

CONTAGIOUS COMMENTS

Department of Epidemiology

Special Edition: **State of the Health of Colorado's Children**

Attached is a ten-year analysis of the trends in rates of hospitalization of Colorado's mothers and children. Some progress has been made, but there is much more we all can do to be sure every child has a true medical home!

Highlights

Colorado Mother's & Children's Healthcare: 2010 – Current Status

- Fewer mothers and children in Colorado have private health insurance resulting in an increasing strain on public sector resources and systems.
- Mothers and children with public or no health insurance have worse health outcomes as measured by hospitalization rates.
- The poor health outcomes in mothers and children with public or no health insurance are associated with indicators of a lack of access to and/or utilization of a consistent, quality medical home.
 - Not all mothers and children have consistent healthcare insurance
 - Not all insured mothers and children have access to consistent primary care
 - Not all primary care settings provide true “medical home” care
 - Not all families consistently utilize available primary care services

Colorado Mother's & Children's Healthcare: 2010 – Action Plan

- Colorado has become a national leader in providing a medical home for all children but more needs to be done:
 - Assure all mothers and children have consistent healthcare insurance (Eliminate Uninsured, Churning)
 - Assure all insured mothers and children have access to consistent primary care
 - Assure all primary care settings provide true “medical home” care
 - Educate families to consistently utilize primary care services
- To continue to improve healthcare outcomes, Colorado needs access to and analysis of better data.
 - It will be critical to support the efforts of the All-Payer Claims Database (APCD) Advisory Committee in the development of an all-patient, all-provider, all-payer database with claims (and hopefully outcome) data to more effectively identify and remedy the risk factors associated with the disparity of outcomes noted in this current analysis.

There is an Ethical case and a Business case for providing a Medical Home for all Colorado's children

- There is nothing in our current analysis that would suggest that universal access to effective and efficient medical-home-based, preventive and primary care for mothers and children cannot be achieved with a commensurate reduction in avoidable ED use and hospitalization and improvement in health outcomes.
- There is an economic (\$250 million) as well as humanitarian incentive to improve healthcare access and quality for all of Colorado's mothers and children.

Widening Disparities in Hospitalization Rates of Colorado's Mothers and Children from 2000-2009: An Opportunity to Improve Care and Reduce Costs

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❖ Introduction

A recent publication documented the disparities in morbidity, mortality, and charges for hospitalized Colorado children with public or no health insurance as compared to those with private insurance from 1995-2003.¹ Since then, our ongoing analysis, now covering 2000 to 2009 and including newborns and their mothers, shows these disparities have actually increased in many disease categories. There are some encouraging trends in a few categories (e.g. vaccine-preventable disease) suggesting that, by providing a quality medical home with a greater emphasis on prevention and acute primary care, outcomes can be improved for Colorado mothers and children with commensurate hospital charge savings in the hundreds of millions of dollars.

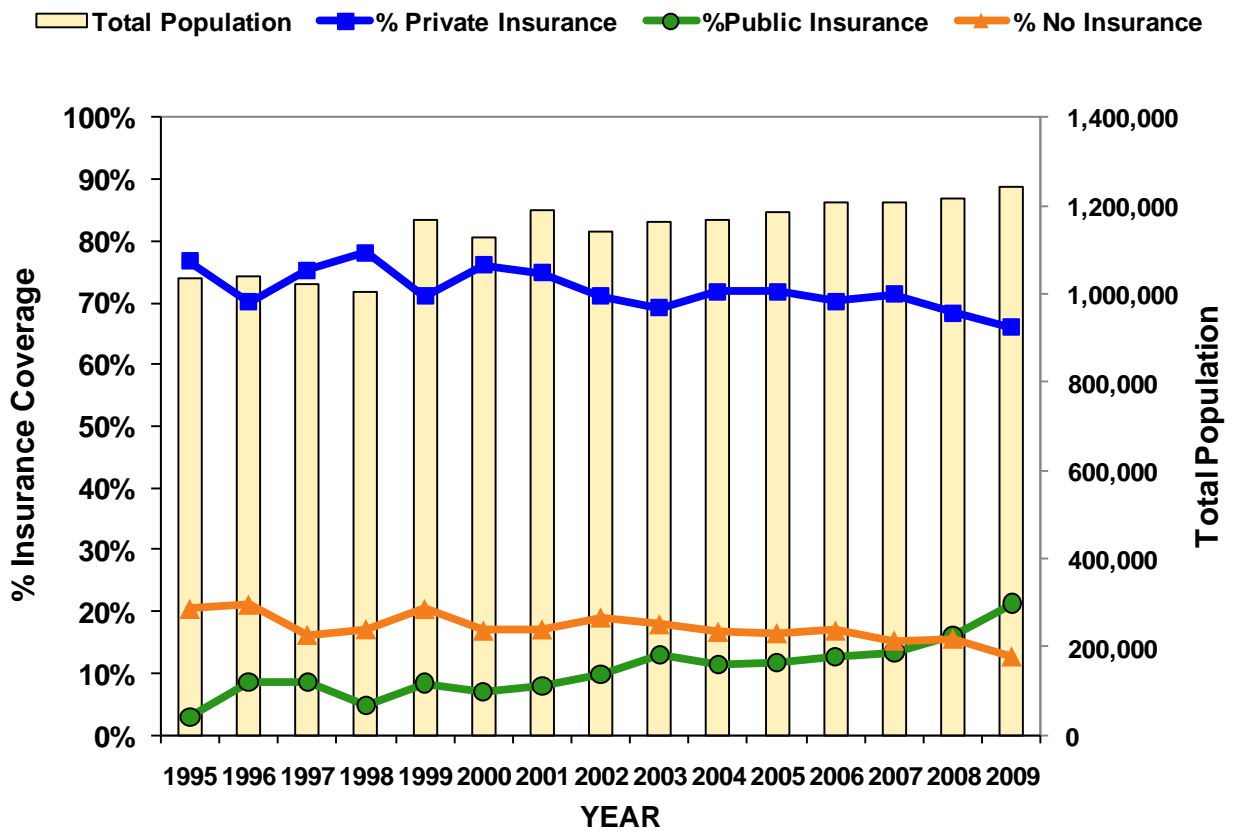
❖ Summary of Results:

- 1. The percentages of Colorado children ages 1 month to 17 years with private health insurance or no insurance have gradually decreased with a commensurate increase in those covered with public health insurance. [page 2]**
- 2. Hospitalization rates for many health outcomes (morbidity, mortality, charges) for hospitalized children with public or no health insurance have increased from 2000 to 2009 while decreasing for those with private insurance. [page 3]**
- 3. Comparisons of hospitalization rates for children with private health insurance and those with public or no health insurance suggest opportunities to improve health care for all Colorado children. [pages 4 - 6]**
- 4. The number of Colorado births with private health insurance is gradually decreasing: 45% of births currently have public or no health insurance with increased rates of admission for complications in the newborn period. [page 7]**
- 5. The number of Colorado pregnant women with private health insurance is gradually decreasing: 45% of pregnant women currently have public or no health insurance associated with increased rates of admission for pregnancy complications. [page 8]**
- 6. Excess hospitalization charges for Colorado children and newborns with public or no health insurance approximated \$263 million in 2009 with an additional \$21 million for Colorado mothers with poor prenatal care. [page 9]**
- 7. Discussion. [pages 10-13]**
- 8. Appendices (Methods, Limitations). [pages 14 - 16]**
- 9. References. [page 17]**

1. The percentages of Colorado children ages 1 month to 17 years with private health insurance or no insurance have gradually decreased with a commensurate increase in those covered with public health insurance.

