that maternal request for cesareans was on average about 12.4% consisting of 8.6% for public sector and 31.3% in private sector. Reasons cited by those requesting cesarean were; (a) fear of labor pain (30%), (b) scope for simultaneous tubectomy (35%), (c) previous positive experience with cesarean, (d) health problems (7%), (e) previous negative experience with vaginal delivery, (f) safer for baby (1.5%), and (g) vaginal delivery alters sexual life (1.3%). Opportunity for tubectomy as a motivation for CDMR appears specific to Brazil, in the absence of insurance cover for stand-alone surgical sterilization (Faundes & Guilherme, 1993). A study from Nigeria (Chigbu et al, 2007) reports that prevalence of cesarean on maternal request was 4.4%. Previous infertility and advanced maternal age at first pregnancy were the most common reasons for requesting a CS, although most women said they would prefer a vaginal delivery in subsequent pregnancies.

In an internet/telephone survey 20 to 40 year old women (not necessarily pregnant) in Italy during 2010-2011, 80% women declared preference for normal vaginal delivery. The source which most influenced the preference of these Italian women was their obstetricians, followed by friends and relatives (Torloni et al, 2013).

In summary, the prevalence of cesarean delivery on maternal request (CDMR) is not precisely known but probably occurs in less than 5% of all deliveries. Important factors contributing to maternal requests for cesarean are; (a) fear of vaginal delivery (tocophobia), especially in primiparous women, (b) previous negative experience with vaginal delivery, and (c) erroneous belief that cesarean is safer for the babies. Overall the small proportion of maternal requests would not drive the rising cesarean rates substantially. Other, more important factors must be at play.

The evidence on perceived benefits such as lowered risk of incontinence, preservation of sexual function is equivocal or weak. Much of pelvic floor weakening is due to pregnancy. However, the mode of delivery does appear to have marginal effect over and above the effect of pregnancy. The NIH Evidence Report (Viswanathan et al, 2006) reviewed articles available from studies reporting about incontinence, pelvic organ prolapse and sexual function associated with mode of delivery. Based on this review the NIH State-of-the-Science
Conference on CDMR (NIH, 2006) concluded as follows. The rate of stress urinary incontinence (SUI) after elective cesarean delivery is lower than for vaginal delivery, but the duration of this effect is not clear, particularly in older populations and in women who had multiple deliveries. Weak evidence for reduced risk of anal incontinence in elective cesareans compared emergency cesareans or operative vaginal deliveries. Any differences in sexual function based on route of delivery are no longer evident by six months postpartum and confounding with important factors like changing family roles & relationships, sleep deprivation is very likely. Results of the Childbirths And Pelvic Symptoms (CAPS) trial (Borello-France et al, 2006) published after the NIH Evidence Report, show no significant difference of fecal incontinence, between cesarean and vaginal delivery groups. The cesarean group had marginally higher urinary incontinence six months postpartum, but the difference was not statistically significant. A study (Altman et al, 2007) in Sweden found the risk of stress urinary incontinence 10 years after index delivery was less in cesarean (OR=1) compared with vaginal delivery (OR=3.1) group. No significant difference by mode of delivery, in respect of anal incontinence or urge urinary incontinence. A more recent study in Sweden shows that the odds of urinary incontinence 10 after pregnancy, was higher for the vaginal delivery group (OR: 1.4 to 1.6) compared with cesarean group and the prevalence of symptomatic pelvic organ prolapse 20 years after childbirth was doubled after vaginal delivery compared with cesarean (Gyhagen et al, 2013a,b). A community health survey in Boston reported that women having one or more vaginal delivery had twice the odds of urinary incontinence compared to women with no pregnancies or only cesarean deliveries (Connolly et al 2007). Overall vaginal delivery does appear to marginally increase the risk of urinary incontinence compared with cesarean delivery. However, a large part of the risk of urinary incontinence is attributable to pregnancy, ageing and other vulnerabilities unrelated to the mode of delivery. The marginal benefit from reduced risk of urinary incontinence does not outweigh the adverse maternal and neonatal outcomes of elective cesarean section for no indicated risk (Koc & Duran, 2012).

Tocophobia, at least in a small group of women, the marginal protection against risk of urinary incontinence, and the concept of maternal autonomy has engendered professional debates and deliberations. Proponents of cesarean on strict medical indication, argue that there is no hard evidence that elective cesarean is safer, risk-benefit calculus is poorly developed, and the ethic of informed choice for nonindicated surgery is not overwhelming (Bewley & Cockburn, 2002). On the other hand proponents of maternal autonomy advocate that physicians should counsel and explain all risks and benefits of CDMR, and hope that patients chose vaginal delivery. But if the patient wants cesarean, after considering risk and benefits, her choice should be respected (Ecker, 2013).

The Society of Obstetricians and Gynecologists of Canada (SOGC, 2004) believes that medical indication is important and does not promote cesarean section on demand. The NIH State-of-the-Science Conference (NIH 2006), finding insufficient evidence to recommend for or against CDMR, advised as follows; (a) Any decision to perform a CDMR should be carefully individualized and consistent with ethical principles, (b) Given the risks of abnormal placentation CDMR is not recommended for women desiring several children, (c) No CDMR before 39 weeks gestation, and (d) Effective pain management must be available, so that there is no need for CDMR on this account. The International Federation of Gynecology and Obstetrics (FIGO, 2012) has observed that there is no hard evidence on relative risks and benefits of term Cesarean delivery for nonmedical reasons, as compared with vaginal delivery. Rather available evidence suggests that normal vaginal delivery is safer in the short and long term for both mother and child. Hence, performing cesarean for
nonmedical reasons is ethically not justified. The American College of Obstetricians and Gynecologists (ACOG, 2013) reiterates the NIH recommendation and observes that, in the absence of maternal or fetal indications for cesarean, a plan for vaginal delivery is safe and appropriate and should be recommended. The UK’s National Institute of Clinical Excellence guidelines (NICE 2011) require that; (a) specific reasons for a CS request ought to ascertained and recorded, (b) the woman should be apprised of the overall risks and benefits of CS, if there is no medical indication, (c) help her address anxieties about child births, if any, and offer access to perinatal mental health support, and (d) if a vaginal birth is still not acceptable offer a planned CS. If the attending obstetrician is unwilling to perform a CS, refer the case to one who will carry out the CS.

