

**Technical Research Report to the Child Life Council**  
**The Economic Value of a Child Life Program for non-sedated MR Imaging**

**The Child Life Research Team**

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# Introduction

This report presents key findings of the work completed between May 1, 2013 and May 14, 2014 under the grant titled “The Economic Value of a Child Life Program for non-sedated MR Imaging”. The report is organized into three main sections followed by an appendix.

The **first section** provides key background information related to the development of the MR-I Can Do It (non-sedate) Program at Children’s National Health System in Washington, DC.

The **second section** presents the key findings connected to the three originally proposed research themes. These are related to the economic value and health benefits of the non-sedate program viewed from three completely different, but related, perspectives:

- 1) **Individuals:** Individual families and their insurance companies directly and immediately benefit from Child Life supported non-sedate programs. Participating families will spend less money and time completing the required MR exams and their children will avoid all of the potential risks associated with sedation. The potential reduction in medical bills varies across settings and depends on the type of medical facility, staffing patterns, etc.
- 2) **Hospitals:** Hospitals do not charge patients for Child Life Services and must consider the funds required to run non-sedate programs as an investment in high-quality patient care. Over the long-term, hospitals might realize a financial return on that investment if such programs increase the hospital’s capacity or efficiency to conduct MR exams or if they create a higher volume of business as a result of increased referrals from satisfied families or their referring physicians.
- 3) **Society:** The financial and health benefits of Child Life supported non-sedate programs would quickly multiply if more institutions across the US could implement and scale-up such programs to serve the majority of all medically eligible children. Scaling-up such programs would also generate a real societal benefit in terms of promoting the more rational use of pediatric anesthesia services (a scarce medical resource).

The **third section** of the report summarizes the major conclusions of the research and provides recommendations for the future. The **last part** of the report contains several appendices, including a bibliography and more in-depth background information about the history of Child Life Services at Children’s National Health System, development of the non-sedate program and changes in sedation rates over the past five years.

## Institutional Review Board Approval

The Institutional Review Board (IRB) at Children’s National approved this research project. All of the analyses that used hospital data derived from a retrospective review of existing medical records were approved as part of one application on October 22, 2013. A separate IRB application was required to gain approval to conduct a telephone survey of families and an internet-based survey of their referring physicians. The survey activities were approved on February 10, 2014.

## Section 1 Development of the MR-I Can Do It Program

The goal of the MR-I Can Do It (non-sedate) Program at Children's National is to reduce the number of children over 6 years of age who require sedation during MR exams. Up until 2012, hospital operating guidelines recommended that any child under 8 years old automatically be scheduled for a sedated MR exam. However, Radiology Department staff members found that many children as old as 12 were routinely being scheduled for sedation. This prompted the department to formally launch a non-sedate program and start the process of educating referring physicians and other medical staff members (radiologists, anesthesiologists, nurses, schedulers, technologists, etc.) about the new initiative.

Between January 2012 and June 2013, Child Life Specialists in the Radiology Department at Children's National worked with over 200 patients at the hospital and successfully helped 94% of them complete their diagnostic MR exams without sedation. The non-sedate program is now fully operational and although the Child Life Specialists will work with children of all ages, the program continues to focus on serving children at the lowest end of the 6 to 17 year-old age bracket. **Appendix B** provides a more detailed description about the evolution of Child Life Services in the Radiology Department and how the non-sedate program fits into the hospital's long-term goals of providing high quality and family-friendly care.

### Overview of MR-I Can Do It Program participants

This report is based on data recorded from the initial series of 240 patients who participated in the non-sedate program for MR imaging at the main hospital or the new outpatient imaging center from December 2011 through June 30, 2013. **Appendix C** provides a more detailed timeline of how the non-sedate program was originally established and now operates. **Appendix D** shows how overall sedation rates changed before and after the program began.

Data from the 207 children (86%) who participated in the non-sedate program at the hospital between January 2012 and June 30, 2013 were selected as the core group for analysis. All 9 (4%) of the 240 patients who participated in the program's pre-testing phase were excluded. Another 24 (10%) of the remaining patients were seen at the outpatient imaging center and excluded because: 1) the outpatient center offered a scaled-down version of the non-sedate program, 2) record-keeping procedures varied across the two sites and 3) complete data were available for only some (but not all) of those participants.

**Table 1** shows a few key characteristics of the core group of 207 children who participated in the non-sedate program at the hospital between January 2012 and June 30, 2013. 194 children (94%) succeeded in completing their MR exam without sedation. Nearly 90% were in the program's primary target age group (6-17 years old) and, of those, over half were 6-8 years old. In addition, over half of the program participants were female, had a brain scan (the single most common type of MR exam among all pediatric patients seen at the hospital) and/or had their MR exam on a Monday, the one day of the week which, during that time period, routinely had 2-3 dedicated exam slots set aside for the non-sedate program.