Since 1995, the population of children in Colorado 1 month to 17 years of age has gradually increased to over 1.2 million in 2009 (Figure 1). At the same time the percentage of children covered by private insurance for at least part of the year has decreased with a commensurate increase in children covered by public insurance (Medicaid, SCHIP) and a decrease in those without any health insurance. Although these trends have been consistent over the past 15 years they seem to have accelerated in 2008 and 2009. In 2009 an estimated 66.0 % of Colorado children were covered by private health insurance down from 78.8 % in 1998 – a greater than 10% decrease. An estimated 12.7% of Colorado children still had no health insurance for at least part of the 2009 down from a high of 20.5% in 1996, and an estimated 21.3% were covered with public insurance up from 2.8% in 1995.

Figure 1: Health Insurance Status of Colorado Children, 1995-2009 (Source: US Census)



2. Hospitalization rates for many health outcomes (morbidity, mortality, charges) for children with public or no health insurance have increased from 2000 to 2009 while decreasing for those with private insurance.

As shown in Table 1, hospitalization rates for Colorado children with private health insurance have been decreasing from 2000 to 2009 in most disease categories although adjusted average charges have steadily increased. Over the same time, hospitalization rates for children with public or no health insurance have been increasing in many disease categories with widening gaps between their rates and those with private health insurance. Children with public or no health insurance were hospitalized 2.19 times more often in 2007-2009 than children with private insurance. They were hospitalized significantly (1.38-3.20 times) more often for: chronic disease, asthma, diabetes, vaccine-preventable disease, psychiatric disease, bronchiolitis and ruptured appendix, and were 2.52 times more likely to be admitted through the emergency department, 2.32 times more likely to be admitted with a high severity of illness, and 2.82 times more likely to die during hospitalization. Hospital charges per "insured" child were 1.98 times higher for children having public or no health insurance than for those with private insurance.

In all disease categories except psychiatric admissions, bronchiolitis and vaccine-preventable diseases, the rates of hospitalization increased in children with public or no insurance and gaps widened as compared to those with private insurance. If Colorado children with public or no health insurance in 2009 had the same rates of hospital morbidity and charges as children with private insurance, some proportion of \$185 million dollars in charges could have been saved and/or reallocated to improve access or quality of care.

| Disease Categories | Average Yearly Rate/100,000 (2007 to 2009) | | Relative Risk (2007-2009) | Estimated Charge Savings in Millions: 2009 | Trend 2000 to 2009 ^a | | |
|---|--|-------------|---------------------------|--|---------------------------------|----------------------|-----------------------------|
| | Private | Public/None | Public/None vs Private | Public/None vs Private | Private Rate Trend | Public/No Rate Trend | Relative Risk Disparity Gap |
| Psychiatric Disease | 153 | 213 | 1.38*** | \$5 | Decreasing* | Decreasing* | Not Changing |
| Charges (\$ per covered child) ^b | \$417 | \$827 | 1.98** | | Increasing** | Increasing*** | Widening*** |
| Ruptured Appendix | 23 | 48 | 2.06*** | \$4 | Decreasing | Increasing* | Widening*** |
| Vaccine Preventable Disease | 8 | 16 | 2.08*** | \$3 | Decreasing** | Decreasing | Not Changing |
| All Hospitalizations | 1,443 | 3,160 | 2.19*** | \$185 | Decreasing** | Not Changing | Widening*** |
| Chronic Disease | 220 | 496 | 2.26*** | \$65 | Not Changing | Increasing*** | Widening*** |
| Severity > 2 | 209 | 484 | 2.32*** | | Decreasing | Increasing | Widening* |
| Hospitalization via ED | 767 | 1,928 | 2.53*** | \$117 | Decreasing | Increasing* | Widening*** |
| Diabetes | 28 | 74 | 2.61*** | \$4 | Decreasing | Increasing*** | Widening*** |
| Asthma | 122 | 340 | 2.80*** | \$13 | Not Changing | Increasing*** | Widening*** |
| Fatality Rate | 5 | 14 | 2.82*** | | Decreasing | Not Changing | Not Changing |
| Bronchiolitis | 105 | 336 | 3.20*** | \$17 | Decreasing* | Not Changing | Not Changing |

^aNot Changing: R² < 0.2 and/or p > 0.05; Decreasing: R² > 0.2, slope negative; Increasing: R² > 0.2, slope positive

^bCharges adjusted to 2009 Consumer Price Index

* p < 0.05; ** p < 0.01; *** p < 0.001

3. Comparisons of hospitalization rates for children with private health insurance and those with public or no health insurance suggest possible opportunities to improve health care for all Colorado children.

As shown in Figure 2, 43.6% of the excess hospitalizations in 2009 for those with public or no health insurance consisted of children with ambulatory-sensitive clinical conditions (e.g. asthma, diabetes, vaccine-preventable disease) that might be amenable to strategies to improve preventive and/or primary care for children with acute illnesses.

Except for three categories of illness (vaccine-preventable disease, bronchiolitis and psychiatric disease), the trends in hospitalization rates have generally been increasing for children with public or no health insurance (Example: Table 1, Figure 3 a & b). The opposite seems to be true for children with private insurance, with rates decreasing in most categories with only asthma and chronic disease being unchanged over the last 10 years suggesting the benefit of implementing successful ambulatory-sensitive condition management strategies for all children.

Further analysis of the asthma and diabetes hospitalization categories demonstrates interesting contrasts. Hospitalization rates for both are increasing for children with public or no health insurance while they are stable (asthma) or actually decreasing (diabetes) for children with private insurance (Figure 3: a,b).

Table 2 (next page) shows factors that are related to readmission to the hospital for diabetes and asthma. These rates are higher in children admitted through the emergency department (ED) and lower in privately-insured children. Children living in the Denver metropolitan area are less likely (OR < 1.0) to be readmitted for diabetes but more likely (OR > 1.0) to be readmitted for asthma suggesting that management strategies in the Denver metropolitan area may be more effective for diabetes than asthma.

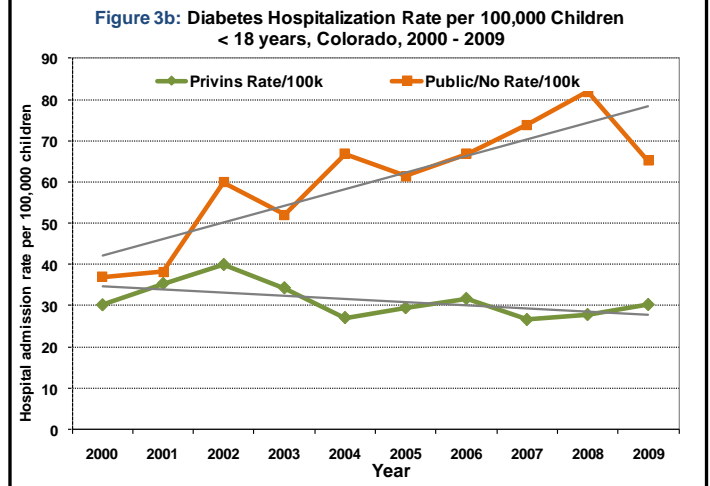
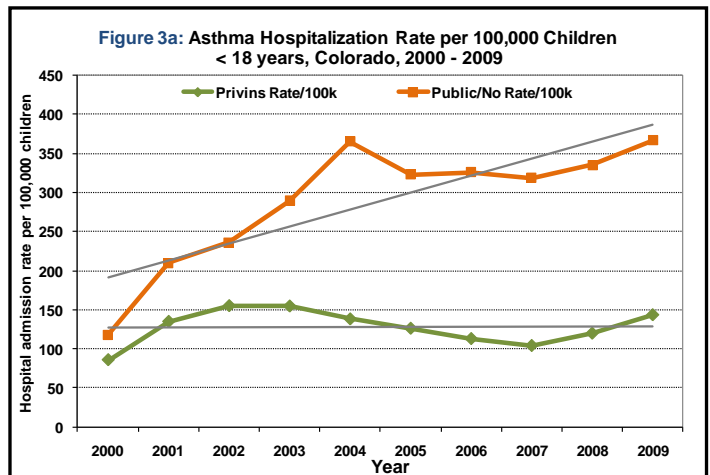
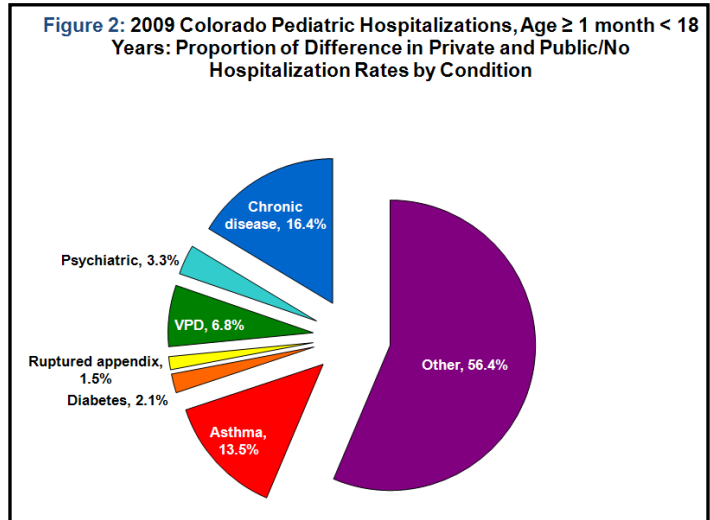