H. Experiences from Interventions & Strategies to Reduce CSR:
Several strategies have been advocated and/or adopted by various stakeholders at different places to control the rising trend of unnecessary cesareans. Professional bodies and health care authorities have deliberated on contemporary evidence-base and have adopted practice guidelines regarding appropriateness of various interventions in childbirth. For example; as early as in 1986, the Society of Obstetricians and Gynecologists of Canada (SOGC) endorsed the National Consensus Conference on Aspects of Cesarean Birth (NCCACB) criteria for diagnosis of dystocia and guidelines for vaginal birth after cesareans (NCCACB, 1986). The ACOG and the Society for Maternal-Fetal Medicine (SMFM) have recommended several clinical and obstetric management practices to reduce the incidence of unnecessary cesareans (ACOG, SMFM, 2014). The US AHRQ-CER identified several clinical & obstetric management practices that have been found to reduce cesarean birth in low-risk women (Hartmann et al, 2012). The National Institute of Clinical Excellence (NICE) in the UK has issued clinical guidelines on cesarean sections from time to time (NICE, 2011, 2013). However, guidelines and continuing education programs do not usually alter behavior in the absence of complementary systemic interventions (Davis & Taylor-Vaisey, 1997; Yana & Jo, 2004). Health system characteristics and interventions help align stakeholders' incentive towards achievement of a public health goal. Hence, available evidence on the association of various systemic characteristics and interventions are summarized below, to facilitate policy formulations.

1. Aligning maternity care fees to discourage unnecessary cesarean sections:
A corollary of the observed effects of financial incentives on mode of delivery is that equalization of fees should help reduce and/or check the rise in cesarean rates. Several efforts at various kinds of fee equalization have been documented. In 1993, the California Blue Cross increased physician fee for vaginal deliveries by 3% and reduced cesarean fees by 18% to equalize the two. The CSR reduced from 25.3% before reform to 24.6%, one year after reform. The rate for nonbreech deliveries went down by 1.2%. This reduction was statistically significant. The rate for breech presentations went up by 7.4% reducing the overall decline in CSR to a statistically nonsignificant 0.7% (Keeler & Fok, 1996). The partial to insignificant effect, might have been due to the weakness of a small fee differential of 21%, and a comparatively low baseline CS rate of 25.3% in California. The fee differential under Taiwan’s NHI implemented in 1995 was much higher at 90%. Although, the NHI primarily pays fee-for-service, a global fee system is adopted for childbirth services. In 2003 NHI raised VBAC fee on par with cesarean. In 2005 the fee for other vaginal births was also raised to equal the fee for cesareans. In 2006 NHI required a copayment for cesareans on maternal request. The baseline CSR in 2002 was 33.8%. Thus the setting for fee equalization in Taiwan was characterized by; (a) stronger financial incentive due to larger fee differential,
and (b) higher base line CSR. The VBAC rate was 1.7% in 2001 & 2002. After fee equalization, VBACs increased to 3.5% in 2003, 4.8% in 2004, and 4.9% in 2005. However, the fee equalization in 2005 for all vaginal deliveries did not generate much of an impact. The total CSR went down from 33.8% in 2002 to 32.9% in 2003, 31.7% in 2004 and did not change much in 2005 after equalization of fees for all vaginal deliveries with that of cesareans. The odds of elective cesarean for women below 40 years, after fee equalization, was about 0.714 to 0.870. Thus the fee equalization policy did work for mothers below 40 years. There was no effect for mothers above 40 years. The copayment policy, on the other hand, did not work. Among mothers below 40 years age, odds of elective cesarean increased, after copayment was introduced. There was no effect for mothers above 40 years. Neither the supply side financial incentive of fee equalization nor the demand side incentive of copayment had any effect on mothers above 40 years. Study authors considered this as plausible, as the risk of medically indicated cesarean increases with maternal age (Lo, 2008; Chen et al, 2014).

In 2011 the South Carolina Department of Health in collaboration with other stakeholder organizations launched a birth outcomes initiative (BOI) to improve birth outcomes and contain Medicaid expenditure. March of Dimes, one of the collaborators had campaigned to reduce induction of labor and cesarean deliveries at 37 and 38 weeks, so as to reduce incidence of prematurity and concomitant NICU admissions. Researchers had estimated that eliminating the practice of early elective delivery would save substantive sums in delivery costs by avoiding unnecessary cesareans and save much more by reduced NICU admissions. Blue Cross Blue Shield, South Carolina’s largest commercial insurer was persuaded to join in the collaboration. Together the Medicaid and Blue Cross were paying for 85% of deliveries in South Carolina. The Department of Health engaged with professional associations of obstetricians and pediatricians to develop practice bulletins about early elective deliveries based on national guidelines and contemporary evidence-base. The South Carolina Hospital Association and about 100 other stake holders throughout the state were recruited into the collaboration. In September 2011, all 43 birthing hospitals in South Carolina signed a pledge to stop early elective deliveries. Each signatory hospital designated two project champions - one clinical and one administrative. By summer of 2012, the voluntary effort had reduced early elective induction by 50%. In August 2012 the Department of Health introduced appropriate medical records and reporting mechanisms that will help identify early elective induction and cesareans. From January 2013, the Department of Health and the Blue Cross Blue Shield stopped reimbursement of early elective induction and cesareans for both hospitals and physicians. South Carolina became the first state in the US where both public (Medicaid) and private (Blue Cross Blue Shield) entities implemented same nonpayment policy for early elective deliveries for both hospitals and physicians. Because of the elaborate preparations and strongly built collaborations, providers and patients generally accepted the roll-out of the new nonpayment policy. Preliminary data showing reduced NICU admissions, and increased cesareans at 39 weeks suggests positive effect of the intervention. The Department plans to pursue this voluntary collaborative approach with hospitals and providers to bring cesarean rates down. Similar policies are also being considered by other states in the US (Perelman et al, 2013).

2. Integrating and Strengthening Midwife-led Maternity Services:
Midwives play a central role in the organization of maternity services in several countries such as Australia, Denmark, France, Sweden, Netherlands, New Zealand and UK, all of which have low maternal mortality at <10 / 100000 live births (McKay, 1993; DeVries, 2001). In many of these countries perinatal mortality and CSR among women primarily cared
for by midwives with back up physician services, have been found to be lower (Van Alten et al, 1989). The WHO believes that use of midwives to provide maternal health care has the potential to reduce inequities in access to antenatal and postpartum care, provided that they are recruited from, and retained in, under served communities and are adequately trained, supported and supervised (Wiysonge, 2009). A midwife-led normal birth unit (MNBU) was setup in an urban hospital in China to separate obstetric care from maternity care, facilitate normal birth, enhance midwifery practice. All women who accessed the MNBU were supported by both a midwife and a birth companion, referred to as ‘two-to-one’ care. Comparison group consisted of a randomly selected retrospective cohort accessing standard care during the same six-month period, and satisfying the same inclusion exclusion criteria. Initial data showed that the vaginal birth rate in the MNBU was 87.6% compared with 58.8% in the standard care unit. The cesarean rate in MNBU was 8.4% as against 38.5% in standard care unit (Cheung et al, 2011). Hofmeyr et al (2014) report about successful establishment of alongside midwifery unit in a tertiary maternity hospital in South Africa. A cost-effectiveness study in a Canadian hospital found that midwife-led care was more effective (fewer NICU admissions) and less costly, compared with family-practitioner-led and obstetrician-led cases (Walters et al, 2015).