**Table 1. Key characteristics of the MR-I Can Do It program participants**

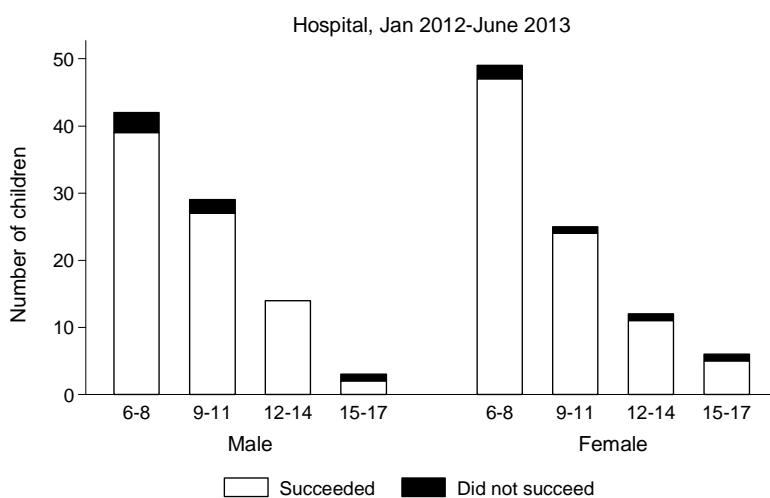
Characteristic	Count	%
Number that completed a non-sedated exam	194 out of 207	94%
Number in the program's entire target age group (6-17 years)	180 out of 207	87%
Number at the lowest end (6-8 years) of the target age group	91 out of 180	51%
Number that were female	111 out of 207	54%
Number that had a brain scan <sup>a</sup>	141 out of 207	68%
Number that had an MR exam on a Monday <sup>b</sup>	110 out of 207	54%

<sup>a</sup> Brain scans are the most common type of MR exam conducted on children of any age

<sup>b</sup> Mondays were the only day of the week with dedicated exam slots set aside for the non-sedate program

Only 13 (6%) of the children who tried to complete a non-sedated MR exam at the hospital did not succeed. There were no consistent differences among children who succeeded or not in terms of age or gender (see **Figure 1**) or the type of MR exam (data not shown).

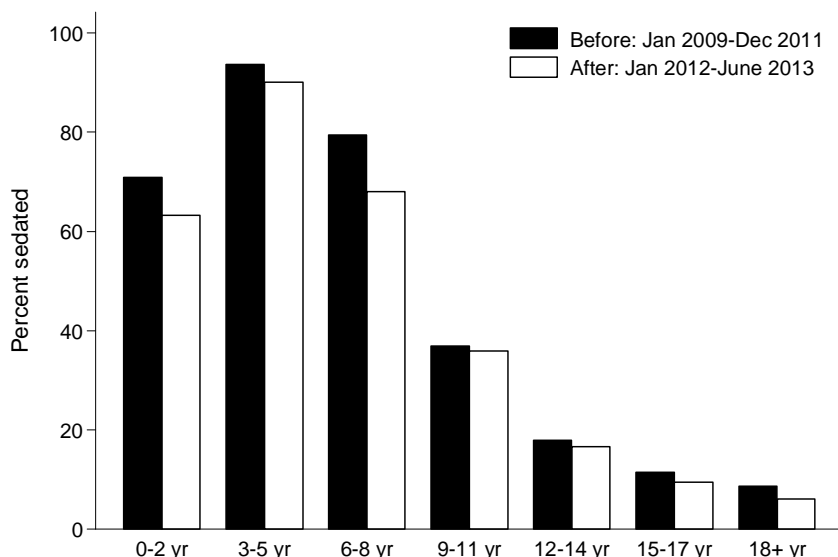
**Figure 1. Number of children who did (or did not) succeed in completing a non-sedated MR exam at the hospital, by age group and gender**



### Program impact and reach

At the hospital, the overall sedation rate declined from 49% in the three year period (2009-2011) before the non-sedate program was launched to 44% in the 18-month period afterwards (Jan 2012-June 2013). This trend took place across all age groups (see **Figure 2**), but the largest drop was observed among the youngest set of children (6-8 year olds) targeted by the MR-I Can Do It program. Before it began, 79% of 6-8 year olds were sedated as compared to only 68% afterwards. This represents a 14% reduction in the sedation rate among this particular age group. Thus, the non-sedate program initially succeeded in reaching one of its prime target groups and served enough children to make an observable difference in the sedation rates.

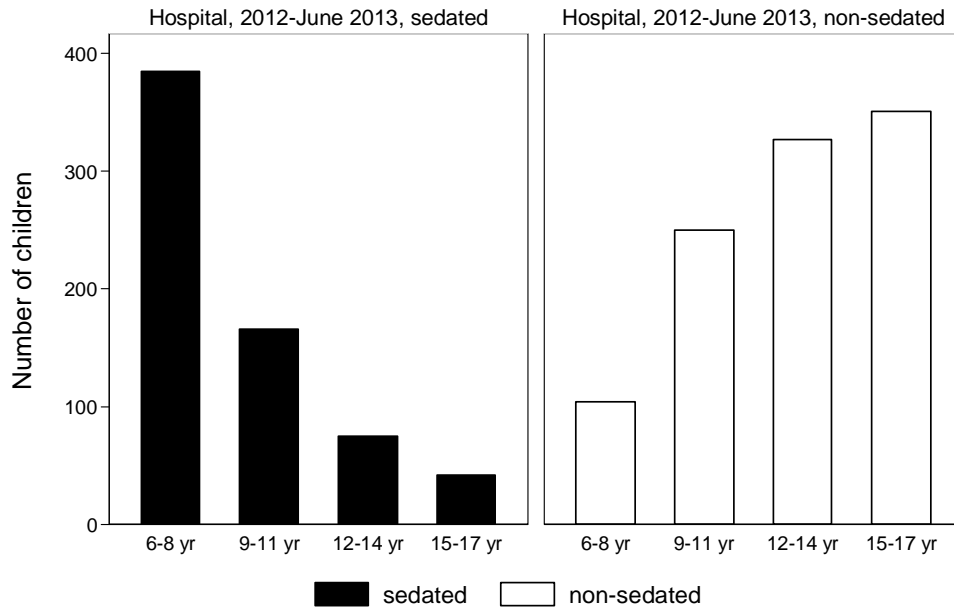
**Figure 2. Age-specific sedation rates before (2009-2011) and after (January 2012-June 2013) the non-sedate program was launched**