Table 3: Significant Determinates of Readmission for Diabetes and Asthma, 2000 - 2009

| Characteristic | Diabetes | | Asthma | |
|---------------------------|------------------|---------|------------------|---------|
| | OR* (95% CI) | p-value | OR (95% CI) | p-value |
| Male sex: | 0.79 (0.67-0.92) | 0.003 | 1.21 (1.13-1.31) | <0.001 |
| Denver Metro Area: | 0.83 (0.71-0.98) | 0.024 | 1.68 (1.56-1.81) | <0.001 |
| Private insurance: | 0.71 (0.61-0.83) | <0.001 | 0.77 (0.72-0.83) | <0.001 |
| Admit via ED: | 1.32 (1.12-1.55) | <0.001 | 1.08 (1.00-1.17) | 0.041 |

*OR = Odds of being readmitted for same condition

In contrast, as shown in Figure 4, as vaccination rates for Colorado (estimated by the National Immunization Survey) have increased (bars), rates of vaccine-preventable disease have decreased dramatically for both privately-insured (blue line) as well as children with public or no health insurance (red line). The disparity gap between the two insurance groups remains but, overall, it appears that this one element of primary preventive care has proven to be successful for all of Colorado's children.

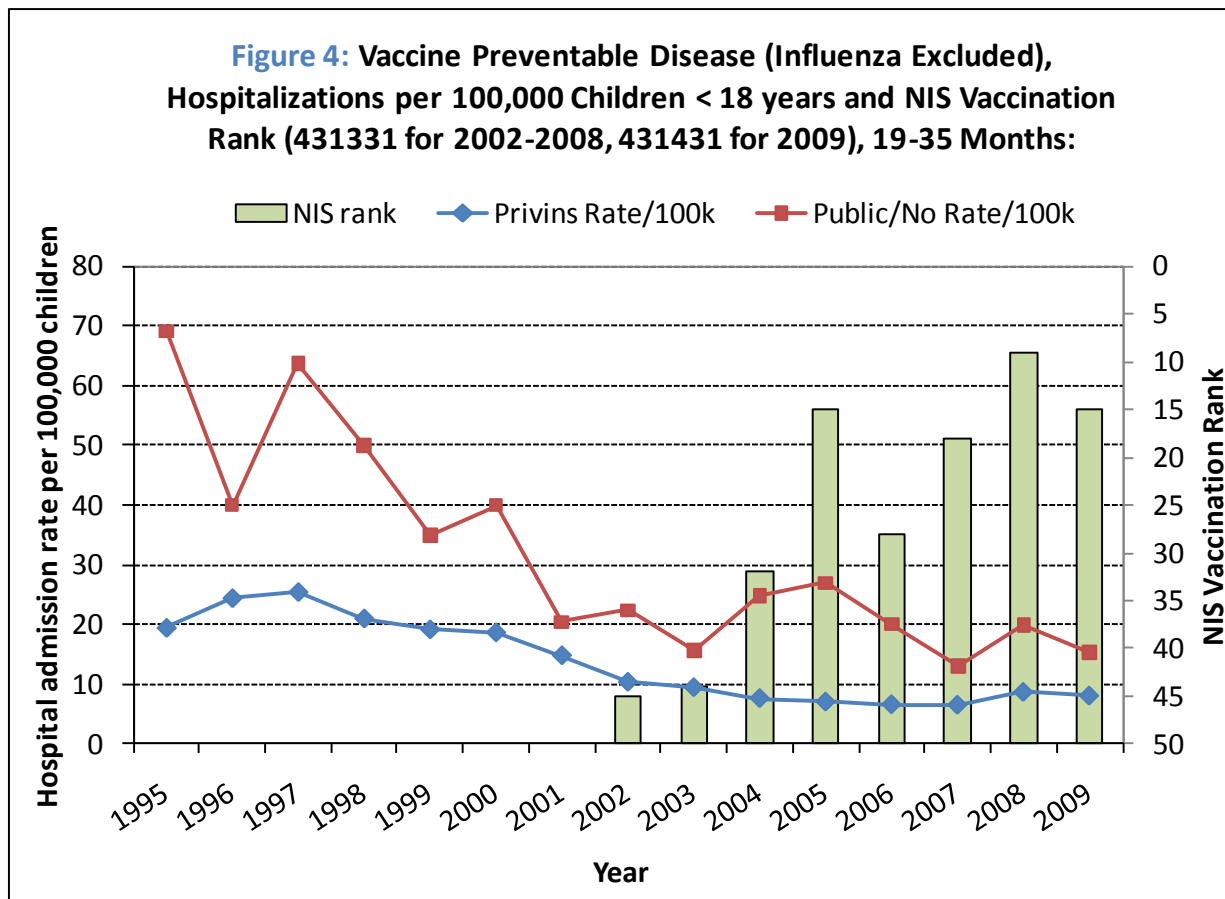


Table 3: Significant Correlates with Hospital Admission for Colorado Children with Public or No Health Insurance as Compared to Children with Private Health Insurance, 2000 – 2009.