Goings (1995) refers to the National Maternity Hospital in Dublin, Ireland as one of the best known and well-studied examples. There, midwives are responsible for the management of all laboring women, including private patients who are delivered by midwives with their personal physician in attendance. Midwives are closely involved with the education and training of resident physicians. The active management of labor, one of the components of this system, is partially credited with the impressive outcomes of care there, but the inclusion of midwives in their maternity service is, undoubtedly, an important factor.

Key features of midwife-led models in low maternal mortality countries with a long tradition of midwifery may help strengthen organization of obstetric care in a country like India. A survey (Malott et al, 2009) of midwifery systems in Australia, Denmark, France, Sweden, Netherlands, New Zealand, & UK found that they invariably have bachelor degree level midwifery courses spreading over 3-4 years of study with an even distribution of 50% theoretical and 50% clinical work. Internships and guided experience of 40 to 60 births is the usual criteria for midwifery license. Licensed midwives usually practice in hospitals with admitting privileges and authority to prescribe relevant medicines. In some countries like the Netherlands, New Zealand, and UK, midwives may practice independently with access to hospitals. Starting with Ontario in 1994, several provinces in Canada have integrated midwives in their health system to improve maternity care. Higher ratings of positive birth experience has been reported among women with midwife as the primary birth attendant (Chalmers et al, 2008).

3. Continuous psychosocial support during labor:

Traditionally women have been supported by other experienced women during labor and childbirth. In 127 of 128 societies, for which data was available around mid 1980s, a woman is present throughout labor with the mother to be (Klaus, et al, 1986). Worldwide it is extremely unusual for women to give birth alone. Assistance at birth is deeply rooted in human evolutionary history and may explain evidence that social support has a positive impact on birth outcomes. Fear of birth or tocophobia is a common reason for electing to give birth by c-section. The evolutionary perspective argues that fear and the deeply rooted need for assistance during birth can often be alleviated with emotional support such as provided by doulas, thus avoiding unnecessary risky and costly c-section (Trevathan and Rosenberg,
Continuous support has been identified as the most effective component of active management of labour (Thornton, 1996). Doula is an experienced woman who supports and assists another woman during labor. Dais in India play a similar role. Continuous labor support may also be provided by experienced family members and friends. These birth/labor companions provide both emotional and physical support; they rub mothers’ backs, hold their hands, and share information as well as encouragement (Pascoe, 1990). Continuous labor support includes; (a) emotional support by continuous presence, reassurance and praise, (b) information about labour progress and advice regarding coping techniques, (c) comfort measures such as comforting touch, massage, warm baths/showers, promoting adequate fluid intake and output and (d) advocacy by helping the woman articulate her wishes to others (Hodnett et al, 2012). Midwife-led maternity care along with continuous labor support by an additional birth companion has been referred to as “two-to-one” or “two-one” model of care in China (Cheung et al, 2011, Wang et al, 2012).

The AHRQ-CER (Hartmann et al, 2012) included three doula support studies (Kennel et al, 1991; Trueba et al, 2000; McGrath & Kennel, 2008). Doulas in these studies had received about 3 weeks training in the art & science of labor support according to the Lamaze Childbirth Education or Doulas of North America curriculum. These trials showed a 5% to 22% reduction in cesarean rates for women who received doula support. Another study (Campbell et al, 2006), included in the AHRQ-CER, trained a friend or family member in labor support, who acted as a lay doula. Support by these family or friends shortened the labor process. However, the reduced cesarean rate in the lay doula group was not statistically significant. The AHRQ-CER included three studies (Hemminki et al, 1990; Gagnon et al, 1997; Hodnett et al, 2002) comparing continuous support by a nurse or a midwife with usual care. Continuous support by nurse or midwife did have some beneficial effects, but there were no significant difference in cesarean rates.

The AHRQ-CER was primarily designed to inform professional practice and healthcare policy in the US. Hence it excluded studies that did not reflect contemporary practice in the US. In addition interventions that did not explicitly intend to reduce cesareans were also excluded. On the other hand, the Cochrane systematic review (Hodnett et al, 2012) included studies from all over the world, and the trials that measured effect of continuous support on cesarean rates irrespective of whether it was a primary or secondary outcome in the study design. The 22 trials in the Cochrane review consist of seven trials included in the AHRQ-CER; nine trials excluded by the AHRQ-CER mostly because they did not reflect US contemporary practice, or cesarean was a secondary outcome; and six trials that had not been picked up by the AHRQ-CER.

The Cochrane systematic review mentioned above, found that women who had continuous one-to-one support during labour were more likely to have a spontaneous vaginal birth, shorter labour and less likely to have cesareans. Labor support appears to be effective in reducing fear of childbirth, and distress associated with laboring alone in an unfamiliar environment. Subgroup analysis revealed that labor companions who were neither hospital employees nor part of the woman’s social network were most effective in improving the delivery experience and reducing the need for cesarean sections. Reviewers conjecture that divided loyalties, additional duties besides labor support, self-selection, the constraints of

---

4 Kashanian, 2010; Klaus, 1986; Madi, 1999; Morhason-Bello, 2009.
institutional policies, and routine practices may all have played a role in the apparently limited effectiveness of members of hospital staff. On the other hand support of family members and friends is qualitatively different and more complex than that of a woman who is experienced, often trained, and is solely tasked with providing labor support. Additional support from a family member or friend is effective in improving woman’s satisfaction with their birth experiences.

Yuenyong et al (2008) point out that one of the unintended consequences of the transition from home to institutional deliveries in Thailand is that pregnant women loose psychosocial support. Hence, hospitals need to adopt policies that will empower women to appropriately choose a support person. Key considerations from the pregnant woman’s perspective are; (a) can she count on the her, (b) does the support candidate want to be there?, (c) is the pregnant woman comfortable with her, (d) will she give appropriate support?, (e) how might she deal with the unexpected?, and (f) will she be willing to attend a special educational session to prepare for the birth?. Experience of normal childbirth is desirable. Persons lacking situational awareness, requiring direction and attention, those who react badly under pressure, do not recognize the role of nurses and midwives, and those who doubt if the pregnant woman in question can have a natural birth, would not be suitable.