Other hospitals have launched comprehensive non-sedate MR programs with the support of Child Life Specialists and reported larger initial reductions. In Cincinnati, a comprehensive non-sedate program for CT and MR among children < 7 years of age achieved a 54% reduction in sedation rates (from 56% to 26%) among 6-7 year old children (Khan et al. 2007). In Pittsburgh, a 35% reduction in sedated MR exams was achieved when the CT non-sedate program was expanded, but details about the age of participating children was not mentioned (Etzel-Hardman et al. 2009). Two other reports from children’s hospitals examined the effect that simply adding an audio/visual system had on age-specific MR sedation rates. In Hamilton, Canada, the sedation rate was reduced 74% among 4-10 year olds (from 47% to 12%) (Lemaire et al. 2009), while in Denver, the rate was reduced 24% among 3-10 year olds (from 53% to 40%) (Harned & Strain 2001).

The non-sedate program at Children’s National Health System certainly had the potential to reach even more children during the first 18 months of implementation. A review of the electronic medical records suggests that many more children were probably eligible to participate, but were not referred to the Child Life Specialists for various reasons. When we examined the five most common types of brain scans in detail, we identified over 650 sedated children who had the same type of scans as the non-sedate program participants (see **Figure 3**). Even if three-fourths of those sedated children were ineligible due to a pre-existing medical condition, that still leaves around 150 more children who should have been given the option to participate in the non-sedate program between January 2012 and June 2013.

**Figure 3. Number of children in different age groups who completed one of the five most common types of brain scans after the non-sedate program had been launched**



A more extensive analysis of other types of scans would have identified more children who should have been referred to the non-sedate program. During the first 6 months of 2013 (a full year after it was fully operational), 67% of all children in the 6-8 year old age bracket were still being sedated which suggests that more intensive effort should be made to reach out to this target age group in the future.



## Section 2 Economic value of the non-sedate program: Three different perspectives

### Section 2A Individual perspective: Potential cost and time savings

For individual families, the economic value of the non-sedate program depends on three key factors. First, whether or not their child actually succeeds in avoiding sedation if they do participate. Second, how much less expensive a non-sedated MR exam will be wherever they have it done. And third, how much less time it takes to complete a non-sedated MR exam.

#### Results from Children's National in Washington, DC

Success rate of the non-sedate program: Children's National is a free-standing, tertiary care children's hospital staffed by pediatric radiologists, pediatric anesthesiologists and Child Life Specialists capable of dealing with an extremely wide range of patient needs. In this setting, the initial success rate of the MR-I Can Do It non-sedate program has been quite high (94%), so nearly all families who do participate will benefit by spending less money and less time getting the exam their child needs.

Cost savings related to medical bills associated with a non-sedated MR exam: On average, Children's National charged families ~\$3000 for sedation services during a routine MR exam in 2013. Therefore, a family whose child completes his or her MR exam without sedation will receive substantially lower medical bills. These estimates were based on propofol sedation during a routine MR exam which did not require any special intervention by the pediatric anesthesiology team due to complications. The estimate also excludes the underlying costs of the MR exam itself because the MR exam charge is the same for sedated and non-sedated patients.

Time savings associated with a non-sedated MR exam: At Children's National, families who need to get a sedated MR exam for their child must plan on devoting a day and a half (or slightly more) to the entire process, while a non-sedated exam takes about half a day (or slightly more) from start to finish. **Table 2** shows the average amount of time required to complete the various steps for each type of exam in this location.

Children who need a sedated MR exam have to start preparing 6-8 hours before the exam. They must stop eating and drinking in order to clear their stomachs and their family is asked to bring them to the hospital 1 hour before the MR exam. After arrival, it can take up to an hour to register, check in with the nurse, complete the metal screening with the MR technologists and then finish the anesthesia work-up. The induction period for the sedation process takes approximately 15 minutes and is followed by the actual MR exam (which may take an hour or more). After the exam, children are brought to the recovery room for another hour. Even after leaving the hospital sedated children may stay groggy for a while and need to be closely monitored. For a full day after the exam, a parent or other caregiver should restrict the children's activities and continue to monitor them to ensure that they stay safe and are not experiencing any complications.