| Variable | OR (95% CI) | p-value |
|--|------------------|---------|
| Overall Hospitalizations | | |
| Admission via ED | 1.31 (1.28-1.33) | <0.001 |
| High severity Illness | 1.09 (1.07-1.12) | <0.001 |
| Younger (< 1), Older (> 1) | 0.95 (0.95-0.95) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.37 (1.31-1.43) | <0.001 |
| More recent years (> 1) | 1.09 (1.08-1.09) | <0.001 |
| Asthma | | |
| Younger (< 1), Older (> 1) | 0.97 (0.96-0.97) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.43 (1.17-1.74) | <0.001 |
| More recent years (> 1) | 1.13 (1.11-1.14) | <0.001 |
| Diabetes | | |
| Admission via ED | 0.71 (0.63-0.80) | <0.001 |
| High severity Illness | 1.31 (1.07-1.59) | 0.008 |
| Younger (< 1), Older (> 1) | 1.02 (1.01-1.03) | 0.006 |
| Rural (> 1), Urban (< 1) | 1.47 (1.08-2.01) | 0.015 |
| More recent years (> 1) | 1.15 (1.12-1.17) | <0.001 |
| Ruptured Appendix | | |
| Younger (< 1), Older (> 1) | 0.93 (0.91-0.94) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.67 (1.19-2.33) | 0.003 |
| More recent years (> 1) | 1.09 (1.07-1.12) | <0.001 |
| Vaccine-preventable Disease (not Influenza) | | |
| Admission via ED | 1.28 (1.04-1.57) | 0.020 |
| Younger (< 1), Older (> 1) | 0.95 (0.92-0.97) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.74 (1.11-2.71) | 0.015 |
| More recent years (> 1) | 1.08 (1.04-1.11) | <0.001 |
| Psychiatric | | |
| Admission via ED | 1.55 (1.47-1.64) | <0.001 |
| High severity Illness | 1.45 (1.31-1.60) | <0.001 |
| Younger (< 1), Older (> 1) | 0.92 (0.91-0.93) | <0.001 |
| More recent years (> 1) | 1.04 (1.03-1.05) | <0.001 |
| Chronic Disease | | |
| Admission via ED | 1.48 (1.42-1.55) | <0.001 |
| High severity Illness | 1.15 (1.09-1.20) | <0.001 |
| Younger (< 1), Older (> 1) | 0.95 (0.95-0.96) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.55 (1.36-1.77) | <0.001 |
| More recent years (> 1) | 1.09 (1.08-1.10) | <0.001 |
| Bronchiolitis | | |
| Admission via ED | 1.55 (1.47-1.64) | <0.001 |
| Younger (< 1), Older (> 1) | 0.91 (0.90-0.92) | <0.001 |
| Rural (> 1), Urban (< 1) | 1.77 (1.50-2.08) | <0.001 |
| More recent years (> 1) | 1.08 (1.07-1.10) | <0.001 |

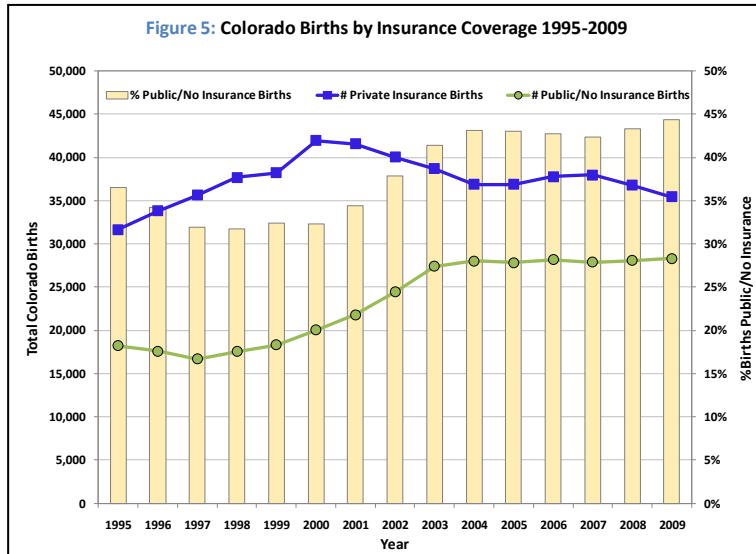
Another important distinction between the two health insurance categories has been the decreasing rate of admission of privately-insured patients through the emergency department implying a preceding acute care visit in a primary care setting prior to admission whereas children with public or no health insurance were increasingly (2.5 times) more likely to be admitted through an emergency department (Table 1). This may also be reflected by the increased likelihood (2 times greater) of being hospitalized with a ruptured appendix for children with public or no health insurance suggesting a lack of access to acute primary care.

The preceding analysis suggests that there are fundamental differences between the way that some children with public or no health insurance utilize health care in Colorado as compared to children with private insurance. Table 3 compares the two insured groups by the available variables that may reflect approaches to health care utilization. An odds ratio (OR) greater than 1.0 means that children with public or no health insurance are more likely to be admitted for that disease with that characteristic: admission through the emergency department [Admission via ED], with increased severity of illness [High Severity illness], a greater likelihood of living in a rural area of Colorado [Rural (< 1), Urban (> 1)], being older [Younger (< 1), Older (> 1)], or more likely to be admitted in more recent years [More recent years (> 1)]. Conversely an odds ratio less than 1.0 means that children with public or no health insurance are less likely to be admitted to the hospital with that characteristic.

For most of the diseases listed in Table 3, children with public or no health insurance who are admitted to the hospital are more likely than children with private insurance to be younger, from rural areas, to be admitted through the emergency department and have a higher severity of illness. Table 3 also validates the recent temporal trend for widening hospital admission disparities in recent years demonstrated in Table 1.

4. The number of Colorado births with private health insurance is gradually decreasing: 45% of births currently have public or no health insurance with increased rates of admission for complications in the newborn period.

In 2009 almost 45% of Colorado births had public or no insurance reflecting a gradual decrease in the number of births with private insurance since the year 2000 (Figure 5). As shown in Table 4, Colorado newborns with public or no health insurance were hospitalized with complications 1.02 to 1.42 times more often in 2007-2009 than children with private insurance, many strongly associated with prematurity (see Appendix, Limitations). They were significantly more likely to have a higher severity of illness and to die in hospital. If Colorado births with public or no health insurance in 2009 had the same outcomes as children with private insurance, \$78 million in hospital charges might have been saved or reallocated. It is concerning the prematurity and low-birth-weight rates are increasing in both those with private insurance and those with public or no insurance.



2009 had the same outcomes as children with private insurance, \$78 million in hospital charges might have been saved or reallocated. It is concerning the prematurity and low-birth-weight rates are increasing in both those with private insurance and those with public or no insurance.

Table 4: Changes in Newborn Hospitalization Rates for Children < 1 month by Insurance Category, Colorado 2000-2009

| Disease Categories | Average Yearly Rate/100,000 (2007 to 2009) | | Relative Risk (2007-2009) | Estimated Charge Savings in Millions: 2009 | Trend 2000 to 2009 ^a | | |
|--------------------|--|-------------|---------------------------|--|---------------------------------|----------------------|-----------------------------|
| | Private | Public/None | Public/None vs Private | Public/None vs Private | Private Rate Trend | Public/No Rate Trend | Relative Risk Disparity Gap |
| Prematurity | 9,323 | 9,474 | 1.02 | | Increasing*** | Increasing*** | Not Changing |
| RDS | 1,846 | 1,921 | 1.04 | | Increasing* | Increasing*** | Not Changing |
| Jaundice | 20,426 | 22,450 | 1.10*** | \$20 | Increasing*** | Increasing*** | Increasing** |
| Wet Lung | 2,473 | 2,752 | 1.11** | \$2 | Decreasing | Not Changing | Not Changing |
| Hypoglycemia | 2,360 | 2,709 | 1.15** | \$2 | Not Changing | Not Changing | Not Changing |
| LBW | 6,705 | 7,825 | 1.17*** | \$25 | Increasing*** | Increasing* | Not Changing |
| Severity > 2 | 5,288 | 6,160 | 1.17*** | \$25 | Increasing* | Increasing*** | Not Changing |
| VLBW | 1,063 | 1,433 | 1.35*** | \$21 | Decreasing | Decreasing | Not Changing |
| Septicemia | 805 | 1,147 | 1.42*** | \$23 | Not Changing | Increasing* | Increasing* |
| Fatality rate | 251 | 406 | 1.62*** | | Not Changing | Not Changing | Not Changing |

^aNot Changing: R² < 0.2 and/or p > 0.05; Decreasing: R² > 0.2, slope negative; Increasing: R² > 0.2, slope positive

^bCharges adjusted to 2009 Consumer Price Index

* p < 0.05; ** p < 0.01; *** p < 0.001

5. The number of Colorado pregnant women with private health insurance is gradually decreasing: 45% of pregnant women currently have public or no health insurance associated with increased rates of admission for pregnancy complications.