The International Federation of Gynecology and Obstetrics guidelines on management of second stage of labour (FIGO-SMNH Committee, 2012) recommends; (a) to allow every woman to be accompanied by her choice of a supportive person (husband, friend, mother, relative, TBA), (b) to provide psychosocial support, and (c) there should be at least two people assisting at every birth, whether it is another health professional, family member, TBA, or village health worker. Arrangements for having another person besides the primary skilled attendant should be planned during the pregnancy.

4. Institutional Programs for Appropriate Obstetric Practices:
Experience shows that, practice guidelines and continuing education on their own do not effect enough change in professional behavior to reduce cesarean rates. However, hospital or department level programs to reduce cesarean sections generally succeed (Stafford, 1990b). For example; physicians at a rural community hospital in Canada committed to follow the NCCACB guidelines, almost simultaneous around its release in 1986. After five years, the overall cesarean section rate decreased from 23% in 1985 to 13% in 1989. This decrease was due to a drop in the number of dystocia-related cesarean sections, and increase in VBAC (Iglesias et al, 1991). Another study (Somilan & Burrows, 1993), during this period, of two hospitals in Canada reported a reduction of 8.7% in the total CSR and of 15% in the repeat CSR, after adoption of the NCCACB guidelines. A department-wide effort in an academic medical centre at Jacksonville, Florida, achieved a reduction of CSR from 28% in 1986 to 11% in 1989. Most of the decrease was attributed to changes in management of dystocia and trial of VBAC (Sanchez-Ramos et al, 1990).

Department leaders of Mount Sinai Hospital, Chicago persuaded all teaching and affiliated private obstetricians for a prospective program to achieve a targeted reduction in the cesarean rate. The program used clinical guidelines with objective criteria for dystocia, fetal distress and repeat cesarean, to educate physicians. A second opinion was required for all cesareans, except in case of emergency. Detailed peer review, facilitated by computerized perinatal database, was instituted. Physicians were informed of their personal CSR at quarterly intervals. Obstetricians whose CSR was more than 12%, were invited to a private consultation with the division director to review their individual data. During the first two years of the program, the CSR fell from 17.5% in 1985 to 11.5% in 1987. Rates of both
primary and repeat cesareans decreased, although only the decline in the rate of primary cesareans, from 12 to 6.8 percent, was statistically significant. These results were achieved without any detriment to maternal or perinatal outcomes. The program was accomplished with support from both clinical staff and hospital administration. Follow-up after six years indicated that, total CSR of 10-12% can consistently be achieved without adverse outcome. Additionally, operative vaginal procedures were employed less that 3% of cases. This effort indicated that long-term reductions and cesarean utilization are possible with a comprehensive departmental program (Myers & Gleicher, 1988, 1993).

During late 1980s, obstetricians at the Northwestern University Medical School in Chicago implemented three initiatives to reverse the escalating CSR. VBACs were encouraged; every obstetrician’s annual CSR was circulated to all attending physicians; and evidence-based protocol for management of term primipara was recommended. The total, primary, and repeat CSR declined from 27.3%, 18.2%, and 9.1% in 1986 to 16.9%, 10.6%, and 6.4%, respectively, in 1991. The reductions happened both for private patients (30.3% to 19.1%) and clinic patients (20.8% to 11.5%). Better management of dystocia and VBACs were the principal factors contributing to the lower cesarean section rates (Socol et al, 1993). The Loyola University and Ravenswood Hospital Medical Center in Chicago, adopted several strategies in 1994 including physician and public education, practice guidelines, peer review & feedback and set a target to reduce CS rate. Three year average CSR for pre and post intervention periods were compared. Total CSR decreased from 22.5% to 18.6%, the primary CSR decreased from 13.5% to 10.6% and the repeat CSR from 9.0% to 7.9% (Poma, 1998).

A community hospital in California, instituted, in 1988, a program of increasing awareness, confidential provider feedback, more aggressive laboring techniques, and other clinical guidelines. The overall CS rate decreased from 31.1% in 1988 to 15.4% by 1994. Primary cesareans reduced from 17.9% to 9.8% and repeat cesareans reduced from 13.2% to 5.7%. The fall in primary CSR was attributable to a drop in cesareans for cephalopelvic disproportion and fetal distress. Fall in repeat CSR was attributable to increased VBAC (Lagrew & Morgan, 1996).

In 1989, a teaching hospital in San Francisco started generating quarterly perinatal statistics for physicians and practice groups. The practice-group ‘report cards’ were discussed in departmental meetings. Individual ‘report cards’, were shared confidentially with the concerned obstetricians. Departmental attention was focussed on high achievers (personal cesarean rate <14%). Those in the best quartile were publicly recognized by the department-chair, the chief of obstetrics, and chair of the perinatal committee. Several grand rounds per year were devoted to issues involving cesarean birth rates. The process created considerable stir. Individual physicians complained that differences in the obstetric risk profile of their patients was the cause of differences in CSR. In 1993, stratified CSR for standard nullipara and standard multipara were included in the report cards to facilitate risk adjusted comparisons. Summary comparisons were restricted to those who had attended at least 20 child births in a year. In 1987 three groups of obstetricians with one third of the maternity volume had organized a separate service in another medical centre. The main teaching hospital and the separated group had similar type of post graduate training in obstetrics, similar obstetrician demographics, and similar payer mix. However, the main teaching hospital continued to deal with high-risk obstetrics, while the separated group dealt with low-risk case. The separated group merged back with the main hospital in 1992. Thus the separated group was a natural control for the 1989-91 period. CSR in the main teaching hospital and the separated group, during 1987-1989 was about 23 to 25%. After introduction
of the audit & feedback system, the CSR in the main teaching hospital reduced to 20.7% in 1991. In 1992 the audit & feedback system was introduced in the separated group, and their CS rate fell from 24.6% to 20.3%. By 1993 the CSR reduced to about 18%. The declines were in both primary and repeat cesareans. Although variance in obstetricians’ individual CSR decreased over time, those in the lower quartile stayed in the lower quartile year after year, whereas those in the upper quartile, while improving, also maintained their relative position (Main, 1999).

In 1995, hospital administrators and obstetricians at a major maternity hospital in Quito, Ecuador introduced a second opinion policy for cesareans, except in case of emergency. All obstetricians were updated with latest clinical & practice guidelines. The CSR prior to the professional update & second opinion policy was 26.6%. After one year, the CSR had declined by 4.5%. A smaller 2.1% reduction occurred in another major hospital in Quito where students of the coprincipal investigator attempted to reduce cesarean delivery (Sloan et al, 2000).

