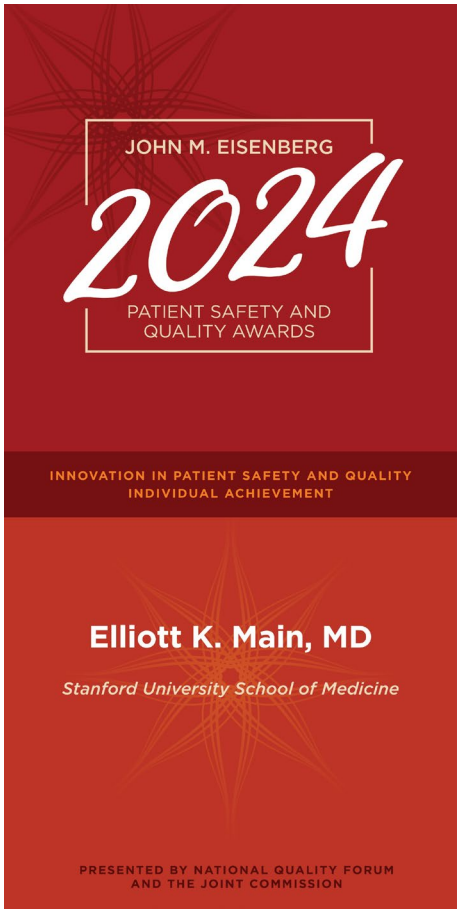

2024 Application Summary for John M. Eisenberg Patient Safety and Quality Award – Individual Achievement Awardee

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Executive Summary

Dr. Main has led maternal quality and safety programs at hospital, health system, state, and national levels. Under his leadership maternal mortality, severe morbidity and cesarean births in California have seen a significant and sustained decline and now serve as a model for national maternal QI activities. In 2006, Dr. Main led the launch of the California Maternal Quality Care Collaborative (CMQCC) and led the first state-wide maternal mortality review committee with a focus on QI. Over the next 17 years he perfected tools and programs for scaling-up maternal QI efforts to state and national levels. He was instrumental in: (1) development and adoption of a first-ever set of national maternity quality measures (NQF, TJC, CMS), (2) first sustained public reporting of OB metrics (by California, TJC, LeapFrog, USNWR, CMS), (3) development of widely-adopted OB QI toolkits, (4) pioneering large-scale maternal QI learning collaboratives (with ≥120 hospitals each), (5) development and adoption of national OB safety bundles by ACOG/HRSA, and (5) the development and support of state Perinatal Quality Collaboratives modeled after CMQCC now in 49 states. He serves as an advisor on maternal QI for CMS, AHRQ, TJC, HRSA, CDC, and WHO.

Describe how the individual (nominee) has addressed an important area for improving patient safety and quality.

High rates of maternal mortality and morbidity has been recognized as a national health crisis. Dr. Main has led the development of key interventions to address this through the creation of large-scale perinatal QI collaboratives with the identification of successful strategies for scaling-up QI programs to have national impact.

In 2006, he founded the CA Maternal Quality Collaborative (CMQCC) and created the model for state Perinatal Quality Collaboratives (PQCs) that is followed nationally. The interventions were developed and tested in California-which is a large-scale test site: nearly 500,000 annual births in 220 hospitals representing 1 of every 8 births in the US.

1. Create the need for change using findings from the CA maternal mortality review committee (Dr Main chaired from 2007 to 2023) and highlighting large hospital variation in multiple OB quality measures.

2. Establish a multidisciplinary maternal quality collaborative to produce 7 QI toolkits (Appendix A) with best practices and extensive practical implementation resources. These toolkits are open source and have each been downloaded >14,000 times throughout CA and across the nation. But toolkits require structured implementation activities.

3. Implement QI toolkits in large-scale hospital learning collaboratives, these have averaged 100-120 hospitals broken into groups of 8-10 with MD and RN mentors leading monthly meetings over 18 months.

4. Create a Rapid-cycle Maternal Data Center (MDC) that provides outcome and quality measure data that are ≤6 weeks old with benchmarks and race stratification and multiple features to support the learning collaboratives (Appendix B). Importantly, Dr. Main designed measure analysis tools that moves beyond reporting of rates and allows hospital leaders to identify their local QI opportunities to guide interventions. The MDC now serves all 220 CA hospitals and most hospitals in Oregon, Washington, and Hawaii.

5. Creation of coalition of partner organizations that can support QI initiatives and exert pressure for change. These include professional, hospital, and community organizations, as well as health plans and purchasers (including Medicaid) and the Department of Public Health. With all organizations pulling in the same direction, the pressure for change is quite strong. Dr. Main brought these strategies to the national AIM initiative based at ACOG (funded by HRSA) that is supporting state PQCs in 49 states.

Describe how the individual has made a significant advancement in the area of patient safety and quality.

Dr Main was instrumental for advancing methods for measuring and reporting maternal healthcare quality and establishing a framework for implementing quality maternity care through national maternal safety bundles.

1) Creation of national quality metrics for obstetrics: Prior to 2006 there were no endorsed quality indicators for obstetrics. Dr. Main led the research to establish (and led the process for NQF endorsement) of all 4 of the current OB metrics now in use by TJC and CMS: PC-02 Low-risk Cesarean rate, PC-05 Exclusive Breastfeeding rate, PC-06 Unexpected Newborn Complications, and PC-07 Severe Obstetric Complications. PC-02 is now a National Outcome Measure. To achieve sustainability, stewardship of these measure has been transferred to NQF while Dr. Main remains an advisor. (Appendix C)

2) Promotion of public reporting of maternity measures (transparency): Dr. Main created a set of partnerships to annually report selected California maternity outcomes on public websites. A major development is that the California HHS Secretary gives annual public awards to hospitals who met national targets. This has proved to be a significant boost to our state QI projects. Dr Main chairs or serves on the TJC, Leapfrog, and US NWR committees for public release of national maternity measures. He is also the lead advisor to CMS for their Birthing Friendly Initiative that will publicly report selected OB measures for every hospital in the US.

3) Establishment of national safety bundles for obstetrics: Building on the successful maternal quality implementation toolkits developed by CMQCC, Dr. Main spearheaded the development of national safety bundles in his role of co-lead for the Alliance for Innovation on Maternal Health (AIM) at the American College of Obstetricians and Gynecologists (ACOG). He chaired the committee for the initial bundle on Hemorrhage and developed the structure for key elements that every hospital should implement: Readiness, Recognition, Response, and Reporting /System learning that is used by all subsequent bundles. In his role at AIM, Dr Main has co-authored or supervised

the publication and dissemination of additional hospital bundles on Hypertension, Sepsis, Cardiac Conditions, Mental Health, Substance Use, and Postpartum Transitions. These are used by every Perinatal Quality Collaborative to lead state QI activities. Of note, Safety Bundle implementation is now required for hospitals to achieve CMS Birthing Friendly designation.

Describe how the individual's contribution has had a proven, direct impact on improving patient safety and quality.

The CA Maternal Mortality Committee, (Dr Main, Chair) identified hemorrhage and hypertension as the most common preventable causes of maternal mortality. These disorders became CMQCC's first toolkits (they now have had 2nd and 3rd editions) and our first state-wide QI collaboratives. 4 cohorts were launched between 2010 and 2014 that reached nearly all 220 CA hospitals. CA maternal mortality fell by 50% during this time period and been sustained. Major reductions were seen in deaths from hypertension (fell by 75%) and hemorrhage from atony (fell by 55%) (Appendix D).