In 2009, almost 45% of Colorado's pregnant women had public or no insurance reflecting a gradual decrease in the number with private insurance since the year 2000 (Figure 6). As shown in Table 5, Colorado pregnant women with public or no health insurance were significantly more likely to be hospitalized with complications of pregnancy in many categories but not for preeclampsia. Just as for newborns, there were positive correlations between disease categories, as many complications are related (e.g. premature labor and early delivery), occurring in the same patient. Poor prenatal care and admission through the emergency department showed the highest relative risk associated with the public or no insurance population. These mothers were significantly more likely to have a higher severity of illness. If Colorado mothers with public or no health insurance in 2009 had the same prenatal care as mothers with private insurance, \$21 million in hospital charges might have been saved or reallocated. Of concern, pregnancy complications seem to be increasing in many categories for both privately-insured mothers and those with public or no health insurance.

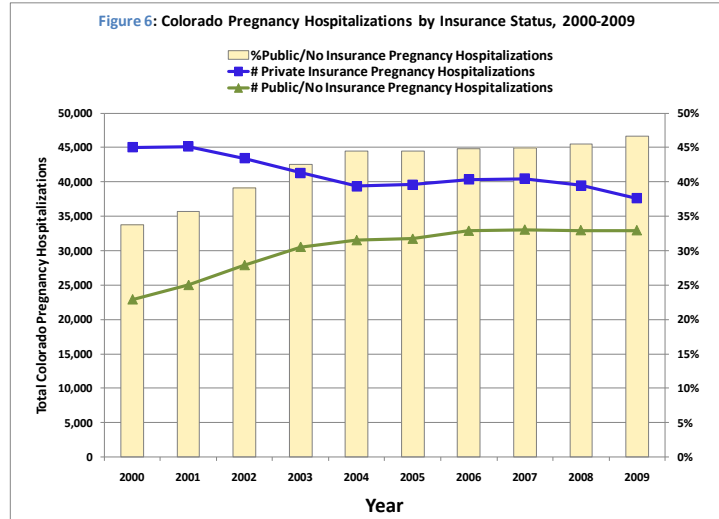


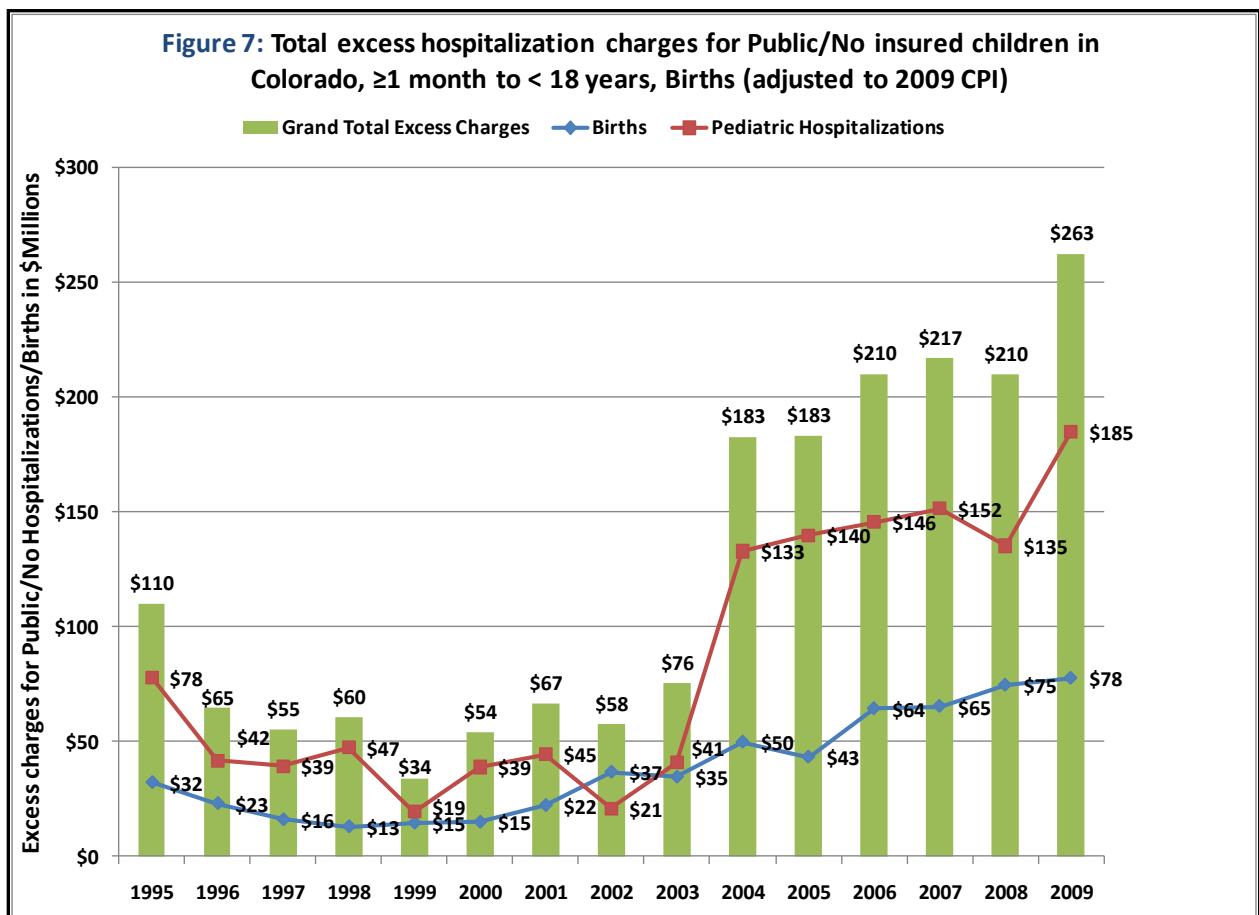
Table 5: Comparison of Changes in Pregnancy Hospitalization Rates by Insurance Category, Colorado 2000-2009

| Disease Categories | Average Yearly Rate/100,000 (2007 to 2009) | | Relative Risk (2007-2009) | Estimated Charge Savings in Millions: 2009 | Trend 2000 to 2009 ^a | | |
|----------------------------|--|-------------|---------------------------|--|---------------------------------|--------------------|----------------------|
| | Private | Public/None | | | Public/None vs Private | Private Rate Trend | Public/No Rate Trend |
| Mild preeclampsia | 2,517 | 2,325 | 0.92 | | Increasing | Not Changing | Not Changing |
| Previous Cesarean delivery | 12,783 | 12,419 | 0.97 | | Increasing*** | Increasing*** | Not Changing |
| Severe preeclampsia | 1,468 | 1,448 | 0.99 | | Increasing*** | Increasing*** | Not Changing |
| Membrane rupture | 4,034 | 3,980 | 0.99 | | Not Changing | Not Changing | Not Changing |
| Post-term delivery | 11,263 | 11,246 | 1.00 | | Increasing** | Increasing*** | Not Changing |
| Precipitous labor | 2,586 | 2,823 | 1.09 | | Decreasing** | Decreasing | Not Changing |
| Fatality | 3 | 10 | 3.86 | | Not Changing | Decreasing | Not Changing |
| Transient preeclampsia | 3,579 | 2,712 | 0.76*** | -\$4 | Not Changing | Not Changing | Not Changing |
| Abnormal fetal heartrate | 15,680 | 14,652 | 0.93*** | -\$4 | Increasing* | Increasing*** | Not Changing |
| Early delivery | 6,773 | 7,445 | 1.10*** | \$3 | Increasing** | Increasing | Not Changing |
| Cesarian delivery | 17,482 | 20,745 | 1.19*** | \$17 | Increasing*** | Increasing*** | Decreasing** |
| Severity ≥ 3 | 6,505 | 8,076 | 1.24*** | \$16 | Increasing** | Increasing* | Not Changing |
| Abnormal glucose tolerance | 3,810 | 4,888 | 1.28*** | \$5 | Increasing | Increasing*** | Increasing* |
| Premature labor | 1,365 | 2,322 | 1.70*** | \$4 | Decreasing*** | Decreasing** | Increasing* |
| Anemia | 11,138 | 19,609 | 1.76*** | \$44 | Increasing** | Increasing*** | Not Changing |
| ED admission | 3,937 | 7,114 | 1.81*** | \$15 | Not Changing | Increasing | Not Changing |
| Poor prenatal care | 950 | 6,707 | 7.06*** | \$21 | Not Changing | Not Changing | Not Changing |

^aNot Changing: R² < 0.2; Decreasing: R² > 0.2, slope negative; Increasing: R² > 0.2, slope positive
^bCharges adjusted to 2009 Consumer Price Index
* p < 0.05; ** p < 0.01; *** p < 0.001

6. Excess hospitalization charges for Colorado children and newborns with public or no health insurance approximated \$263 million in 2009 with an additional \$21 million for Colorado mothers with poor prenatal care.