In 1999 obstetricians of a teaching hospital, in southern Thailand, reached a consensus to reduce cesarean delivery rate and improve quality of maternal & fetal care. They focused on reducing primary cesarean rate which was rising mainly on account of variations in diagnosis of dystocia. A clinical practice guideline for cesarean due to dystocia was developed by adapting from national guidelines. Physician participation was voluntary. Physician compliance was audited after about 1½ years. Pregnancy outcomes for a similar period before adoption of clinical guidelines was the baseline. Physician compliance with practice guidelines was about 89%. Compliance was lower at 83.1% among private practice physicians compared with 98.7% among non-private practitioners. After implementation of guidelines, the observed cesarean rate fell from 10.7% in 1999 to 8.6% in 2001. Primary cesarean rate fell from 22.3% in 1999 to 21.2% in 2002 (Suwanrath-Kengpo et al, 2004).

The Latin American Study Group (Althabe et al, 2004) conducted a cluster randomized trial to estimate the potential of mandatory second opinion to reduce CSR. Only public hospitals participated in this trial. Practice guidelines were made available to physicians. The attending physicians were required to seek second opinion, but had the authority to dispense with it in cases of emergencies. The panel of consultants (second opinionists) designated by the obstetric department, had to have equivalent or higher clinical qualification. The same physician could be attending one day and consultant on another. The second opinion policy was associated with a 1.9% lower CS rates in the intervention hospitals compared with the controls. The intervention most likely worked by reducing the diagnosis of dystocia and fetal distress, and there by reducing the need for emergency cesarean after onset of labor. The observed reduction of CSR was similar for hospitals with different baseline rates suggesting that intervention would work in different settings. Opinion poll of physicians after the trial but before analysis of results, showed wide acceptance and appreciation of the mandatory second opinion policy. About 87% physicians in both control and intervention hospitals thought that this was a feasible strategy to apply in public hospitals and 41% thought that it would be feasible in private hospitals as well. About 91% physicians said they would recommend use of second opinion policy in public hospitals and 65% said they would recommend its adoption in private hospitals.

Dr. Robson, author of the ten group classification of cesareans, and colleagues established a medical audit cycle for the labor ward in a county hospital in UK. Guidelines for management of dystocia were developed and introduced. The effect was monitored
prospectively from 1989 through 1992. After four years, the overall CSR had decreased from 12% in 1988 to 9.5% in 1992 (Robson et al, 1996).

A tertiary care hospital in Taiwan, instituted a program, in 1997, to lower the CSR. Guidelines for management of dystocia and VBAC were emphasized, a second opinion was required for all cesareans, every cesarean case were required to be discussed in the weekly departmental conference, physician’s cesarean rates were presented in departmental conference. Four year average CSR decreased from 37% during 1993-96 to 30.7% during 1997-2000. Primary CSR declined form 21.3% to 17.8%, and repeat cesareans decreased from 15.7% to 12.9%. Major contributors to the reduction were dystocia and VBAC (Liang et al, 2004).

In 2005, a teaching hospital in Yunnan province of China introduced a continuous quality improvement program. First, all obstetricians were updated with evidence-based guidelines to build consensus for avoiding unnecessary cesareans. All cesarean decisions were peer reviewed daily. Obstetricians practicing unnecessary cesareans were denied potential financial incentives. All expectant mothers were educated about the risks and benefits of alternate modes of birth. Patients who insisted on having cesarean delivery without a medical indication had to sign a special consent form that clearly delineates for them and their family members the risks and potential complications associated with cesarean section. The patients were also required to record their reasons for wanting to deliver by cesarean. The CSR ranged from 53.5% to 56.1% during 2001 - 2004. After introduction of the quality improvement program, the CSR dropped to 42.4% in 2005, and gradually declined there after to 36.1% in 2011. The difference between the actual rates of primary cesareans and the risk-adjusted rates became progressively smaller over time (Runmei et al, 2012).

A meta-analysis (Chaillet and Dumont, 2007) that included several of the studies cited above (Socol et al, 1993; Lagrew & Morgan, 1996; Robson et al, 1996; Poma, 1998; Liang et al, 2004; Althabe et al, 2004) estimated that the cesarean delivery rate was reduced by 13% when audit and feedback were used exclusively but decreased by 27% when audit and feedback were used as part of a multifaceted intervention, which involved second opinions and culture change. Authors of a systematic review (Khunpradit et al, 2011) that included some of the studies cited above (Poma, 1998; Liang et al, 2004; Althabe et al, 2004), concluded that implementation of guidelines with mandatory second opinion can lead to a small reduction in cesarean section rates, predominately in intrapartum sections. Peer review, including pre-cesarean consultation, mandatory secondary opinion and post-cesarean surveillance can lead to a reduction in repeat cesarean section rates. Guidelines disseminated with endorsement and support from local opinion leaders may increase the proportion of women with previous cesarean sections being offered a trial of labour in certain settings.

A systematic review on effect of audit & feedback in general on professional practice and outcomes (Ivers et al, 2012), suggests that audit & feedback may be more effective when baseline performance is low, the source of feedback is a supervisor or colleague, it is provided at least ‘monthly’, it is delivered in both verbal and written formats, and when it includes both explicit targets and an action plan. Studies on adoption of practice guidelines and the effect of hospital peer review process stress the importance of, outcome feedback, continuous scrutiny and strong departmental leadership. Recognition, praise, public accord in professional circles, and private admonishments are essential for audit & feedback systems to be effective. Many such projects have failed because of lack of committed leadership (Main, 1999).
5. Scaled-up Multi-institution Programs To Reduce Unnecessary Cesareans:

The New York State Department of Health, launched a peer-review program, in 1989, in collaboration with the obstetricians’ specialty society to reduce cesarean rates. Review teams consisted of 3-4 physicians trained by the ACOG. The review teams visited intervention group hospitals, interviewed key staff members, and reviewed 100 labour & delivery records to assess quality of care. Review teams provided feedback to the hospital through a debriefing interview and a written summary of findings. After five years, the reviewed hospitals had reduced their cesarean rate somewhat, but the reduction was not statistically significant compared with nonreviewed hospitals (Bickell et al, 1996). However, other studies show that collaboration with professional champions and opinion leaders does help increase compliance with practice guidelines. For example; a randomized controlled trial with 76 physicians in 16 community hospitals evaluated audit and feedback and local opinion leader education as methods of encouraging compliance with a guideline for the management of women with a previous cesarean section. After 24 months, vaginal births after cesarean were 85% higher among physicians educated by an opinion leader, but there was no improvement in the audit & feedback group compared with the control group (Lomas et al, 1991).