During the same time period, he led a 147-hospital study of severe maternal morbidity (SMM) from hemorrhage using a difference design comparing 99 participating hospitals with 256,541 annual births compared to 48 hospitals not yet adopting the hemorrhage toolkit. The reduction of Hemorrhage SMM was 20.8% in the intervention arm and only 1.2% in the non-intervention group. This paper won a major award from the Society of Maternal Fetal Medicine in 2017.

An analysis of additional data stratified by race and ethnicity found that Black patients had significantly higher rates of SMM at baseline, but Black patients had the greatest impact from the QI interventions, reducing the racial disparity by more than 50%. Most of the residual difference was related to higher rates of prenatal anemia and cesarean delivery among Black patients both potentially preventable (Appendix E). A follow-up survey of hemorrhage bundle implementation found that 100% of CA hospitals had a Hemorrhage Cart and 92% had established standard hemorrhage response protocols, the two most important elements of the toolkit.

Dr Main also led the first cost effective analysis of a maternal QI initiative and found it was both cost-effective (for society) and cost saving (for the hospitals). The largest CMQCC QI initiative was to reduce primary cesarean births which directly or indirectly touched all 220 CA hospitals. CA baseline rate was the same as the US (26.0%). To address this intractable problem, we pulled every identified change lever with the help of our partner organizations and were able to reduce the statewide CA cesarean rate to 22% over 3 years meeting the US HP2030 target while the US rate remained unchanged. Safety and balancing measures, including the composite term baby complications, found no harm. The results above have been sustained for over 4 years. (JAMA 2022 and Appendix F).

Describe how/why the individual's contribution is/was an innovation in the area of patient safety and quality?

Obstetrics was late to the scene for quality improvement. There was little interest, no measures, no leadership, and no consensus on action. This has changed dramatically in the last 15 years due in large portion to Dr Main's efforts. He has a unique career of leading OB QI progressing from Hospital to Health System to State to National levels with lessons and tools created at each level being scaled to the next. Dr Main's most important innovations include:

Development of the full-featured state Perinatal Quality Collaborative (PQC). Obstetric care is largely provided in medium to small community hospitals that have been very resistant to QI. Educational efforts alone did not lead to improvements. Dr. Main developed CMQCC as a multi-faceted organization that included multiple change levers:

1) Rapid access to structure, process, and outcome data (Appendix B).
2) Development and dissemination of OB quality measures (Appendix C).
3) Intensive quality improvement training through toolkits and collaboratives (Appendix D).
4) Extensive partnering with all other organizations involved in maternity care (hospital and professional organizations, payers, purchasers, public health, and community groups) (Appendix A).

To overcome tough QI challenges such as lowering the cesarean rate or reducing maternal mortality, we showed that as many change levers as possible need to be pulled at the same time to generate population impact and second, the more pulled the greater the Collective Impact with significant and sustained impact for tough issues (Appendices D,E,F). The PQC model has shown flexibility as it has moved to new and varied QI topics including developing and testing practical tools for addressing health equity gaps.

National Spread: Formation of AIM, National safety bundles, replication of state PQCs. The success of CMQCC in improving California maternity outcomes states directly led to the formation of the Alliance for Innovation on Maternal Health (AIM) to develop and support PQCs in all states (now totaling 49; see AIM Appendix G). Dr Main has served as the clinical lead and implementation director for AIM and led kick-off meetings in 42 states. Under Dr Main's leadership, AIM developed national safety bundles (see earlier discussion), and AIM has a national maternal data center co-designed by Dr Main. These efforts demonstrate national impact, replicability, and scalability.

Appendix A: California Maternal Quality Care Collaborative (CMQCC)

Background: After successfully leading maternal quality and safety programs at both the level of hospital (~6,000 annual births) and large health system (~40,000 annual births), **Dr Main** was selected by the State of California in 2006 to establish the California Maternal Quality Care Collaborative (CMQCC), to address maternal health issues in California (~500,000 annual births), with a focus on reducing maternal mortality rates (see Appendix D). In 2007, **Dr Main** led the first state maternal mortality review committee that had the specific goal of identifying clinical improvement opportunities and then turning those into statewide quality improvement projects. Committed to evidence-based and data-driven quality improvement. **Dr Main** has served as the Medical Director from establishment in 2006 through April 2023 and currently Clinical Professor in the Stanford Dept of OB/GYN.

Mission: End preventable morbidity, mortality, and racial disparities in maternity care

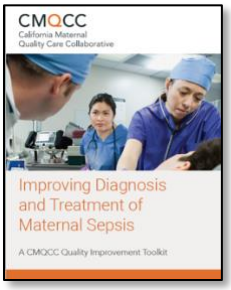
Staffing: Started with a single FTE, now grown to 15 full and part time staff with many volunteer clinicians to support QI projects

Funding: Started with a contract from the California Department of Public Health for a maternal mortality committee and now have diversified mix of contracts, research grants and hospital membership fees. In 2021, CMQCC passed a milestone when 100% of California maternity hospitals were contracted as full members, demonstrating the value that CMQCC provides our membership.

Maternal Data Center Introduction: The Maternal Data Center is a critical value that CMQCC provides to every California hospital (and beyond). It is also the backbone for all CMQCC QI projects allowing very large initiatives to be done with a very reasonable budget. See Appendix B for a full description.

QI Toolkits: CMQCC Maternal Quality Improvement Toolkits aim to improve the health care response to leading causes of preventable death among pregnant and postpartum patients as well as to reduce harm to infants and women from overuse of obstetric procedures. All Toolkits include a compendium of best practice tools and resources, care guidelines in multiple formats, hospital-level implementation guide, and a professional education slide set. They run between 130-210 pages. The Toolkits are developed in partnership with key experts from across California, representing the diverse professional and institutional environments that care for pregnant and postpartum patients. All toolkits are hosted on the CMQCC website and are freely available.[3] On average each toolkit has been downloaded over 14,000 times. They are widely used throughout California and the U.S. Toolkits are reviewed every 3-4 years and revised as needed. Below is the list of Toolkits

- Elimination of Non-medically Indicated (Elective) Deliveries Before 39 Weeks Gestational Age (2010)
- Improving Health Care Response to Obstetric Hemorrhage, V3.0, 2009, 2015, 2022
- Improving Health Care Response to Hypertensive Disorders of Pregnancy, V2.0, 2010, 2021
- Improving Health Care Response to Cardiovascular Disease in Pregnancy and Postpartum, 2017
- Support Vaginal Birth and Reduce Primary Cesareans, v2 2016, 2022
- Improving Health Care Response to Maternal Venous Thromboembolism, 2018
- Mother & Baby Substance Exposure Initiative Toolkit, 2020
- Improving Diagnosis and Treatment of Maternal Sepsis, 2020



QI Collaboratives: After identifying improvement opportunities through research, CMQCC takes a multifaceted solutions-based approach to quality improvement, that: 1) Are based evidence-based quality improvement toolkits; 2) Follow a IHI learning collaboartive model that **Dr Main modified to include MD and RN mentors**[4] to coach the change process in the monthly meetings; 3) Provide hospitals with the perinatal performance metrics and benchmarking data through the Maternal Data Center; and 4) Partner with state agencies, professional groups, consumer organizations and policymakers to support the change process. **Prior Collaboratives**: Hemorrhage-5 cohorts (220 hospitals total) (see appendix E); Hypertension-3 cohorts (78 hospitals total); NTSV Cesarean-5 cohorts (160 hospitals total) (see appendix F); **Current Collaboratives**: Equity and Labor Support 2 cohorts (18 hospitals total); Aspirin to Prevent Preeclampsia Pilot (5 hospitals total); Sepsis 1 cohort to start in October 2023 (expect 60 hospitals). Dr Main also designed a "QI Academy", a 12-month mini-training collaboartive for teams from 6-8 hospital to "learn while doing" an OB QI project—8 cohorts have graduated on a rolling 6-month basis.