**Table 2. Timeline for completing a sedated or non-sedated MR exam**

<b>Activity</b>	<b>Duration for a sedated MR exam (min)</b>	<b>Duration for a non-sedated MR exam (min)</b>
Prepare for sedation (stop eating and drinking)	6-8 hours before the MR exam	Not necessary
Arrival and registration at the hospital	60	30
Nurse's workup	15 <sup>a</sup>	Not necessary
MRI metal screening	10	10
Child Life preparation	10	10
Anesthesia consent	5-7	Not necessary
Anesthesia induction	15	Not necessary
Positioning on scanner	5-7	10
MRI scan	Varies widely <sup>b</sup>	Varies widely <sup>b</sup>
Anesthesia recovery	45-60	Not necessary
Post-scan discharge	15	15
Restrict the child's activities and monitor the child for any side effects due to sedation	For 24 hours afterwards	Not necessary

<sup>a</sup> Can take as long as 30 minutes if complicated

<sup>a</sup> The expected duration of an MR exam varies widely depending on which part (or parts) of the body is being scanned and which scanning protocol (or protocols) is required. On average, brain scans often take 45 minutes to 1 hour, but other types of MR exams can take even longer (~1.5 hours).

In comparison, a non-sedated exam takes much less time. Children can eat normally and the family is asked to arrive at the hospital only 30 minutes before the MR exam. There is no induction period for sedation and no recovery period afterwards. Once the MR exam is done a non-sedated child can go right back to their usual activities and their parents can also return to work, if necessary.

In reality, the total amount of time saved by a given family will depend on the time of day the MR exam is scheduled since making the logistical arrangements needed to accommodate work schedules, time, and considerations depend on the time of day. However, in general, families whose children can participate in a non-sedate program can expect to save at least one half (or perhaps as much as a full) day in getting their child the exam he or she needs.

The overall amount of time required to complete a sedated MR exam is probably quite similar in other locations because the most time-consuming steps (pre-exam preparation and post-exam monitoring) are based on standard guidelines for pediatric sedation.

Indirect cost savings as a result of spending less time obtaining a non-sedated MR exam: In addition to receiving lower medical bills, families whose children complete a non-sedated MR exam can expect to 1) have the primary caregivers spend less time away from work (meaning less in lost wages and/or not needing to take a sick or vacation day), 2) pay less money on additional child care if there are other children in the family who cannot come with them to the hospital on the day of their sibling's exam and 3) pay less money on child care the next day to look after the child who had the sedated exam if a caregiver is unable to do that.

**Table 3** shows the total estimated amount of time a family must devote to obtaining a sedated or non-sedated exam and the costs linked to those time periods. We have not attempted to assign a monetary value to these indirect cost savings for families because employment policies, wages and family structures vary widely and individuals value the opportunity cost of lost time differently. However, having a non-sedated MR exam definitely means that the family will incur fewer additional costs overall.

**Table 3. Additional costs related to the time required to complete a sedated or non-sedated MR exam**

<b>Costs assumed by the family</b>	<b>Sedated</b>	<b>Non-sedated</b>
Lost wages (and/or lost time devoted to other activities)	1-2 days	0.5-1 day
Child care for other children during the MR exam	1-2 days	0.5-1 day
Child care for the sedated child before or after the MR exam	1-2 days	0.5-1 day

### Representative cost data from other children’s hospitals across the US

Cost savings associated with a non-sedated MR exam: The amount that an individual hospital or an MR imaging center charges for sedation services can vary widely and be difficult to determine since billing practices change over time and billing data is often considered to be protected business information. We attempted to gather comparative cost data from a variety of US children’s hospitals in order to produce more widely applicable results, but discovered that relatively few institutions were willing to share that type of information.

For our projections we assumed that the cost of sedation varied from \$1000 to \$5000 per case based on our best-guess estimates derived from a search of the published medical literature, internet-based sources and an informal survey of 20 geographically representative children’s hospitals known to have active Child Life programs. See **Table 4** for more details about the individual estimates.

**Table 4. Estimated cost of sedation services (per exam) in different locations across the United States**

<b>Location</b>	<b>Amount</b>	<b>Type of sedation service</b>	<b>Notes</b>
Boston Children’s	~ \$1,750	Nurse led sedation	“Sedation-free MRI resonates with younger patients”. (Boston Children’s Hospital website, no date)
Children’s National (Washington, DC)	~ \$3,000	Pediatric anesthesiologist	Hospital billing information (estimates from 2013)
Unnamed children’s hospital (Midwest region)	\$3127.50 <sup>a</sup>	General anesthesia	Personal communication with research team member (2014)
Unnamed children’s hospital (Southwest region)	\$3127.50 <sup>a</sup>	General anesthesia	Personal communication with research team member (2014)
Unnamed hospital(s)	~ \$3,500-4,000	Unknown	Presentation posted on www.cinemavision.biz (Anonymous, 2011)

<sup>a</sup> The average cost of sedation across the two locations was \$3,127.50 for a 60 minute MR brain scan (without contrast) for a patient who weighed 60 pounds.