Figure 7 shows the potential excess charge savings for hospitalization of children and newborns with public or no health insurance in Colorado as compared to those with private health insurance. It is important to emphasize that these estimates represent hospital charges not costs, but nonetheless reflect the proportional impact of different trends in access and utilization of healthcare resources by children in the two different health insurance groups. In 2009, the net excess difference in hospital utilization charges for children with public or no health insurance amounted to \$263 million, rising to \$284 million if excess charges for pregnant women with poor prenatal care were included.



7. Discussion:

Fewer mothers and children in Colorado have private health insurance resulting in an increasing strain on public sector resources and systems.

This analysis of health insurance and hospitalization rates for Colorado mothers and children from 2000 to 2009 demonstrates a number of consistent trends. A decreasing proportion of mothers, newborns and children are covered by private health insurance with a commensurate increase in the proportion covered by public health insurance (Medicaid, SCHIP). Still, in 2009, 12.7% of Colorado's children have no healthcare insurance (an estimated 153,000 children in Colorado)³ although many may be eligible for Medicaid or SCHIP. The shift of mothers, newborns and children from private to public or no health insurance has put a tremendous burden on Colorado's health resources with an estimated \$284 million in excess hospitalization charges in 2009.

The gradual decrease in the percentage of Colorado mothers and children covered with private health insurance and the increase in those covered by public insurance appears to have recently accelerated, likely due to the economic recession.⁴ In 2008-09, 19.4% of Coloradans were uninsured for some part of that time while 10.5% were uninsured for the prior 12 months. This "churning" (disruption in insurance coverage) is a major deterrent to consistent, continuous primary and preventive health care. Colorado currently has one of the fastest growing rates of increase in the number of children (and families) living in poverty which, by definition, puts an additional strain on our limited healthcare (and other) public resources.⁵ Because available data sources limit us to combining Medicaid/SCHIP and uninsured in our analysis, and because public health insurance eligibility is related to the Federal Poverty Level, what we are measuring is, in part, the downstream effect of families living in poverty.

Mothers and children with public or no health insurance have worse health outcomes as measured by hospitalization rates.

Over the past 10 years, children with private health insurance have shown a decrease in hospital admission rates for many diseases (Table 1). Conversely, hospitalization rates in many disease categories are significantly higher and increasing for children with public or no health insurance. For the most part, hospitalization rates for mothers and their newborns with public or no health insurance are not improving and significant disparities persist when compared to those with private insurance (Tables 4,5).

The poor health outcomes in mothers and children with public or no health insurance are associated with indicators of a lack of access to and/or utilization of a consistent, quality medical home.

For the years 2007-2009, pregnant women with public or no health insurance were 7 times more likely than those with private insurance to have poor prenatal care, 1.8 times more likely to be admitted through the emergency department (implying a lack of access to primary care), and 1.2 times more likely to be admitted with a higher severity of illness (suggesting more complications and/or a delay in care). Their newborns had both a higher severity of illness and higher fatality rate. Similarly, children one month to 17 years of age are 2.5 times more likely to be admitted through the emergency department, 2.3 times more likely to be admitted with a higher severity of illness, and have a 2.8 times greater fatality rate. Many of the disease categories associated with higher hospitalization rates for children with public or no insurance are considered ambulatory-sensitive (e.g. ruptured appendix, asthma, diabetes) meaning that they may be influenced by access to consistent primary and/or preventive care.

Since many uninsured mothers and children are retroactively qualified for Medicaid or SCHIP once they are admitted to hospital, our analysis can not distinguish their contribution to the excess admission rates in many disease categories observed in our public or no insurance group. Nonetheless, it is likely that the higher admission rates in this public or no insurance group, as well as increasing admission rates through the emergency department and higher severity of illness are consequences, in part, of a lack of access either to consistent health insurance coverage and/or consistent preventive and acute primary care (including prenatal care).^{5,6,7} A shift of high risk patients with pre-existing conditions from private insurance to public or no insurance could also contribute to increased hospitalization rates in the latter group. A relative lack of access to primary care resources may also be reflected in the increased number of hospital admissions for children with public or no health insurance in rural areas.⁸

Colorado has become a national leader in providing a medical home for all children but more needs to be done.

Based on Senate Bill 07-130, Colorado Statute recognizes that: *"Medical care provided through emergency departments, walk-in clinics, and other urgent-care facilities is often more costly and less effective than care given by a physician with prior knowledge of the child and his or her family; and(d) The state department should strive to find a medical home for each child receiving services through the state medical assistance program".*² Major efforts have been made by the Department of Health Care Policy and Financing (HCPF) and Colorado Department of Public Health and Environment (CDPHE) in the last few years to increase access to a medical home for mothers and their children in Colorado, but it is likely that not all care settings are structured or staffed to fully provide such care (Text Box A). This leaves families and children to seek care in emergency departments as a last resort, delaying effective intervention and resulting in the higher severity of illness noted in tables 3 and 5.⁹

Changes in the hospitalization rates for vaccine-preventable diseases (influenza excluded) are a useful example of how preventive care can successfully impact both private and publicly insured populations. It appears

Text Box A

Colorado Revised Statutes²

25.5-1-123. Medical homes for children -

1) The general assembly hereby finds and declares that:

(a) The best medical care for infants, children, and adolescents is provided through a medical home, as defined in section 25.5-1-103, and that is consistent with the joint principles of a patient-centered medical home. Those principles shall include a whole-person orientation, care that is coordinated and integrated across all elements of the complex health care system and the patient's community, and care that provides for quality and safety of the patient where qualified health care practitioners provide primary care and help manage and facilitate all aspects of medical care ...

25.5-1-103. Definitions.

... All medical homes shall ensure, at a minimum, the following:

- a) Health maintenance and preventative care;
- (b) Anticipatory guidance and health education;
- (c) Acute and chronic illness care;
- (d) Coordination of medications, specialists, and therapies;
- (e) Provider participation in hospital care; and
- (f) Twenty-four-hour telephone care.

clear that improving vaccination rates in Colorado has been accompanied by a decrease in hospitalization rates for those same diseases, both in privately and publicly insured populations. The vaccination schedule requires frequent visits in the first several years of life, but vaccination providers (e.g. some public clinics) are not always structured to take advantage of those visits to provide additional preventive or acute primary care. It is also well documented that, in Colorado, public insurance has historically compensated providers for care at rates less than overhead cost and, until recently, has imposed administrative burdens that impede enrollment and continuity of care.¹⁰ These issues have been aggressively addressed by HCPF in collaboration with other State agencies and community groups in the last several years but are continually threatened by budget limitations.