Partner Organizations: The spectrum of important partner organizations that have been mobilized to support maternal QI include:
State Agencies: Maternal and Child Health; Vital Records; Regional Perinatal Programs; Office of Statewide Planning
Health Plans: MediCal (Medicaid); Commercial and Medicaid Managed Care Organizations; Blue Network
Professional: State ACOG (OB); AWHONN (nursing); CNMA (midwives); Emergency Medicine; and Anesthesiologists
Hospitals: State Hospital Associations; hospital system leaders (eg. Kaiser, Sutter, etc.); Public hospital leaders
Public/Community: March of Dimes; Community groups; CalHosptialCompare; California Health Care Foundation

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[1] California Maternal Quality Care Collaboartive (CMQCC) comprehensive website: https://www.cmqcc.org/

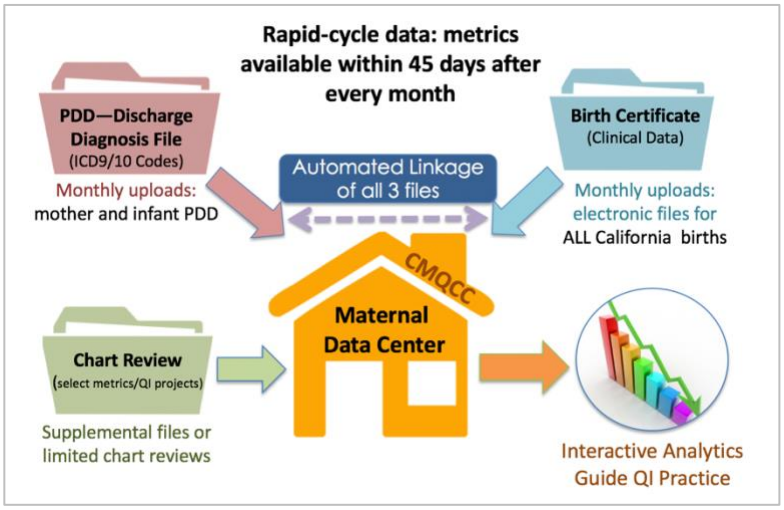
[2] Markow C, Main EK. Creating Change at Scale: Quality Improvement Strategies used by the California Maternal Quality Care Collaborative. Obstet Gynecol Clin N Am. 2019 46:317-328.

[3] CMQCC QI Toolkits: https://www.cmqcc.org/resources-tool-kits/toolkits

[4] Main EK, Dhurjati R, Cape V, Vasher J, Abreo A, Chang SC, Gould JB. Improving Maternal Safety at Scale with the Mentor Model of Collaborative Improvement. Jt Comm J Qual Patient Saf. 2018 May;44(5):250-259.

Appendix B: California Maternal Data Center (MDC)

The Maternal Data Center (MDC) is an online web tool that generates near real-time data and performance metrics on maternity care services for hospital participants.[1] Hospitals submit patient discharge data for mothers and babies – data that they already collect – to the MDC, which instantaneously links the discharge data to birth certificate or clinical data. **Dr Main** negotiated an agreement with the California Vital Records Center to provide CMQCC deidentified birth certificates for every birth, every month.



This provides a rapid cycle data set with minimal effort for the hospital. Hospital systems often provide system feeds. The result is a low-burden tool that gives clinicians the perinatal performance metrics and benchmarking data they need to drive quality improvement.

- All 220 California maternity hospitals participate
- 40 Washington state hospital participate
- 25 Oregon state hospitals participate
- Recently we opened the MDC to hospitals from other states and a number from Hawaii and Texas have joined
- In total, over 1.7 million records are linked each year
- **Low burden, Low Cost, High Value!**

Dr. Main, based on his background in QI and hospital and hospital system leadership, designed the key features and functions of the MDC to make it indispensable for both large scale QI initiatives as well as for hospital day-to-day monitoring of the maternal-infant service line.[2,3] Key features are listed below:

- Automatically generate reports for national-endorsed maternal and neonatal quality metrics, including those used by CMS, The Joint Commission, AHRQ, Leap Frog, US News & World Report, and others including health plan requests
- Run chart displays of over 60 quality and performance measures for mothers and infants (start dates and time intervals are easily configurable on the fly)
- Each measure can be benchmarked by hospital level, hospital volume, hospital type, payer (eg Medicaid vs commercial), for systems and against state/national targets
- Each measure is automatically stratified by race and ethnicity using patient self-identified race from the birth certificate
- All measures have drill-down capabilities to examine numerator cases to facilitate understanding why a rate is elevated
- Selected key measures have a series of sub-measures for further analysis to identify specific QI opportunities for the facility. This "measure analysis" has proven to be a very useful feature to move QI action forward.
- Delivery provider is accurately captured from the Birth Certificate which permits evaluation of each provider's (or provider group's) contribution and performance on quality metrics. This has been invaluable for the Early Elective Delivery and the NTSV Cesarean Delivery measures.
- Analyses that identify ICD-10 coding issues that impact the hospital's measure performance
- Hospital birth statistics are generated, including demographics, utilization, comorbidities and prematurity statistics
- 16 Data quality measures that are logic based (beyond missing and improbable values)
- Caterpillar plots comparing your hospital against all others (deidentified)
- Built-in function for creating Control Charts with opportunities to annotate interventions and change the baseline
- Definitions for all measure denominators and numerators complete with code lists are easily visible and printed
- Support for easy documentation of structure measures used in a quality collaboartive
- Interactive forms for case reviews in QI committees focused on Severe Maternal Morbidity that automatically use data already in the system and frame important review questions

The MDC has 3 full time staff who provide education and user service to hospital staff that has won accolades. A multi-state multi-disciplinary advisory group prioritizes changes and selects new features.

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[1] CMQCC Maternal Data description with link to demonstration site. https://www.cmqcc.org/maternal-data-center

[2] Main EK. Reducing Maternal Mortality and Severe Maternal Morbidity Through State-based Quality Improvement Initiatives. Clin Obstet Gynecol. 2018 Jun;61(2):319-331.

[3] Markow C, Main EK. Creating Change at Scale: Quality Improvement Strategies used by the California Maternal Quality Care Collaborative. Obstet Gynecol Clin N Am. 2019 46:317-328.