## Annual cost savings generated by a non-sedate program under different cost and program volume structures

On an annual basis, non-sedate programs can generate substantial cost savings to pass on to individual families and their insurance companies (see **Table 5**). The potential cost savings vary widely depending on the costs of sedation services and annual program volume. Mid-range estimates suggest that the annual cost savings could easily fall in the \$500,000-\$1,500,000 range in settings with program volumes of 200-400 participants per year. Even smaller volume programs in settings where sedation services are billed at lower rates can expect to generate hundreds of thousands of dollars in cost savings.

**Table 5. Annual cost savings passed on to families (and their insurance companies) under different cost structures for sedation services and total volume of participants in a non-sedate program supported by child life services**

Amount billed for each sedated case <sup>a</sup>	Annual volume of program participants (Total number of sedated cases avoided per year) <sup>b</sup>								
	50 <sup>c</sup>	100	200	300	400	500	600	700	800
<b>\$1,000</b>	\$50K <sup>d</sup>	\$100K	\$200K	\$300K	\$400K	\$500K	\$600K	\$700K	\$800K
<b>\$1,500</b>	\$75K	\$150K	\$300K	\$450K	\$600K	\$750K	\$900K	\$1,050K	\$1,200K
<b>\$2,000</b>	\$100K	\$200K	<b>\$400K</b>	<b>\$600K</b>	<b>\$800K</b>	\$1,000K	\$1,200K	\$1,400K	\$1,600K
<b>\$2,500</b>	\$125K	\$250K	<b>\$500K</b>	<b>\$750K</b>	<b>\$1,000K</b>	\$1,250K	\$1,500K	\$1,750K	\$2,000K
<b>\$3,000</b>	\$150K	\$300K	<b>\$600K</b>	<b>\$900K</b>	<b>\$1,200K</b>	\$1,500K	\$1,800K	\$2,100K	\$2,400K
<b>\$3,500</b>	\$175K	\$350K	<b>\$700K</b>	<b>\$1,050K</b>	<b>\$1,400K</b>	\$1,750K	\$2,100K	\$2,450K	\$2,800K
<b>\$4,000</b>	\$200K	\$400K	<b>\$800K</b>	<b>\$1,200K</b>	<b>\$1,600K</b>	\$2,000K	\$2,400K	\$2,800K	\$3,200K
<b>\$4,500</b>	\$225K	\$450K	\$900K	\$1,350K	\$1,800K	\$2,250K	\$2,700K	\$3,150K	\$3,600K
<b>\$5,000</b>	\$250K	\$500K	\$1,000K	\$1,500K	\$2,000K	\$2,500K	\$3,000K	\$3,500K	\$4,000K

<sup>a</sup> Range based on best-guess estimates from an informal survey of the published medical literature, internet-based sources and personal contacts

<sup>b</sup> The annual volume of program participants corresponds to 1, 2, 4, 6, 8, 10, 12, 14 and 16 cases per week x 50 work weeks per year

<sup>d</sup> Total annual cost savings equals the amount billed for a sedated case multiplied by the annual volume of program participants in the same location.

## Annual program costs subsidized by the hospital

The total estimated cost of starting and then running a non-sedate program staffed by a full-time Child Life Specialist for a three-year period in a brand new location is ~ \$235,000 (see **Table 6**). Start-up costs in the first year are ~\$106,500, based on the assumption that a brand new movie goggle system will be purchased and one full-time Child Life Specialist will be recruited to start and staff the program. **Table 7** provides background data about Child Life Specialist salaries. Annual running costs decrease to ~\$64,500 per year after that.

**Table 6. Program costs (distributed over a three-year time period) that must be assumed in full by a hospital to start up and then run a non-sedate program**

Line items	Year 1	Year 2	Year 3	Years 1-3
<b>Movie goggles<sup>a</sup></b>				
Initial purchase, installation & training	\$45,000	0	0	\$45,000
Extended warranty/maintenance	0	\$3750	\$3750	\$7,500
<b>Other equipment and supplies</b>				
Promotional brochures for physicians				
Information packets for parents				
Mock scanner(s)	\$1500	\$750	\$750	\$3,000
Movies & music DVDs				
Distraction devices/toys, etc.				
<b>Child Life Specialist<sup>b</sup></b>	\$60,000	\$60,000	\$60,000	\$180,000
<b>Grand Total</b>	\$106,500	\$64,500	\$64,500	\$235,500

<sup>a</sup> Cost estimates obtained from the Cinemavision website ([www.cinemavision.biz](http://www.cinemavision.biz))

<sup>b</sup> Personnel costs may be lower in some locations. The \$60,000 estimate is based on the upper end of the estimated range of a typical compensation package for a Child Life Specialist (with leadership responsibilities) in different parts of the United States.

**Table 7. Estimated annual cost (salary + benefits) of staffing a non-sedate program with one dedicated full-time Child Life Specialist in different part of the United States**

Staffing category	Annual salary <sup>a</sup>	Plus benefits (20% of base) <sup>b</sup>
Child Life Specialist (CLS)	\$42,700	+ \$8,540 = \$51,240
CLS with leadership responsibilities	\$49,500	+ \$9,900 = \$59,400

<sup>a</sup> Mean salary reported in "Summary of the 2012 Child Life Profession Compensation Survey Results" downloaded from [www.childlife.org](http://www.childlife.org) on Dec 9, 2013 (Anonymous, no date).