In the 1980s, the Maryland Hospital Association (MHA) developed hospital wide quality indicators to support quality improvement (QI) efforts of participating hospitals. Participation in the MHA-QI project was voluntary. Quality indicators were developed with help of participating hospitals. Project gathers data, computes the indicators for all participating hospitals and shares with each. There was no external review, no effort to identify outliers, and no punitive use. Thus the overall aim of the MHS-QI project was to provide information that can be used by participating hospitals to continuously improve their quality. Voluntary participation and reporting implies that the respective hospital administrations were committed to the goal of quality improvement. Hospital CSR was one of the quality indicators. CSR between 1991 and 1996 of regularly reporting hospitals was compared with those that did not continuously report data on this parameter. Among the 110 continuously participating hospitals in the QI Project, the total CSR declined from 22.5% in 1991 to 19.4% in 1996. For this same group, the primary CSR declined from 15.8% to 13.9%, and the repeat CSR declined from 75.0% to 61.2%. Cesarean rates remained almost the same at 21.2% in 1991 and 20.7% in 1996, for the comparison group of 957 hospitals (Kazandjian & Lied, 1998).

In 1995, a nonprofit organization, namely the Institute for Healthcare Improvement (IHI) in Boston, developed a collaborative model to facilitate evidence-based healthcare improvements. The collaborative model sought to provide a structure for learning and action that would engage hospital management, physicians and midwives in making real, system-level changes to improve care. A faculty leadership team, consisting of clinicians who have demonstrated commitment to evidence-based maternity care in their own practice was constituted to oversee and assist the program team. By September 1996 and in response to a call for participation, 28 healthcare organizations had joined the collaborative. These organizations had backing of their senior leaders who had agreed to designate an improvement teams, and sustain effective changes. Over the course of one year multidisciplinary teams from each participating organization attended three face-to-face learning sessions. At the first learning session, expert faculties presented evidence-based concepts for improving maternal and neonatal outcomes and reducing cesareans, and how they can be applied locally. At the second and third learning sessions, team members report their experiences and learn more from one another. Between the learning sessions, teams test
and implement changes in their local settings, collect data to measure impact, and send monthly reports for collaborative overview. The teams in participating hospitals are supported by the program and faculty leadership teams through conference calls, peer site visits, and web-based discussions. After one year, 15% hospitals reduced their cesarean rates by 30% or more. Another 50% hospitals achieved 10-30% reduction in their cesarean rates. The remaining 35% hospitals were unable to reduce cesareans significantly. Successful hospitals had made complementary changes in both medical and nursing practices, their teams were highly motivated, and regularly tracked and discussed their progress (Flamm et al, 1998; IHI, 2003).

A program in Belgium (Buekens et al, 1993), communicated annual clinical management profiles to the heads of obstetric departments of participating hospitals, over a period of five years, from 1985 to 1989. The management profiles included information about the range, median, 10th and 90th percentiles of the distribution for each obstetric interventions and the position of the concerned unit amidst the full set of participating hospitals. Feedback gathered at the end of the five year study period, showed that about 88% of the heads of obstetric units shared the clinical management profiles to their staff. However, there was no change in practice, suggesting that stand alone programs of sharing comparative performance data is not enough.

In the Netherlands a randomized trial was organized in 1994 to estimate the effect of an obstetric peer review program on hospital cesarean rates. Participating departments were randomly assigned to a report recipient or a control group. The recipient group hospitals got an annual report containing risk rated estimate of expected CSR, the actual CSR and its ranking based on the difference between expected and actual cesareans in that hospital. These reports were sent to all obstetricians in the respective hospitals. Shortly after each report, graphs were sent again to draw attention to the previously-received report and to obtain answers to brief questions. Obstetricians in the control group of hospitals did not get any such report. Information evenings were organized during annual meetings of the Dutch Society of Obstetricians and Gynecologists to draw attention to the value of the reports. After five years, cesarean rates for full term pregnancies (37 to 41 weeks) in the report recipient group became more homogeneous than in the control departments. Other obstetric intervention rates were similar in the report group and the control group. Answers to the comprehension questions at the end of the study period showed that just under half of the obstetricians understood the message in the peer review reports correctly (Elferink et al, 2002).

In 1992, Florida state in US mandated that practice guidelines regarding cesarean section deliveries be disseminated to obstetricians. The law also required that peer review boards at hospitals be established to review cesarean deliveries and that the exact dates of implementation of the guidelines be reported to a state agency. A retrospective analysis (Studnicki et al, 1997) of live births occurring in Florida hospitals during 1992 and 1993, before and after formal hospital certification of the implementation of the guidelines found that the guideline certification program did not accelerate the consistent but gradual downward trend in cesarean births which had already been evident in the three prior years. There was some evidence to show that the guideline program may have affected repeat cesareans more than primary cesareans, especially in the first quarter of 1993, immediately after the hospital certification period. The date of guideline implementation reported by hospitals was not related to any systematic change in observed cesarean section rates. Authors of the study concluded that the mere dissemination of practice guidelines by a state agency may not achieve either the magnitude or the specificity of the results desired without
an explicit and thorough guideline implementation program. Blunt legislative mandates may be ineffective when multiple initiatives are already achieving desired outcomes.

The CSR in Korea increased from 4.4% in 1982 to 43.0% in 1999. In 2000, the Korean government started public disclosure of CSR of all hospitals with substantive number of deliveries. The overall CSR decreased from 43.0% in 1999 to 36.0% in 2006. Most of the reduction was from hospitals with the highest baseline CSR and highest number of deliveries. However, market share, competition, characteristics of revenue generation and ownership did not significantly influence the change of rates. Professional and management concerns about public image of institutions appear to have driven the reduction in CSR. In 2007, the national medical insurance institute introduced a "Pay for Performance" policy. It ranked hospitals according to their CSR and sanctioned financial incentives or penalties. However, the continued disclosure of information on the CSR coupled with financial incentives failed to reduce the CSR any further. The Korean CSR remained between 36.0% and 36.9% during 2007 to 2012. Recently, the financial incentives or penalties have been discontinued (Kim et al, 2005; Jang et al, 2011; Chung et al, 2014).

The North region of Portugal, where CSR was high at 36%, the Healthcare Administration appointed an independent committee, in 2010, to evaluate the problem and propose strategies to reduce the CSR. The committee visited all state-owned hospitals in the region with CS rates above 35% and held meetings with the obstetric and midwifery staff to present data on international CS rates, individual hospital comparisons, risks associated with CS, financial aspects related with CS, and to share the proposed measures to decrease CS rates. Some of these measures required local implementation of clinical guidelines, and CS audits. Continuing medical education on various aspects of obstetric emergencies were organized. A share of hospital funding was indexed to the annual CSR, and individual targets were negotiated with each state-owned hospital. Some of these initiatives rapidly disseminated to the national level. Financial incentives to achieve specific CSR targets were negotiated with a small number of hospitals in other health regions in 2010 and 2011, and the model was adopted for all hospitals in 2012. In March 2013 the Portuguese government nominated a National Committee to control CS rates. Uniform criteria for the funding of public hospitals indexed to the CSR were implemented in 2014, together with continued monitoring and dissemination of obstetric indicators. Overall, national CSR decreased by 9.6% from 2009 to 2014 (Ayres-De-Campos et al, 2015).