Appendix C: National Maternal Quality Measures Developed by Dr Main

1. **Nulliparous Term Singleton Vertex (NTSV) Cesarean Rate (also known as Low-risk First-birth Cesarean) (PC-02)**
   Prior cesarean measures proved unsatisfactory for performance measurement and QI initiatives. NTSV cesarean was conceived in 1994 and following several years of use within the Sutter Health System, **Dr Main** published a description in 1999.[1] The following year, the ACOG Taskforce on Cesarean Delivery Rates[2] cited **Main's** study and chose it as best measure for Cesarean deliveries. Based on the ACOG recommendation, it was quickly adopted by NCHS who has been publishing state rates annually. **Dr Main** has performed a number of QI studies for Cesarean reduction using the measure and successfully applied for NQF endorsement (NQF#0471). The Joint Commission adopted it as PC-02, and subsequently it has been used by LeapFrog and US News& World Report and others for public reporting. Federally, it has been the cesarean measure for HP2010, 2020, and 2030; CMS has adopted it as a Pediatric Core Measure and recently it was chosen as a required measure for Birthing Friendly designation. NTSV Cesarean rate is the central measure for the CMQCC Supporting Vaginal Birth Toolkit.
2. **Under 1500g infants NOT delivered at an Appropriate Level of Neonatal Care**
   This concept was initially proposed by the CDC, but **Dr Main** developed measure specifications and all the validation data and sponsored a successful NQF endorsement (NQF#0477)**.**[4] As we have used it further in CA, it works better as a state/regional measure rather than at the hospital level. In that use, it remains valuable for population health and monitoring regionalization of perinatal care.
3. **Exclusive Breast Feeding Among Term Infants (PC-05)**
   Casual hospital use of formula to partially or completely feed newborns has been shown in multiple studies to significantly reduce successful breastfeeding through 6 weeks of life. Measure specifications were created by **Dr Main**, validated, and successfully taken through the NQF endorsement process (NQF#0480, also as an electronic measure as NQF#0480e).[4] It has subsequently chosen by The Joint Commission as PC-05. It has been a useful measure for preparation for Baby Friendly and WHO 10-steps initiatives to support breastfeeding.
4. **Unexpected Newborn Complications (PC-06)**
   There has long been a demand for a composite measure to identify the most important outcome for families having a birth -- taking home a healthy baby. This measure simply asks: of babies without preexisting conditions (no preemies, multiple gestations, birth defects or other fetal conditions) and who are normally grown and were not exposed to maternal drug use, how many had severe or moderate neonatal complications? It has two levels: Severe and Moderate.[4,5] One critical area for use has been as a safety or balancing metric for QI cesarean initiatives demonstrating that one can lower the cesarean rate and not cause any harm for the infants.[6] Measure specifications were created by **Dr Main**, validated, and successfully taken through the NQF endorsement process (NQF#0716, also as an electronic measure as NQF#0716e), and It is adopted by TJC as PC-06.

Dr Main *has had significant input for two additional national measures, but was not the original developer:*

1. **Elective Delivery Before 39 Weeks Gestation**
   This measure was developed to reduce neonatal harm from elective deliveries at 36-38 weeks of gestation. With The Joint Commission, **Dr Main** adjusted the specifications (PC-01, NQF#0469) and worked with CMMI to have it adopted as the only Obstetric measure on the Medicare Inpatient Quality Report system. **Dr Main** was the lead author on both the CMQCC/March of Dimes QI Toolkit: *Elimination of Non-medically Indicated (Elective) Deliveries Before 39 Weeks Gestational Age*, and the NQF/CMMI Toolkit: *Playbook for the Successful Elimination of Early Elective Deliveries.*
2. **Severe Maternal Morbidity / Severe Obstetric Morbidity (PC-07)**
   This was originally a CDC measure for population health assessment. **Dr Main** has done extensive work to validate it for hospital use,[7] update code sets to ICD-10,[8] create a risk-adjustment model,[9] and serves as the clinical lead on a CMS/Yale CORE/Joint Commission taskforce that is creating a national CMS-required version for hospital use (PC-07).

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[1] Main EK: Reducing cesarean birth rates with data-driven quality improvement activities. Pediatrics, 1999, 103: 374-383.

[2] ACOG Task Force on Cesarean Delivery Rates. Evaluation of cesarean delivery (monograph). Washington, DC: American College of Obstetricians and Gynecologists; 2000.

[3] Main EK, Bloomfield L, Hunt G. Development of a large-scale obstetric quality-improvement program that focused on the nulliparaous patient at term. Am J Obstet Gynecol 190:1747-58, 2004.

[4] CMQCC Quality Measures: https://www.cmqcc.org/focus-areas/quality-measures

[5] Gould JG, Abreo AM, Chang SC, Main EK. Time of Birth and the Risk of Severe Unexpected Complications in Term Singleton Newborns. Obstet Gyecol 2020;136:377-385**.**

[6] Main EK, Chang S, Cape V, Sakowski C, Smith H, Vasher J. Safety Assessment of a Large-Scale Improvement Collaborative to Reduce Nulliparous Cesarean Delivery Rates. Obstet Gynecol 2019;133: Apr;133(4):613-623

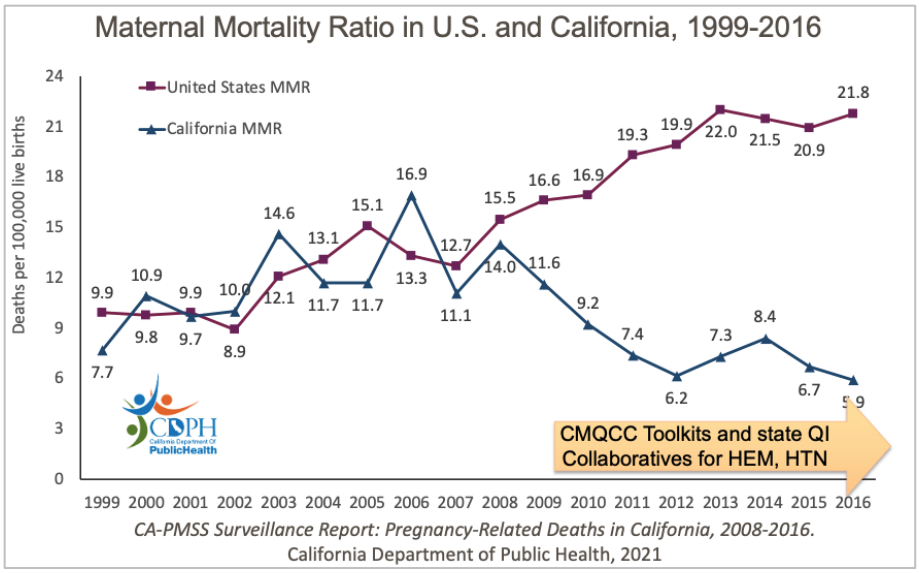
[7] Main EK, Abreo A, McNulty J, Gilbert W, McNally C, Poeltler D, Lanner-Cusin K, Fenton D, Gipps T, Melsop K, Greene N, Gould JB, Kilpatrick S. Measuring severe maternal morbidity: validation of potential measures. Am J Obstet Gynecol. 2016; 214(5):643.e1

[8] Hirai AH, Owens PL, Reid LD, Vladutiu CJ, Main EK. Trends in Severe Maternal Morbidity in the US Across the Transition to ICD-10-CM/PCS From 2012-2019. JAMA Netw Open. 2022 Jul 1;5(7):e2222966

[9] Leonard SA, Kennedy CJ, Carmichael SL, Lyell DJ, Main EK. An Expanded Obstetric Comorbidity Scoring System for Predicting Severe Maternal Morbidity. Obstet Gynecol 2020 Sep;136(3):440-449.

Appendix D: CMQCC Collaborative Impact on California Maternal Mortality Rates

After successfully leading maternal quality and safety programs at both the hospital and large health system levels, **Dr Main** was selected by the State of California in 2006 to establish a state-wide program to address maternal health issues with a focus on reducing maternal mortality rates. Since 2007, **Dr Main** chaired the first state-wide maternal mortality review committee. He established the specific goal of identifying clinical quality improvement opportunities (new idea at the time) and then turning those into statewide maternal quality improvement projects. Qualitative analysis of the mortality reviews identified that provider and hospital improvement opportunities were present in >95% of deaths (review of maternal deaths in Illinois had nearly identical findings).[1] Hemorrhage and hypertension deaths had the highest rating for preventability and were chosen as the first two CMQCC QI Toolkits and the first large-scale QI collaboratives.[2] After a "warm-up" with the HEN initiative, Merck for Mothers funded a large, 130-hospital, multi-cohort intervention trial led by **Dr Main**.[3] These initiatives ran from 2009 thru 2016. At the same time, professional organizations and the hospital association actively supported the initiatives with a communication campaign.