<sup>b</sup> Actual value of a benefits package was not shown in the summary report (20% was assumed).

### Cost recovery calculations: Costs (per exam) subsidized by a hospital

We estimate that a single Child Life Specialist could fully staff a non-sedate program which served up to 800 patients a year (16 patients a week) if he or she were hired to exclusively run such a program. **Table 8** shows the estimated value of the subsidy (per exam) that hospitals currently provide to staff non-sedate programs. The estimated value varies depending on the total annual volume of patients served and ranges from a low of \$63 to a high of \$300 per non-sedated exam. These calculations also suggest baseline estimates for the amount that hospitals would need to be able to charge in order to fully recover the cost of staffing a non-sedate program.

**Table 8. Cost (per exam) of fully subsidizing one Child Life Specialist to staff a non-sedate program**

Annual MR exam volume	Child Life Specialist (Annual salary + benefits)	
	\$50,000	\$60,000
200 exams	\$250	\$300
400 exams	\$125	\$150
600 exams	\$83	\$100
800 exams	\$63	\$75

<sup>a</sup> Equivalent to 4, 8, 12 and 16 exams per week (50 weeks per year)

Although staff salaries represent the main recurring program cost, the costs associated with any additional equipment (for example, movie goggles) and supplies must also be considered in order to estimate the total value of the subsidy (per exam) that the hospital currently provide to run non-sedate programs. **Table 9** shows the total estimated value of the subsidy (per exam) for non-sedate programs that include movie goggles as part of patient support. Although movie goggles are not absolutely essential for all patients, they are a key component of many successful programs. They contribute to higher levels of patient satisfaction and may permit some children who would not have otherwise succeeded to do complete an MR exam without sedation. The estimated value of the total subsidy varies depending on the program volume and ranges from a low of \$86 to a high of \$400 per non-sedated exam. These calculations suggest the total amount (per exam) that insurance companies would need to be willing to pay in order to incentivize hospitals seeking to fully recover the costs associated with staffing and running a non-sedate program.

**Table 9. Cost (per exam) of fully subsidizing a non-sedate program over a 3 year period<sup>a</sup>**

Annual MR exam volume	Child Life Specialist	Cinemavision system	Other equipment and supplies	Total cost (per exam) <sup>a</sup>
200 exams	\$250-\$300	\$88	\$15	\$350-\$400
400 exams	\$125-\$150	\$44	\$8	\$176-\$201
600 exams	\$83-\$100	\$29	\$5	\$117-\$134
800 exams	\$63-\$75	\$22	\$1	\$86-\$98

<sup>a</sup> Annual costs were \$50,000-\$60,000 for a Child Life Specialist (includes salary and benefits), \$17,500 for a Cinemavision movie goggle system and \$1,000 for all other equipment and supplies.

## Economic value of a non-sedate program to insurance companies

At the present time, insurance companies reap the economic benefits (lower medical bills) generated by non-sedate programs without bearing any of the associated costs. However, we suggest that insurance companies would ultimately benefit much more if they allowed hospitals to seek reimbursement for the provision of child life services. Changing billing practices might incentivize additional hospitals and imaging centers to start or expand non-sedate programs which, in turn, would increase the number of children served and substantially reduce the amount of unnecessary medical claims associated with sedation services for MR imaging.

**Table 10** estimates how many non-sedated exams could be conducted for the cost of a single sedated exam under different cost scenarios. In every single case, far more non-sedated exams can be conducted. Our mid range cost estimates suggest that, on average, the amount of money charged for a single sedated exam could be used to pay for 10-20 non-sedated exams instead.

**Table 10. Number of non-sedated exams that could be paid for using the amount of money charged for a single sedated exam**

Charge per non-sedated exam (with CCLS support)	Charge per sedated exam				
	\$1000	\$2000	\$3000	\$4000	\$5000
\$350-\$400	3	5-6	8-9	10-11	13-14
\$176-\$201	5-6	10-11	15-17	20-23	25-28
\$117-\$134	7-9	15-17	22-26	30-34	37-43

In the final section of this report (societal level benefits) we return to the topic of cost savings generated by non-sedate programs. There we present our initial estimates regarding the potential economic value that could be generated by non-sedated MR imaging programs across the US.

## **Section 2B**                      **Hospital perspective: Potential for increased institutional revenue**

We explored three potential ways in which the non-sedate program might have influenced hospital workflow and directly (or indirectly) helped to offset the costs associated with providing child life services by increasing the hospital's revenue over the long term.

**First**, we assessed the impact of the non-sedate program on the hospital's **capacity** to conduct sedated MR exams in a timely fashion. We hypothesized that wait times would decrease despite stable (or increasing) total MR exam volumes within Children's National Health System.

### **Trends in wait times until the next available sedated MR exam appointment at Children's National Health System: January 2009 – June 2013**

#### **Background**

Over the long term, successful non-sedate programs should help hospitals make more rational use of their pediatric sedation services and shorten the amount of time children who do require sedation have to wait until they can get an appointment for a sedated MR exam.

#### **Objective**

We examined whether the addition of a non-sedate program had a measurable impact on the amount of time non-urgent patients had to wait until they could get an appointment for a 1 or 2 hour-long sedated MR exam at Children's National Health System in Washington, DC.