I. Call to Action for Improvements in Quality of Maternity Services:

Why do we want to reduce CS rates? Clearly nature would not have evolved a birth process that most often relies on operative intervention. This argument, however, leads us to questions like, what would be the optimal rate, which indications are right, how-to and who identifies cases? Despite improvements in the evidence-base, subjective elements in professional judgments can not be ruled out. Evidence & information, as well as beliefs & attitudes motivate the complex dynamics of the overall health system, professional training, staffing practices, healthcare financing policies, and maternal preferences. Many reasons are cited to motivate policies directed to reduce cesareans rates. Hence, public health policy must first prioritize goals and clearly state the order of priorities to reduce cesareans.

Women’s & children’s health must be the core motivator of all policies regarding appropriate mode of birth. Second order considerations such as scarcity of financial resources and maternal preferences ought to be balanced without compromising the maternal and child health outcomes. Unnecessary cesareans is not an isolated question. The phenomenon of rising cesareans is intricately embedded with quality and safety of maternity care services.
Note that safety is a part of the quality continuum (Kazandjian et al, 2008). Early elective inductions are as much a problem as are early elective cesareans. Programs and policies to improve the quality of maternity services, would result in appropriate levels of spontaneous, induced or assisted vaginal deliveries and cesarean sections. Reductions in unnecessary cesarean sections should be viewed as an indicator of the quality of maternity services rather than a goal in itself. In fact CSR has been used as an indicator of quality (Mann et al, 2006). In addition systemic and structural changes are required to balance the geographic reach, ownership profile, institutional characteristics of maternity and child health services. The following interventions are proposed to improve the availability and quality of maternity services, and thereby contribute to reductions in unnecessary cesareans.

1. More Maternity & Child Health (MCH) Hospitals in the Public Sector:
   a. The present stock of maternity facilities is skewed towards private clinics & nursing homes. MCH hospitals are generally more accessible for women and children. Before independence, several maternity & child health hospitals were established by philanthropists and princely states as a public service measure. After independence, building of new MCH hospitals have mostly been out of the reckoning. Health sector plans have provided for postpartum wards, and MCH centres in existing general hospitals at best. The health systems development project proposal of Andhra Pradesh around late 1980s and early 1990s conceived of separate MCH hospitals at administrative centres and towns with population of more than 50000. Although, the Government of India and the World Bank supported health system development projects in many other states, the separate MCH hospital component got left behind.
   b. To develop a backbone of medium volume maternity care units, build separate MCH hospitals in District Headquarters, Other Administrative Centres such as Revenue Divisional and ITDA Headquarters and large towns with more than 50,000 population. These will be in addition to the MCH services in existing District and Area hospitals and should be located in a different part of the concerned towns, so as to improve geographic and spatial access to services for women and children.
   c. To start with 100 bedded MCH hospitals may be built at District Headquarter towns. Similarly, 30 bedded MCH hospitals may be built at administrative centres such as Divisional and ITDA headquarters and large towns with more than 50000 population. These hospital can gradually expand to meet demands of local population and their respective referral catchment.

2. Better Midwifery and More Midwives:
   a. Unfortunately, various national programs and policies have successively diluted midwifery training, marginalized midwifery role of nurses, and gradually obliterated midwifery models of care (Mavalankar et al, 2011; Sharma et al, 2013; Dasgupta & Prasad, 2013). Experience shows that integrating midwives into maternity care services improves birth outcomes and reduces cesareans. Raising the standards of education, explicit licensing, and team of midwives in health facilities is pivotal to development of integrated maternal and new born care for all (Renfrew et al, 2014).
   b. Increased availability and improved competence of midwives are equally important.
   c. Revise maternity service staffing norms to increase number of midwives. Provide for additional midwives / nurse-midwives commensurate with actual maternity case workload.
   d. Confer admission privileges and prescription authority to midwives and nurse-midwives for maternity & related services only. Attending midwife/nurse-midwife should be
required to direct all high risk pregnancies to obstetricians and seek obstetricians’
intervention in respect of other cases as and when required.
e. Establish institutional protocols for integrated functioning of midwives and
obstetricians.
f. Introduce bachelor degree programs in midwifery. A part of existing BSc-Nursing
program capacity may be set aside for BSc-Midwifery.
g. Develop mid-career midwifery courses for registered nurses wanting to branch off into
full-time midwifery.
h. Develop mid-career courses for adroit auxiliary nurse midwives (ANM) and female
multipurpose health workers (MPHW-F).
i. Centres for advanced midwifery training (CAMT) should be located in maternity
hospitals and facilities with adequate obstetric volume, having midwife-led as well as
obstetrician-led maternity units. CAMTs should be located in facilities having at least
one team consisting of a well reputed obstetrician, with a track record of mentoring
midwives and specially trained and well reputed Midwife.
j. All midwifery training programs should ensure essential competencies for basic
midwifery practice, as recommended by the International Confederation of Midwives
(ICM, 2013).
k. Allow midwives and specialized nurse-midwives to practice midwifery independently,
in groups or in hospitals.
l. Separate licensing of midwives form general nursing. Registered general nurses may go
on to acquire midwifery license, after completion of specialized midwifery course.
m. Registered Nurses with additional specialized training in midwifery should be entitled to
additional midwifery allowances.
n. Introduce masters program in midwifery to and teaching and development of
professional midwifery.
o. Revise accreditation and empanelment norms for private hospitals and nursing home,
requiring them to provide adequate number midwives / nurse-midwives to staff
commensurate with maternity case workload.