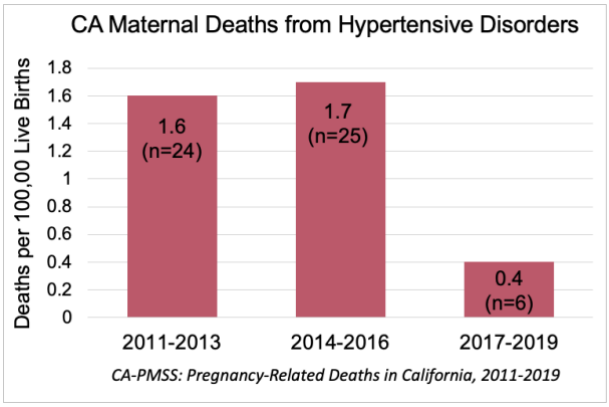


• The CA Department of Public Health run chart on the left shows that CA rates were the same as the overall US rates of Maternal Mortality until after 2009 when they began to decline and then achieved rates of 6-8/100,000 births similar to rates seen in high-resource countries of Western Europe.[4] In the meantime, the US rates have continued to rise to the highest rates ever (not show is the even higher rise of maternal mortality rates seen with COVID-19 in 2020-2021).

• The only interventions in this time period were the statewide Hemorrhage and Hypertension Collaboratives and the extensive maternal mortality awareness campaigns by our professional and hospital organizations. A follow-up survey indicated that every hospital in California now had a Hemorrhage Cart, similar concept to a Crash Cart but loaded with equipment, supplies, and educational materials for a hemorrhage. Most (>86%) also had a stage-based standard treatment protocol for hemorrhage and were also using that for drills.

• Racial inequities for maternal mortality are stark. Black patients in both US and CA have a 3-times higher risk of maternal death than White or Hispanic patients. The rates for Black women also fell by nearly 50% but the disparity continued at 3-times higher.

The rates for individual causes of maternal death are also instructive. The column chart on the right presents the rates of death from hypertension in 3-year intervals. The rate of pregnancy-related deaths from hypertensive disorders of pregnancy (preeclampsia/ eclampsia) decreased significantly in 2017-2019. For the first time, hypertensive disorders were no longer among the top five leading causes of pregnancy-related deaths in California.[5] The Hypertension Toolkit was implemented in the second half of the Statewide safety initiative described above and was focused on rapid treatment (<60min) of severe-range hypertension during delivery admissions and early postpartum follow-up.



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[1] Main EK, McCain CL, Morton CH, Holtby S, Lawton ES. Pregnancy-related mortality in California: Causes, characteristics, and improvement opportunities. Obstet Gynecol. 2015; 2015 Apr;125(4):938-47.

[2] CMQCC OB Hemorrhage Toolkit and Hypertensive Disorders of Pregnancy Toolkit: https://www.cmqcc.org/resources-tool-kits/toolkits

[3] Main EK, Markow C, Gould J. Addressing Maternal Mortality and Morbidity In California Through Public-Private Partnerships. Health Aff (Millwood). 2018 Sep;37(9):1484-1493.

[4] *CA-PMSS Surveillance Report: Pregnancy-Related Deaths in California, 2008-2016*. California Department of Public Health, 2021 www.cdph.ca.gov/Programs/CFH/DMCAH/surveillance/CDPH%20Document%20Library/CA-PMSS/CA-PMSS-Surveillance-Report-2008-2016.pdf

[5] *CA-PMSS: Pregnancy-Related Deaths in California, 2011-2019.* Sacramento: California Department of Public Health, 2022.

Appendix E: CMQCC Collaborative Impact on Maternal Morbidity from Hemorrhage

Obstetric Hemorrhage occurs in 3-5% of births but is quite variable in severity. The goal of most QI projects is to early recognize and rapidly treat bleeding so that it does not spin out of control and develop major complications (Severe Maternal Morbidity or SMM). The OB Hemorrhage Collaboartive led by **Dr Main** studied 99 hospitals who implemented the CMQCC Hemorrhage Toolkit[1] and compared to 44 contemporary hospitals who had not yet implemented the hemorrhage toolkit. Both before and after and difference-in-difference analyses were performed. Over 70,000 patients with hemorrhage were included. The results below show large improvement in the implementation group: 20.8% reduction and even larger in hospitals with prior collaboartive experience.[2]

TABLE 4
Comparison of severe maternal morbidity among hemorrhage patients in collaborative and noncollaborative hospitals and in collaborative hospitals with and without prior hemorrhage collaborative experience

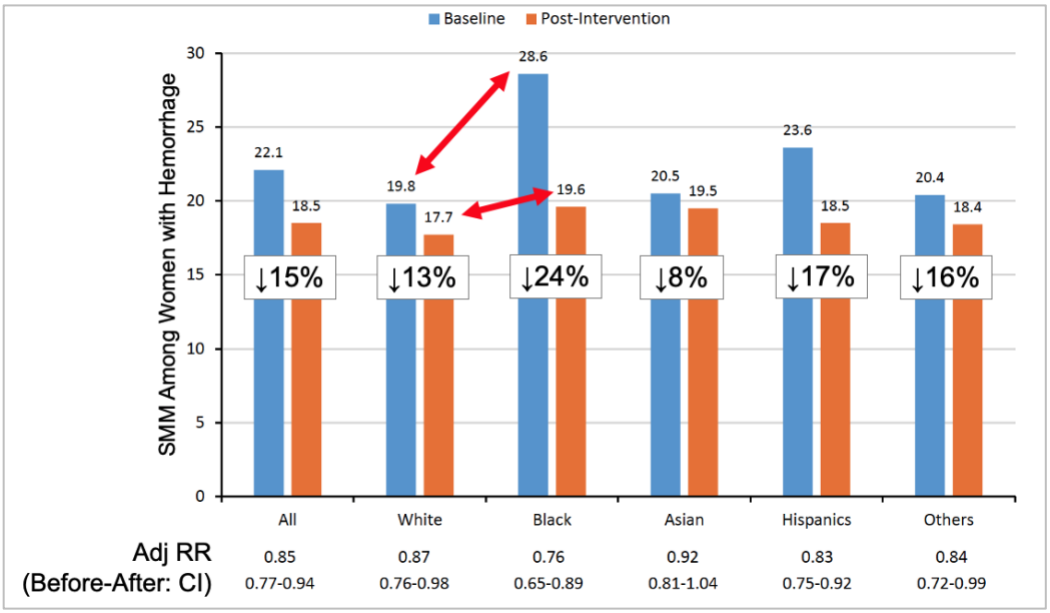
California hospitals with CMQCC rapid-cycle maternal data center	Hospitals, N	Baseline period (4 y), N/D[a]	Baseline SMM-hemorrhage rate (per 100 hemorrhage cases)	Postintervention period (6 mo), N/D[a]	Postintervention SMM-hemorrhage rate (per 100 hemorrhage cases)	Reduction in SMM-hemorrhage	Significance of reduction from baseline to intervention periods, *P* value
Hospitals in CMQCC CPMS	99	13,037/57,320	22.7	1481/8220	18.0	20.8%	<.0001
Without prior hemorrhage collaborative experience	74	7663/33,691	22.7	952/4951	19.2	15.4%	<.0001
With prior hemorrhage collaborative experience	25	5374/23,629	22.7	529/3269	16.2	28.6%	<.0001
Comparison group: hospitals not in collaborative and no prior CMQCC hemorrhage experience	48	4066/14,227	28.6	452/1601	28.2	1.2%	.7713

CMQCC, California Maternal Quality Care Collaborative; *CPMS*, California Partnership for Maternal Safety; *SMM*, severe maternal morbidity.

[a] Denominators (D) indicate number of hemorrhage cases and numerators (N) indicate number among denominator with SMM.