#### **Methods**

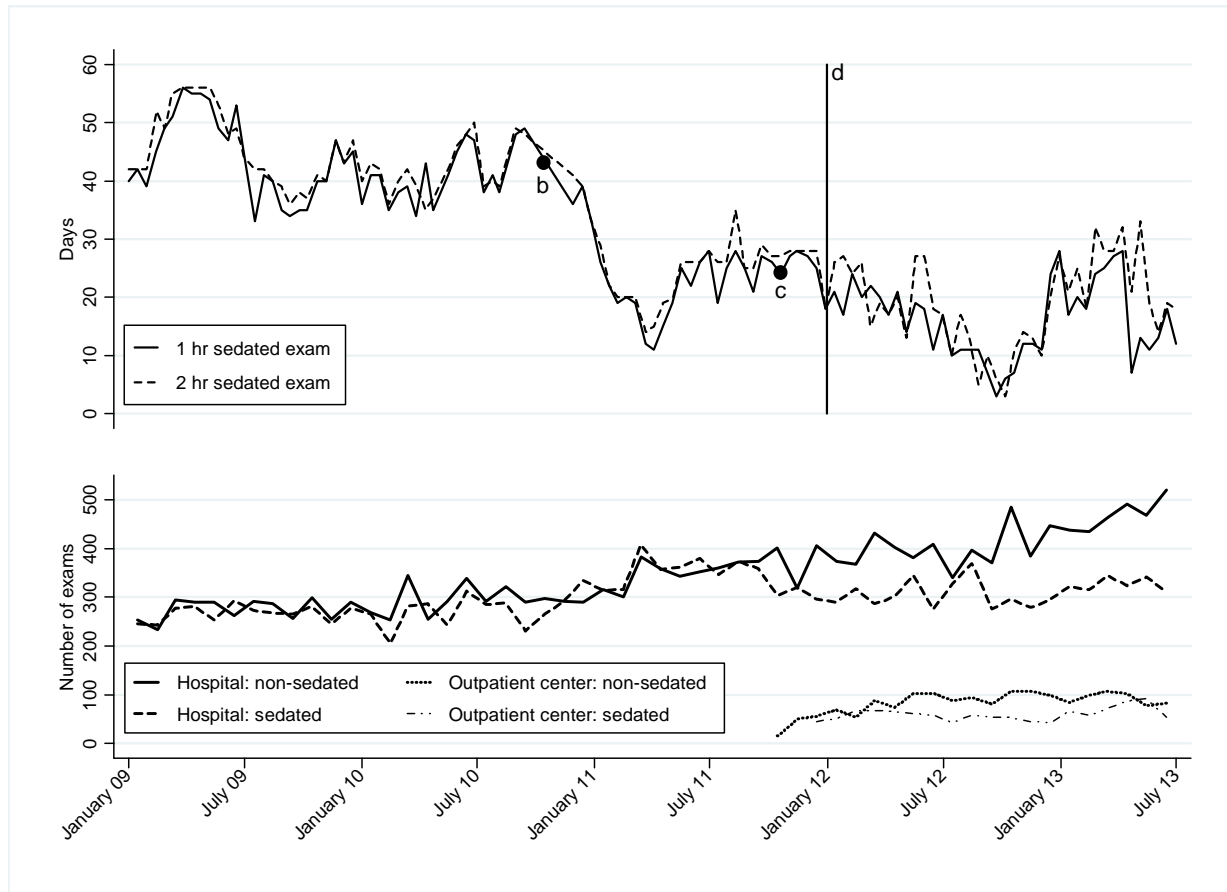
We used routinely collected administrative data to assess trends in these wait time indicators between January 2009 and June 2013. At the hospital, the Radiology Department Operations Manager checks with the scheduling department once every two weeks and records the number of days until the next available appointment for a non-urgent (1 or 2 hour-long) diagnostic MR exam. These wait time indicators are routinely used to track the hospital's ability to serve non-urgent patients in a timely fashion.

#### **Results**

**Figure 4** shows how appointment wait times fluctuated between January 2009 and June 2013 in relation to changes in the monthly volume of sedated and non-sedated MR exams at the hospital and new outpatient imaging center. Over the long term, wait times for a non-urgent (1 or 2 hour-long) diagnostic MR exam generally decreased, even though total MR exam volumes steadily rose.



**Figure 4. Number of days until the next available appointment for a non-urgent sedated MR exam at the hospital compared to the total volume of sedated and non-sedated MR exams (January 2009-June 2013)<sup>a</sup>**



<sup>a</sup> Data sources: Administrative wait time data (Radiology Operations Manager) & MR exam volume data (Radiology Information System)

<sup>b</sup> New general use MR suite opened at the hospital

<sup>c</sup> One additional general use MRI suite opened at the outpatient imaging center

<sup>d</sup> MR-I Can Do It (non-sedate) Program was launched

At least three separate initiatives took place between January 2009 and June 2013 that affected the hospital system's capacity to perform sedated and non-sedated diagnostic MR exams in a timely fashion. Two were designed to expand overall capacity, while the third (the non-sedate program) was intended to make more rational use of the available time slots for sedated MR exams. First, a new general use MR suite opened up in the hospital during the fall of 2010. Second, another general use MR suite opened up a year later as part of the new outpatient center in Rockville, MD. And third, in January 2012 the MR-I Can Do It Program was launched and began serving patients in both locations.