3. Enabling Continuous Labor Support by Dais & Doulas:
a. Develop about three week long continuous labor support training modules to be used by
emergency obstetric care centres (EmOCs), MCH hospitals, and other hospital maternity
units, for training of dais and doulas. Potential candidates for continuous labor support
training would be the ASHAs, traditional dais, and any other woman interested to
support women in labor. Put in place a doula training support system to help MCH and
other hospital maternity units to deliver the training programs in continuous labor
support and maintain appropriate quality.
b. Revise hospital standing orders, maternity unit protocols, and attendant entry policies, to
allow parturient women, avail the services dais and doulas to standby them in the labor
ward as well as in the labor rooms through the entire duration of labor.
c. The dais and doulas are not to be appointed by the EmOCs, MCH or other hospital
maternity units. However, lists of empanelled dais and doulas should be maintained and
their contact details passed on to parturient mothers and/or their families. Dais and
doulas should be directly engaged by the parturient mothers and/or their family
members. Parturient mothers should have freedom to hire dai or doula from any source,
and not be restricted to the hospitals panel of dais and doula. Reproductive and child
health programs may provide for allowances to dais and doula support for
socioeconomically disadvantaged women from remote and rural areas who are not able
to afford to hire dais and doulas. In such cases, the concerned ASHAs may be required
to accompany the parturient mothers and be eligible for appropriate allowance for continuous labor support.

d. Modify labor room layouts to allow for privacy to each laboring woman and the presence of her dai or doula.

e. The dai or doula support policy is to be independent of and in addition to policies regarding allowing presence of family members as may be required by parturient women.

f. Revise accreditation and empanelment norms for private hospitals and nursing homes, requiring appropriate policies and practice enabling continuous labor support by dais and doulas.

4. **Waiting Wards:**

   a. Build and maintain waiting wards for low obstetric risk women reporting before actual onset of labor or in false labor. Waiting wards should be located within the hospital campus, preferably separate from the main hospital building, but with easy access to the labor ward. These minimally staffed areas should allow access to family members, dais and doulas.

   b. Adopt strict admission criteria to the labor ward, in terms of cervical effacement or dilatation.

   c. Allow for easy two way transfers between waiting and labor wards depending actual onset of labor.

   d. Waiting wards will not only improve institutional deliveries by women in remote and rural areas but also improve quality of obstetric care and reduce the risk of early elective inductions and early elective cesareans.

5. **Collaborative Birth Outcome Initiatives:**

   a. Institute voluntary collaborative birth outcome initiatives to accelerate improvements in quality of maternity services, adoption of evidence-based midwifery and obstetric care, enhance birth outcomes and reduce unnecessary operative interventions such as cesarean sections.

   b. The collaborative BOI should be supported by a faculty leadership team, consisting of obstetricians and midwives who have demonstrated commitment to evidence-based maternity care in their own practice.

   c. Engage with and enlist the support of professional associations of stake holders such as obstetricians and midwives.

   d. Engage with and enlist the support of senior administration managerial stake holders of EmOCs, nursing homes, MCH & other hospitals with maternity services.

   e. Recruit EmOCs, nursing homes, MCH & other hospital maternity units, voluntarily agreeing to participate in the collaborative BOI.

   f. Develop change package, identify indicators of change, progress reporting systems and obtain stake holder approval.

   g. Support participating EmOCs, nursing homes, MCH & other hospitals with maternity units, with educational updates, learning sessions, peer visits, discussion groups, periodical meetings and conferences to discuss implementation issues, take stock of progress and develop consensus for further action.

   h. Commission independent evaluations at periodic intervals and take appropriate remedial action.
6. An effective information, education & communication (IEC) program:
   a. A strong IEC program explaining the pros & cons of C-section, by counseling and focused media coverage about the advantages of natural birth process and risks of operative interventions, will help raise awareness.
   b. The IEC campaign should educate and emphasize usefulness of quality enhancing interventions such as birth companions.
   c. The IEC campaign should inform about and discourage useless practices.

7. A Strong Focused Information, Education & Communication (IEC) Campaign to educate potential parents:
   a. About the advantages of natural childbirth for neonatal health.
   b. About the health risks of unnecessary cesarean sections.
   c. Advantages of having a trained dai or doula to provide continuous psychosocial support to parturient mother, in addition to regular maternity care by trained midwife and/or obstetricians.
   d. Advantages of waiting for spontaneous onset of labour instead of inducing labor.
   e. The risk of inadvertent prematurity associated with elective cesarean before onset of labor.
   f. The importance of 39 weeks of gestation and the absolute minimum of 37 weeks of gestation before considering any cesarean, except in case mother’s life is at risk.

Acknowledgments: I appreciate helpful comments and suggestions received from Dr. Sanjeev Upadhyaya, Technical Officer, UNICEF, Hyderabad and his colleagues, on an earlier draft of this white paper. This White Paper was taken up to inform preparation of a policy brief on rising cesarean section rates, in partnership with the UNICEF, Hyderabad.

References:
Ash Alok, Okoh Denis. What is the right number of caesarean sections? [Letters to the Editor]. Lancet 1997; 349(9064):1557.


Engle William A. A recommendation for the definition of "late preterm" (near-term) and the birth weight-gestational age classification system. Semin Perinatol. 2006; 30(1):2-7.


Gyhagen Maria, Bullarbo M, Nielsen Tf, Milsom I. Prevalence and risk factors for pelvic organ prolapse 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or cesarean delivery. BJOG 2013b; 120(2):150-60.


Hildingsson Ingegerd, Rådestad Ingela, Rubertsson Christine, Waldenström Ulla. Few women wish to be delivered by caesarean section. BJOG 2002; 109(6):618-23.


Lerchl Alexander. Where are the Sunday babies? III. Caesarean sections, decreased weekend births, and midwife involvement in Germany. Naturwissenschaften. 2008 Feb; 95(2):165-70.


Patil Mithil M; Nimbargi Vandana, and Meendale SS. Trends of Cesarean Section at Tertiary Care Hospital in India over 10 years. Medical Science. Indian Journal of Applied Research. 2012 Dec; 2(3):153-156. ISSN: 2249-555X.


Sikdar Prabeer Kumar. Telangana hospitals under lens for C-section deliveries. Times of India. Hyderabad; 2015 Apr 3; City: 2 (1-2).


Wiklund Ingela; Edman G; Ryding EL, and Andolf E. Expectation and experiences of childbirth in primipareae with caesarean section. BJOG. 2008 Feb; 115(3):324-31.


Yang Y Tony; Mello Michelle M; Subramnian SV, and Studdert David M. Relationship between malpractice litigation pressure and rates of cesarean section and vaginal birth after cesarean section. Medical Care. 2009; 47(2):234-42.


Zhang J; Troendle J; Reddy UM; Laughon SK; Branch DW; Burman R; Landy HJ; Hibbard JU; Haberman S; Ramirez MM; Bailit JL; Hoffman MK; Gregory KD; Gonzalez-Quintero VH; Kominiarek M; Learman LA; Hatjis CG; van Veldhuisen P, and Consortium on Safe Labor. Contemporary cesarean delivery practice in the United States. American Journal of Obstetrics and Gynecology (AJOG). 2010 Oct; 203(4):326.e1-326.e10.