Main et al. Reduction of severe maternal morbidity from hemorrhage. Am J Obstet Gynecol 2017.

A follow-up study[3] with 6 months additional data examined whether there was a differential improvement associated with race. Black patients started with a significantly higher rate of SMM than other racial groups (28.6% compared to White 19.8%). **Black patients had the greatest improvement with introduction of standardized care for hemorrhage**. The remining Black-White gap was now <2%. Factor analysis identified that the drivers leading to the remaining disparity were higher rates of prenatal anemia and higher cesarean rates among Black patients.[4] Both of these drivers should be amenable to improved care in future combined community-medical system QI collaboratives.



These studies demonstrating clinical benefit were followed by a **formal cost-effectiveness study** which was the first to evaluate a perinatal quality collaboartive.[5] The analysis found that the QI collaboartive was both cost effective (for society as a whole) for reducing morbidity and was actually cost saving (reducing costs to the hospital itself) for the majority of birthing hospitals.

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[1] Improving Health Care Response to Obstetric Hemorrhage, CMQCC QI Toolkit. https://www.cmqcc.org/resources-tool-kits/toolkits/ob-hemorrhage-toolkit

[2] Main EK, Cape V, Abreo A, Vasher J, Woods A, Carpenter A, Gould JB. Reduction of severe maternal morbidity from hemorrhage using a state perinatal quality collaborative. Am J Obstet Gynecol. 2017 Mar;216(3):298.e1-298.e11.

[3] Main EK, Chang SC, Dhurjati R, Cape V, Profit J, Gould JB. Reduction in Racial Disparities in Severe Maternal Morbidity from Hemorrhage in a Large-scale Quality Improvement Collaborative. Am J Obstet Gynecol. 2020 Jul;223(1):123.e1-123.e14.

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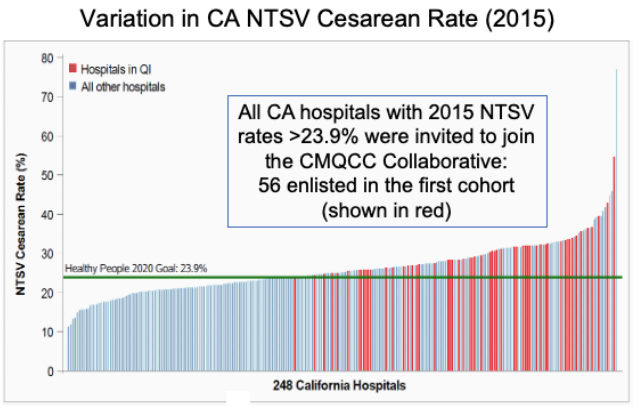
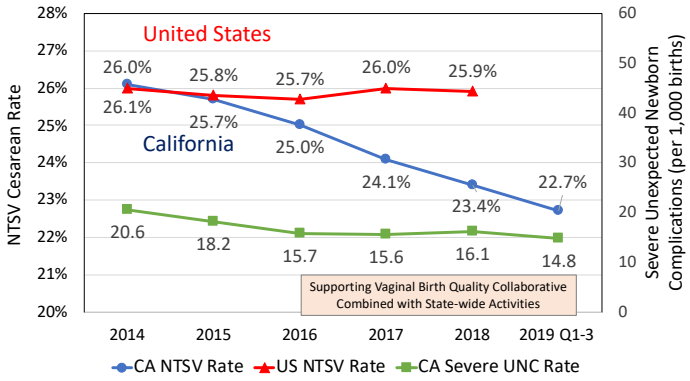
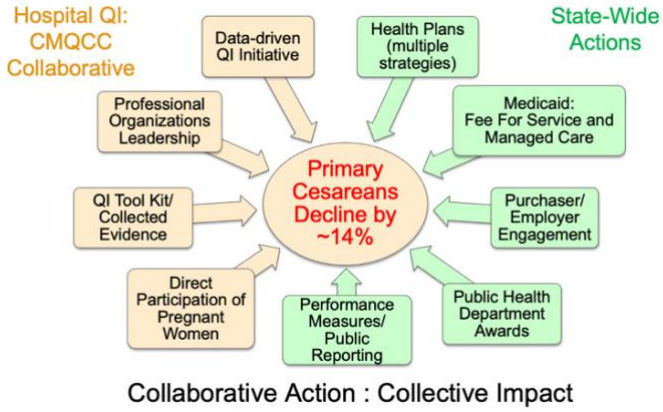
[5] Wiesehan EC, Keesara SR, Krissberg JR, Main EK, Goldhaber-Fiebert JD. State Perinatal Quality Collaborative for Reducing Severe Maternal Morbidity From Hemorrhage: A Cost-Effectiveness Analysis. Obstet Gynecol. 2023 Feb 1;141(2):387-394.

Appendix F: CMQCC Collaborative Impact on First-Birth Cesarean Rates

The rise in cesarean birth since the 1970's has been unprecedented. Total cesarean rates rose from 6% to 33% of all births. All attempts to reduce this trend either failed or success was limited to a 1-2% reduction.[1] The category with the greatest rise is first-birth term vertex singletons (NTSV), hence our creation of the quality measure for that category. Variation among providers is large and appears to be to be related to provider attitudes and unit culture.[2] Variation among hospitals is striking (see graph to the left). **Dr Main** formed a series of QI collaboartive cohorts to support vaginal birth and reduce primary cesarean deliveries. All hospitals with low-risk first-birth cesarean (NTSV) rates higher than the national 2020 target of 23.9% were invited to join a CMQCC QI collaboartive. 56 joined and formed the first cohort. **This group had success in the first year dropping their rates from an average of 29.1% to 24.6%.** We studied this group carefully for any signs of unintended consequences (harms) to either mother or infant and were pleased to be able to report that all balancing metrics were steady and **baby outcomes (the most important) were actually better**.[3] An additional finding was that labor induction was not necessarily protective but in many providers hands it actually led to higher cesarean rates.[4] At the end of the project, analysis of the entire state-wide initiative showed highly significant reduction in cesarean rates from **26.0% (same as the US) to 22.7%, exceeding the HP2020 target of 23.9%.** In comparison, the rate for the entire US did not change in this time period. This paper was published in JAMA with an accompanying editorial.[5] The figure below shows the time course for the Supporting Vaginal Birth Collaborative. Also of note, is that state-wide rates of term neonatal complications (the green line) actually fell while the cesarean rate was reduced. The figure on the right shows the interventions that made the collaboartive a success.







At the outset, the team recognized that reduction of cesarean rates was a particularly difficult QI challenge. Therefore, **Dr Main** recruited as many partner organizations and identified as many change levers as possible. CMQCC did the classic QI collaborative interventions: QI Toolkit, Professional organization leadership, data-driven QI initiative, and patient education videos. In collaboration with our state partners, we add additional levers: Health plan incentives which varied by the plan; Purchaser outreach to hospitals; Annual awards from the CA Secretary of HHS to hospital CEOs for meeting the cesarean target; Extensive transparency efforts including partnering with YELP. Formal factor analysis indicated that the CMQCC Quality Collaborative and the additional state-wide actions had additive effects, each contributing to approximately half of the statewide 14% reduction seen.[6] The concept of multiple QI levers being pulled at the same time has important implications for other difficult QI challenges.

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[1] Main EK, Morton CH, Melsop K, Hopkins D, Giuliani G, Gould JB. Creating a public agenda for maternity safety and quality in cesarean delivery. Obstet Gynecol. 2012 Nov;120(5):1194-8.

[2] White VanGompel E, Perez S, Main EK. Cesarean overuse and the culture of care. Health Serv Res 2019: Apr;54(2):417-424.