It is encouraging that the percentage of mothers and children covered by public insurance (Medicaid, SCHIP) has shown a significant increase, in part, the consequence of statewide efforts to expand eligibility and increase enrollment. For the first time, there are fewer uninsured children than those covered with public insurance. Besides having access to health insurance, mothers and children with public insurance also need access to consistent preventive and acute primary care. Our analysis suggests that this may not be happening as fast as enrollment expands. However, Colorado has clearly stated that the medical home concept is fundamental to children's healthcare (Text Box A) and has clearly demonstrated that it can lower costs and improve outcomes. The nationally-recognized Colorado Children's Healthcare Access Program (CCHAP) has been successful in improving provider availability, implementing medical home standards and has been associated with reductions in emergency department visits and costs for publically-insured children.¹¹ This medical home concept is an important precedent that should be extended to all children and could be an effective model for improving the care of pregnant women and adults through Colorado's emerging Accountable Care Collaborative initiative.

To continue to improve healthcare outcomes, Colorado needs access to and analysis of better data.

To improve one must be able to measure. Colorado Statute stipulates that reports be provided annually to the governor and legislature to document the impact of public health programs on both healthcare access and outcome for Colorado children (Text Box B).² To date, there appears to have been more success in addressing access to primary care than measuring and improving outcome.¹² There are many more measures that could and should be analyzed using current public data sources. Our analysis uses data available through the Colorado Hospital Association but is limited to hospitalization discharge data. Accurate annual information regarding the health insurance status of all Colorado

Text Box B

Colorado Revised Statutes²

25.5-1-113.5. Children's access to health care - reports.

(1) On or before January 1, 2008, and on or before each January 1 thereafter, the state department shall submit a report to the health and human services committees of the senate and the house of representatives, or any successor committees, on measures of access to and quality of health care for children eligible for programs pursuant to this title, including but not limited to data showing whether:

(a) Providers for children are participating in the programs and are accepting eligible children as patients on a regular basis;

(b) Eligible children are enrolling in programs under this title and are remaining enrolled so that the children have continuity of care;

(c) Eligible children are receiving the early and periodic screening, diagnosis, and treatment services required by federal law, including but not limited to regular preventative care and, when appropriate, timely specialty care, and that providers are accurately reporting the data from these visits; and

(d) Providers are using other appropriate measures of access and quality to improve health outcomes and maximize the expenditure of health care resources.

mothers and children is not readily available. Although private insurance companies have excellent enrollment and utilization data it is not made available for analysis. It will be critical to support the efforts of the All-Payer Claims Database (APCD) Advisory Committee in the development of an all-patient, all-provider, all-payer database with claims (and hopefully outcome) data to more effectively identify and remedy the risk factors associated with the disparity of outcomes noted in this current analysis.¹³

There is nothing in our current analysis that would suggest that universal access to effective and efficient medical-home-based, preventive and primary care for mothers and children cannot be achieved with a commensurate reduction in avoidable ED use and hospitalization.

It would be inappropriate to conclude from our results that public health insurance is inferior to private health insurance either in efficiency or efficacy. Health insurance represents a mechanism for paying for healthcare services, not necessarily for the way those services are organized, provided or utilized. Rather, this analysis highlights differences in healthcare delivery and utilization which suggest opportunities for improving healthcare for all of Colorado's mothers and children.

The fact that hospitalization rates are decreasing (Table 1) for children with private health insurance in most disease categories (except for asthma and chronic disease) suggests that a similar reduction in rates may be possible in those with public health insurance assuming that all remaining children have consistent insurance coverage and comparable standards of primary and preventive care are uniformly achieved. This also assumes that families are educated to responsibly utilize consistently available acute primary care and 24/7 access to child-specific after-hours phone triage in a timely fashion instead of using the emergency department or hospital for acute primary care. Appropriate sensitivity to the health care utilization practices and beliefs of different cultures and different healthcare structures in various geographic areas of Colorado is also important.

There is an economic as well as humanitarian incentive to improve healthcare access and quality for all of Colorado's mothers and children.

In 2009, the utilization of hospital inpatient resources by children and newborns with public or no health insurance resulted in an excess of hospital charges exceeding a quarter of a billion dollars (\$263 million) with an additional \$21 million for mothers with deficient prenatal care. A sizable proportion of that amount may be related to a lack of effective preventive and primary care. Disparities in morbidity and charges have increased in more recent years emphasizing the business case to improve care and save tax dollars while reducing cost-shifting to the private sector. This current analysis provides both humanitarian and economic rationale for re-doubling that effort.

8. Appendices:

A: Methods

The data sources and methods are summarized in our previous publications.^{1,14} Numerators are calculated from the Colorado Hospital Association (CHA) discharge database; and denominator estimates for insurance coverage are estimated from US Census data using *DataFerrett*. Children ≥ 1 month and ≤ 17 years of age, pregnant women and newborns with private health insurance are compared to children with either public insurance or no health insurance (Public/No) because many are retroactively qualified (and therefore designated in the CHA database) as publicly-insured.

This current study compares rates of hospitalization in Colorado from 2000 to 2009. Because these rates are based on estimates of insured populations, we conducted a validation of the US Census denominator estimates for overlapping time periods in 2008 using two other independent methods (Table 6) similar to that employed by the Colorado Health Institute.⁴ This analysis demonstrated a range of estimates with convergence around the COV_HI variable which was selected to be used as the denominator for the current analysis. It is important to note that these rates are estimates based on insurance coverage data that may underestimate the number of children who do not have private insurance at some time during the year. Even if a population adjustment of 20% is factored in, the above relative disparities noted in this study still exist.

Table 6: Comparison of denominator estimates

| Source | Insurance Definition | Inclusive Dates | Variable(s) | Insurance Coverage Estimates | | | |
|--|---|---|-----------------------------------|------------------------------|---------------------------------|-----------------|---------------------------------|
| | | | | Private | | Public/None | |
| | | | | n (%) | 95% Confidence Interval | n (%) | 95% Confidence Interval |
| Current Population Survey – March supplement 2009: | At any time during the prior calendar year. | Queried in March regarding any time during 2008 | COV_HI variable unadjusted | 831,604 (68.4%) | 717,719 - 945,489 (59.0%-77.8%) | 383,846 (31.6%) | 302,343 - 465,349 (24.9%-38.3%) |
| | | | COV_HI adjusted by MCAID variable | 805,983 (66.3%) | 693,515 - 918,451 (57.1%-75.6%) | 409,467 (33.7%) | 325,526 - 493,408 (26.8%-40.6%) |
| American Community Survey 2008 | At time of query | Samples taken throughout 2008 | HICOV | 814,325 (67.5%) | 785,377 - 843,273 (65.1%-69.9%) | 392,108 (32.5%) | 371,017 - 413,199 (30.8%-34.2%) |
| Colorado Household Survey 2008-2009 | At time of query | Queried November 2008 to March 2009 | Multiple | 922,688 (71.8%) | 851,853 - 993,523 (68.3%-75.3%) | 362,806 (28.2%) | 307,833 - 417,779 (24.7%-31.7%) |

Newborn hospitalization rates were determined separately using cases categorized as MDC 15 and were further defined by the presence of an ICD-9 live birth code (V30-V39) as the primary diagnosis, admission source and disposition. Those with a live birth code and an admission source from another institution