[3] Main EK, Chang S, Cape V, Sakowski C, Smith H, Vasher J. Safety Assessment of a Large-Scale Improvement Collaborative to Reduce Nulliparous Cesarean Delivery Rates. Obstet Gynecol 2019;133: Apr;133(4):613-623.

[4] Main EK, Chang SC, Cheng YW, Rosenstein M, Lagrew DC. Hospital-Level variation in the frequency of cesarean delivery among nulliparous women who undergo labor induction. Obstet Gynecol 2020, Dec;136(6):1179-1189.

[5] Rosenstein MG, Chang S-C, Sakowski C, Markow C, Teleki S, Lang L, Logan J, Cape V, Main EK. Hospital Quality Improvement Interventions, Statewide Policy Initiatives and Rates of Nulliparous Term Singleton Vertex Cesarean Deliveries in California. JAMA 2021. Apr 27;325(16):1631-1639.

[6] Rosenstein MC, Chang S-C, Tucker CM, Sakowski C, Leonard SA, Main EK. Evaluation of Statewide Program to Reduce Cesarean Deliveries Among Nulliparous Singleton Term Vertex Gestations. Obstet Gynecol 144(4):p 507-515, October 2024.

Appendix G: AIM—National Maternal Quality Collaborative

The Alliance for Innovation on Maternal Health (AIM) is the national, cross-sector commitment designed to lead in the development and implementation of patient safety bundles for the promotion of safe care for every U.S. birth.[1,2] AIM was established in 2014 based at the American College of Obstetricians and Gynecologists (ACOG) and funded by HRSA/Maternal Child Health Bureau (now in its 3rd funding cycle).[3] **The AIM Safety Bundles are supported by implementation resources and by specific quality metrics and measures through the AIM Data Center.** Patient Safety Bundles are a structured way of improving the processes of care and patient outcomes. They are clinical condition-specific and follow an evidence-based, 5R structure (Readiness, Recognition, Response, Reporting/System learning, and Respectful and Equitable Care), that when performed collectively and reliably have been proven to improve patient outcomes.

The focus of AIM is to engage states organizations to work with hospitals and other key state organizations to implement the bundles and report outcomes. The requirements to become an "AIM State" include having an established State Perinatal Quality Collaboartive (PQC), partnered with the state Department of Health and the state hospital association and have access to statewide perinatal datasets. The first 3 states joined AIM in 2013, and **currently, 49 states plus the District of Columbia are members of AIM.**

Dr Main first proposed AIM in 2012 and has been the lead clinical advisor and a member of the executive committee ever since.[1,2] For the last 8 years, he has also been the National Implementation Director for AIM and has visited in person (or virtually) with 42 state Perinatal Quality Collaboratives to assist in kickoff meetings for bundle adoption.

AIM National Safety Bundles

Obstetric Hemorrhage[4] (released 2014, revised 2021)
Severe Hypertension in Pregnancy (released 2015, revised 2022)
Safe Reduction of Primary Cesarean Birth (released 2015, revised 2021)
Care for Pregnancy and Postpartum People with Substance Use Disorder (released 2018, revised 2021)
Perinatal Mental Health Conditions (released 2018, revised 2022)
Postpartum Discharge Transition (released 2019, revised 2022)
Cardiac Conditions in Pregnancy (released 2021)
Sepsis in Obstetric Care (released 2022)

Dr Main led the development taskforce and was the lead author for the first bundle--Obstetric Hemorrhage[4]--which created the structure and the **5R model (Readiness, Recognition, Response, Reporting and Respectful Care) used by all subsequent bundles**. He coauthored 4 other bundles and led the process for quality measure development and editing for all 8 bundles.

AIM has mobilized important national partners to work collaboratively on reducing maternal morbidity and mortality. The Joint Commission has adopted the Hemorrhage and Hypertension bundles as standards for hospital accreditation. More recently, CMS has included adoption of the Hemorrhage, Hypertension, and Sepsis bundles as a key part of the Birthing Friendly Hospital measure to be reported by all hospitals in 2024. Blue Distinction has included the bundles of part of their award program for Blue Cross and Blue Shield Health Plans. As a representative of AIM, **Dr Main** met multiple times with each of these organizations. The power of these organizations has strongly encouraged the participation in AIM of the large majority of U.S. hospitals

CDC also has funding to directly support the formation of state Perinatal Quality Collaboratives but depend on AIM for Safety Bundles and implementation resources. CDC established the National Network of Perinatal Quality Collaboratives (NNPQC). To ensure close collaboration, **Dr Main** has served on the NNPQC Executive Committee since its formation and was co-Chair for the first 2 years.

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[1] Main EK, Menard MK. Maternal mortality: time for national action. Obstet Gynecol 2013 Oct;122(4):735-6.

[2] D'Alton ME, Main EK, Menard MK, Levy BS. The National Partnership for Maternal Safety. Obstet Gynecol. 2014 May;123(5):973-7.

[3] Alliance for Innovation on Maternal Health (AIM). https://saferbirth.org/

[4] Main EK, Goffman D, Scavone BM, Low LK, Bingham D, Fontaine PL, Gorlin JB, Lagrew DC, Levy BS. National Partnership for [1] Maternal Safety: Consensus Bundle on Obstetric Hemorrhage. Obstet Gynecol. 2015 Jul;126(1):155-62. Simultaneous publication in 4 specialty society journals: Obstetrics and Gynecology [American College of Obstetricians and Gynecologists], Journal of Obstetric; Gynecologic & Neonatal Nursing [Association of Women's Health Obstetric and Neonatal Nursing]; Journal of Midwifery and Women's Health [American College of Nurse Midwives]; and Anesthesia and Analgesia [Society of Obstetric Anesthesia and Perinatology].

[5] Henderson ZT, Ernst K, Simpson KR, Berns S, Suchdev DB, Main E, McCaffrey M, Lee K, Rouse TB, Olson CK. The National Network of State Perinatal Quality Collaboratives: A Growing Movement to Improve Maternal and Infant Health. J Womens Health (Larchmt). 2018 Mar;27(3):221-226.

BIOGRAPHICAL SKETCH

NAME: Elliott K. Main, M.D. eRA COMMONS USER NAME: MAIN.ELLIOTT

CURRENT POSITION: Professor of Obstetrics and Gynecology, Stanford University School of Medicine
Medical Director Emeritus, California Maternal Quality Care Collaborative

EDUCATION/TRAINING:

INSTITUTION	DEGREE	Completion Date	FIELD OF STUDY
Yale University	BA	05/1973	Pre-Medical Sciences
University of Vermont College of Medicine	MD	05/1977	Medicine
Washington University School of Medicine	Residency	06/1981	OB/GYN
University of Pennsylvania, School of Medicine	Fellowship	06/1985	Maternal-Fetal Medicine

A. Key Positions

2018- Clinical Professor, Obstetrics and Gynecology, Stanford University, School of Medicine
2013- National Implementation Lead, Alliance for Innovation on Maternal Health(AIM) (HRSA-MCHB project for implementing maternal safety/quality bundles in all states
2011-2018 Clinical Professor, Department of Obstetrics, Gynecology and Reproductive Sciences, University of California, San Francisco (UCSF), San Francisco, CA
2006- Chair, California Pregnancy Associated Mortality Review Advisory Committee (first ever CA-wide maternal mortality review committee)
2006-2023 Medical Director, California Maternal Quality of Care Collaborative (>220 hospitals, >450,000 annual births)
1998-2013 Chairman, Department of Obstetrics and Gynecology, California Pacific Medical Center, San Francisco, CA
1997-2015 Chair, Obstetrical Quality Committee, Sutter Health (18 hospitals, 40,000 annual births)
1992-2011 Chief of Obstetrics, Department of Obstetrics and Gynecology, California Pacific Medical Center, San Francisco, CA
1992-2002 Assistant Clinical Professor, Department of Obstetrics and Gynecology, Stanford University School of Medicine, Palo Alto, CA
1987-1995 Assistant Professor in Residence, Department of Obstetrics, Gynecology and Reproductive Sciences, University of California, San Francisco, San Francisco, CA
1984-1987 Assistant Professor of Obstetrics and Gynecology, University of Pennsylvania School of Medicine, Philadelphia, PA

B. Other Relevant Quality and Safety Experience

2023- Member, WHO Guideline Development Group (GDG) on Postpartum Hemorrhage
2020-2022 Member, WHO Technical Committee for Postpartum Hemorrhage Following Cesarean Birth
2016-2018 Co-Chair, Center for Medicare and Medicaid Services (CMS) Learning and Action Network-Maternity Care
2012- Chair, Perinatal Technical Advisory Committee, The Leap Frog Group
2012-2015 Member, California Medi-Cal Performance Advisory Committee (to re-design the California Department of Health Care Service's Medicaid quality strategy under direction of Ken Kizer)
2012-2013 Member, CMS Expert Panel on Improving Maternal and Infant Health Outcomes in Medicaid/ Children's Health Insurance Program (CHIP)
2012-2013 Co-Chair (with M. Kathryn Menard), American College of Obstetricians and Gynecologists (ACOG) reVITALize project: a national multi-stakeholder effort to improve maternity administrative data (Birth Certificate and Discharge Diagnosis coding)
2011- Member, Perinatal Technical Advisory Committee, The Joint Commission
2011-2019 Co-Chair (with William Callaghan), ACOG / CDC Maternal Mortality Special Interest Group
2010-2012 Co-Chair (with Charles Lockwood), American Medical Association- Physician Consortium for Performance Improvement (AMA-PCPI) Workgroup on Obstetric Quality Measures
2002-2003 Member, California Taskforce for Postpartum Quality Measures (P. Romano, UC Davis, Chair)
1976- Alpha Omega Alpha Society

C. Contributions to Quality and Safety Science (selected from >175 peer reviewed articles)

Severe Maternal Morbidity and Maternal Mortality Background

- Main EK, Menard MK. Maternal mortality: time for national action. Obstet Gynecol 2013 Oct;122(4):735-6.
- Main EK, McCain CL, Morton CH, Holtby S, Lawton ES. Pregnancy-related mortality in California: Causes, characteristics, and improvement opportunities. Obstet Gynecol. 2015; 2015 Apr;125(4):938-47.
- Leonard SA, Main EK, Carmichael SL. The contribution of maternal characteristics and cesarean delivery to an increasing trend of severe maternal morbidity. BMC Pregnancy Childbirth. 2019 Jan 9;19(1):16.
- Carmichael SL, Girsen AI, Ma C, Main EK, Gibbs RS. Using Longitudinally Linked Data to Measure Severe Maternal Morbidity Beyond the Birth Hospitalization in California. Obstet Gynecol. 2022 140:450-2.

Maternal Quality Measures

- Main, EK: Reducing cesarean birth rates with data-driven quality improvement activities. Pediat 1999:103: 374-383.
- Main EK, Moore D, Farrell B, Schimmel LD, Altman RJ, Abrahams C, Bliss MC, Polivy L, Sterling J. Is there a useful cesarean birth measure? Assessment of the nulliparous term singleton vertex cesarean birth rate as a tool for obstetric quality improvement. Am J Obstet Gynecol 2006;194:1644-51.
- Main EK, Abreo A, McNulty J, Gilbert W, McNally C, Poeltler D, Lanner-Cusin K, Fenton D, Gipps T, Melsop K, Greene N, Gould JB, Kilpatrick S. Measuring severe maternal morbidity: validation of potential measures. Am J Obstet Gynecol. 2016; 214(5):643.e1-643.e10.
- Gould JG, Abreo AM, Chang SC, Main EK. Time of Birth and the Risk of Severe Unexpected Complications in Term Singleton Newborns. Obstet Gyecol 2020**;**136:377-385**.**
- Leonard SA, Kennedy CJ, Carmichael SL, Lyell DJ, Main EK. An Expanded Obstetric Comorbidity Scoring System for Predicting Severe Maternal Morbidity. Obstet Gynecol 2020 Sep;136(3):440-449.
- Main EK. Composite Perinatal Morbidity Metrics: Getting closer but still with challenges. Paediatr Perinat Epidemiol. 2022;36:202–204.

Maternal Quality Collaboratives / National AIM Initiative

- Main EK, Goffman D, Scavone BM, Low LK, Bingham D, Fontaine PL, Gorlin JB, Lagrew DC, Levy BS. National Partnership for Maternal Safety: Consensus Bundle on Obstetric Hemorrhage. Obstet Gynecol. 2015 Jul;126(1):155-62. [Simultaneous publication in 4 journals]
- Main EK, Markow C, Gould J. Addressing Maternal Mortality and Morbidity In California Through Public-Private Partnerships. Health Aff (Millwood). 2018 Sep;37(9):1484-1493.
- Henderson ZT, Ernst K, Simpson KR, Berns S, Suchdev DB, Main E, McCaffrey M, Lee K, Rouse TB, Olson CK. The National Network of State Perinatal Quality Collaboratives. J Womens Health (Larchmt). 2018 Mar;27(3):221-226.
- Main EK. Reducing Maternal Mortality and Severe Maternal Morbidity Through State-based Quality Improvement Initiatives. Clin Obstet Gynecol. **2018** Jun;61(2):319-331.
- Wiesehan EC, Keesara SR, Krissberg JR, Main EK, Goldhaber-Fiebert JD. State Perinatal Quality Collaborative for Reducing Severe Maternal Morbidity From Hemorrhage: A Cost-Effectiveness Analysis. Obstet Gynecol. 2023 Feb 1;141(2):387-394.
- Main EK, Sakowski C. How State Perinatal Quality Collaboratives Can Improve Rural Maternity Care. Clin Obstet Gynecol. 2022 Dec 1;65(4):848-855.
- Smith KL, Main E, Bauer ME; Maternal Sepsis Community Leadership Board. Moving from Principle to Practice: A Researcher's Guide to Co-Leading Engaged Research with Community Partners and Patients with Lived Experience to Reduce Maternal Mortality and Morbidity for Maternal Sepsis. Matern Child Health J. 2024 Jun 18. doi: 10.1007/s10995-024-03954-y.

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- Main EK, Morton CH, Melsop K, Hopkins D, Giuliani G, Gould JB. Creating a public agenda for maternity safety and quality in cesarean delivery. Obstet Gynecol. 2012 Nov;120(5):1194-8.
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- Main EK, Chang SC, Cheng YW, Rosenstein M, Lagrew DC. Hospital-Level variation in the frequency of cesarean delivery among nulliparous women who undergo labor induction. Obstet Gynecol 2020, Dec;136(6):1179-1189.
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- Rosenstein MG, Chang S-C, Sakowski C, Markow C, Teleki S, Lang L, Logan J, Cape V, Main EK. Hospital Quality Improvement Interventions, Statewide Policy Initiatives and Rates of Nulliparous Term Singleton Vertex Cesarean Deliveries in California. JAMA 2021. Apr 27;325(16):1631-1639.
- Rosenstein MC, Chang S-C, Tucker CM, Sakowski C, Leonard SA, Main EK. Evaluation of Statewide Program to Reduce Cesarean Deliveries Among Nulliparous Individuals With Singleton Pregnancies at Term Gestation in Vertex Presentation. Obstet Gynecol 144(4):p 507-515, October 2024.