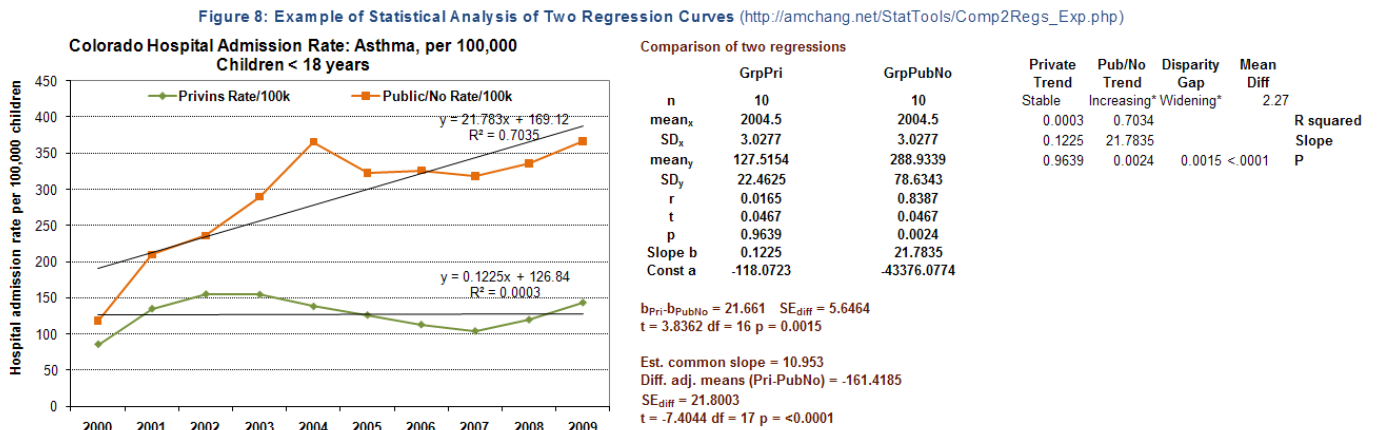
were assumed to be first admissions whereas all others were assumed to be readmissions. A similar strategy was used for pregnant women.

Health insurance status for each hospitalized individual was grouped as Private (Blue Cross/Blue Shield, Commercial Insurance/Indemnity Plans/Self Insured, Other Liability Insurance/No Fault/casualty, HMO-PPO/Managed Care/Discounted) or Public/No (Self-Pay, No Charge/Charity/Research, Other, Colorado Medically Indigent, Medicare, Medicaid, Worker's Compensation, Champus, Other Government).

A preliminary analysis of Medicaid/SCHIP hospitalization rates tended to overestimate the difference between public insurance outcomes as compared to those with private insurance since it included a disproportionate number of hospitalizations of initially uninsured children who were retroactively qualified for Medicaid without a similar adjustment being possible for the denominator. We therefore elected to combine uninsured hospitalized children with those having public insurance to better reconcile available data for rate calculations. No adjustment for multiple hospital admissions for individual children could be made because of the lack of identifiers within the CHA database.

Hospitalization rates for children were calculated for: all hospitalizations, hospitalization via the emergency department, children hospitalized with an APR-DRG severity score greater than 2, chronic disease, ambulatory-care-sensitive conditions including: asthma, diabetes, vaccine preventable disease (excluding influenza), psychiatric disease (MDC 19), and appendicitis due to a ruptured appendix or with peritonitis. For Colorado, total hospital charges for years 1995 through 2008 were adjusted to 2009 prices using the Consumer Price Index. Hospital charges per insured child were calculated by dividing the total hospital charges for hospitalized children by the total number of children in each insured group. The difference between the average hospital charges per child in the public or no insurance group compared to the private insurance group multiplied by the total number of covered individuals in the public or no insurance group yielded the potential excess hospital charge gap between these two populations. This gap represents the maximum savings that potentially could be achieved for children with public or no insurance if they had improved outcomes equivalent to children with private insurance. It was assumed that reported hospital charges represented some multiple of actual hospital costs. Hospitalization rates are reported as the number of hospitalizations per 100,000 children insured in each insurance category.

Statistical analysis utilized standard correlation coefficient, logistic regression, Chi-square and t-test methodology (SAS). Comparisons of regression lines (see example, Figure 8) utilized the method of Chang.¹⁵



B: Limitations

It has been well documented that length of time insured and the frequency of churning makes a difference in health outcomes. Current limitations in access to accurate numerator and denominator data impose constraints on how precisely explanations for observed disparities can be calculated. Up to the present time, denominators for the number of Colorado children in various insurance groups could only be estimated from the Current Population Survey of the US Census Bureau. These estimates likely result in an overestimate in excess charges and morbidity; it is well documented that children move in and out of insured status during a year. In addition, adequate risk-adjustment data (e.g. race/ethnicity, socio-demographic factors) are virtually unavailable. As an example, the percentage of children with either private or public or no health insurance for whom race/ethnicity is not reported is so high (and inconsistent) as to preclude any meaningful analysis of its impact on hospitalization outcomes. Because of these data limitations, it is difficult to predict precisely the impact of approaches to improve outcomes and reduce charges, although there are convincing data in Colorado that improving access to primary care will reduce incremental ED visits and hospital admissions. At the same time, this analysis does not address the magnitude of other potential savings resulting from improved access to medical home care such as: excess emergency department charges, time off work, lost wages, and decreased productivity.

It is also important to recognize that hospitalized children, mothers and newborns may have more than one discharge diagnosis, so estimates of impact and cost for any single diagnostic category may be amplified since each patient can be counted more than once. This is relevant for the tables where we calculated admission rates for individual disease categories but not operative for our calculations for total hospitalizations and total charges. On further analysis, there was very little overlap of diagnoses for children >= 1 month to 17 years of age., however there were strong correlations of newborn complications with prematurity (Table 7) and maternal complications with a lack of prenatal care.

| | hypogly | vlbw | lbw | sepsis | rds | ivh | prematunit | jaundice | wetlung | bronchdis |
|-------------------|---------|---------|---------|---------|----------|---------|------------|----------|----------|-----------|
| hypogly | 1.00000 | 0.05660 | 0.13091 | 0.05857 | 0.06954 | 0.02708 | 0.14399 | 0.10486 | 0.08208 | 0.02896 |
| hypogly | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| vlbw | 0.05660 | 1.00000 | 0.41757 | 0.21538 | 0.43471 | 0.24598 | 0.26467 | 0.14447 | 0.00624 | 0.38377 |
| vlbw | | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| lbw | 0.13091 | 0.41757 | 1.00000 | 0.14899 | 0.35869 | 0.13686 | 0.67194 | 0.26508 | 0.07162 | 0.18511 |
| lbw | | <.0001 | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| sepsis | 0.05857 | 0.21538 | 0.14899 | 1.00000 | 0.22253 | 0.15195 | 0.13527 | 0.09491 | 0.05122 | 0.18737 |
| sepsis | | <.0001 | <.0001 | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| rds | 0.06954 | 0.43471 | 0.35869 | 0.22253 | 1.00000 | 0.19271 | 0.33939 | 0.19113 | -0.01003 | 0.32416 |
| rds | | <.0001 | <.0001 | <.0001 | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| ivh | 0.02708 | 0.24598 | 0.13686 | 0.15195 | 0.19271 | 1.00000 | 0.11454 | 0.06701 | 0.00191 | 0.20029 |
| ivh | | <.0001 | <.0001 | <.0001 | <.0001 | | <.0001 | <.0001 | 0.0683 | <.0001 |
| prematunit | 0.14399 | 0.26467 | 0.67194 | 0.13527 | 0.33939 | 0.11454 | 1.00000 | 0.29338 | 0.11640 | 0.12259 |
| prematunit | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | | <.0001 | <.0001 | <.0001 |
| jaundice | 0.10486 | 0.14447 | 0.26508 | 0.09491 | 0.19113 | 0.06701 | 0.29338 | 1.00000 | 0.09930 | 0.09015 |
| jaundice | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | | <.0001 | <.0001 |
| wetlung | 0.08208 | 0.00624 | 0.07162 | 0.05122 | -0.01003 | 0.00191 | 0.11640 | 0.09930 | 1.00000 | -0.00467 |
| wetlung | | <.0001 | <.0001 | <.0001 | <.0001 | 0.0683 | <.0001 | <.0001 | | <.0001 |
| bronchdis | 0.02896 | 0.38377 | 0.18511 | 0.18737 | 0.32416 | 0.20029 | 0.12259 | 0.09015 | -0.00467 | 1.00000 |
| bronchdis | | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | |

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