**Table 11** shows how the average appointment wait times for a 1 and 2 hour-long sedated MR exam changed over the four time periods defined by those three key initiatives. For both types of exams, the average wait times were substantially longer (> 40 days) before any of the initiatives started when compared to those after all three were underway (< 20 days). During each of the two middle time periods, the average wait times were around 25 days.

**Table 11. Average number of days until the next available appointment for a sedated MR exam at the hospital during four distinct time periods**

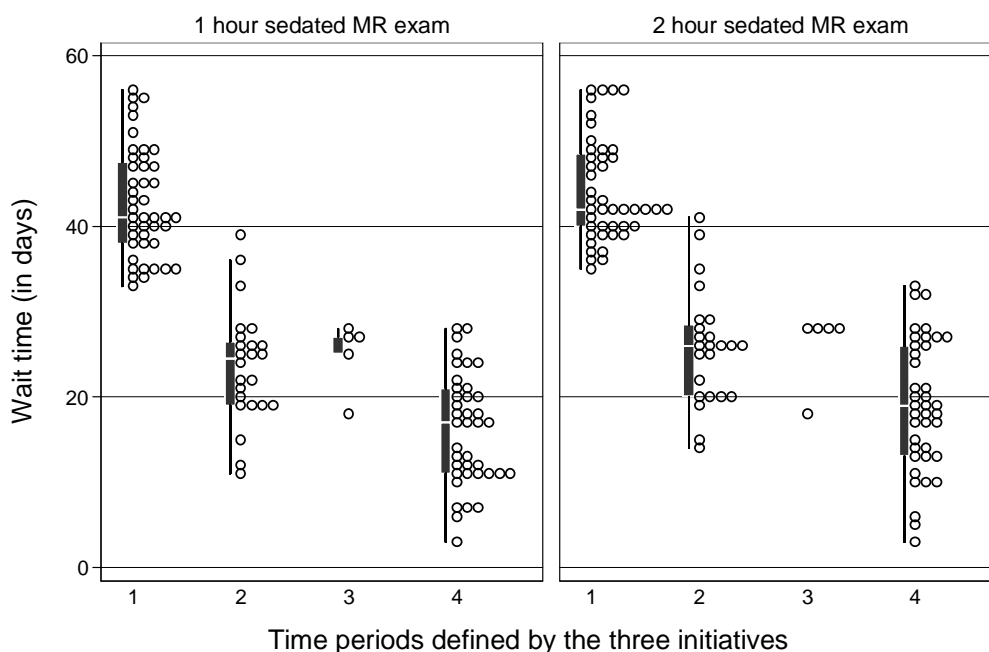
Time periods defined by the three initiatives	Number of wait times measured <sup>a</sup>	1 hr sedated exam		2 hr sedated exam	
		Mean (days)	Std <sup>b</sup> (days)	Mean (days)	Std (days)
1. Before installation of the new MR suite at the hospital	44	42.8	6.4	44.3	6.1
2. After installation of the new MR suite, but before the outpatient center opened	24	23.6	6.7	25.8	6.7
3. After outpatient center opened, but before the non-sedate program began	5	25.0	4.1	26.0	4.5
4. After the non-sedate program began	39	16.1	6.5	19.1	7.7

<sup>a</sup> The data were collected once every two weeks from the scheduling office

<sup>b</sup> Std = standard deviation

**Figure 5** shows how appointment wait times were distributed across each of the four time periods for the 1 and 2 hour-long sedated exams. Each circle represents one wait time measurement. This figure shows that the steepest decline in wait times occurred after the new general use MR suite opened at the hospital in the fall of 2010.

**Figure 5. Distribution of wait times until the next available appointment**



## Discussion

We attribute the long-term trend towards shorter wait times until the next available appointment for a sedated MR exam to a combination of factors. The addition of new MR suites at the hospital and outpatient imaging center increased the total monthly volume of potential MR exams. Assuming that the flow of incoming patients remained stable, adding exam capacity would have naturally shortened the amount of time new patients had to wait for an appointment.

The non-sedate program probably played a more minor role in decreasing overall wait times given that it served a relatively low number of patients who might have otherwise sought sedation. During the first 18 months (January 2012-June 2013), only ~200 patients participated in the non-sedate program while nearly 10 times as many 6-17 year old children (~1750) were sedated at the hospital during the same time period.

However, the non-sedate program certainly did free up sedated MR exam slots for other children to use. Ideally, we would have used individual level medical records to classify all children according to their stated medical (or physical) needs for sedation, recorded how long each one had to wait to get a sedated MR exam after seeking an appointment, and then examined how wait times differed for various groups over time in relationship to when the new MR suites were added and when the non-sedate program was launched.

Unfortunately, the existing electronic medical records did not allow us to gather that type of detailed information for individual patients, so we used administrative data to assess long-term trends in wait times instead. In the future, prospective program evaluations could be designed to include other indicators that provide a better reflection of how non-sedate programs contribute to a more rational use of sedation services by preferentially serving children who have a greater medical need for sedation.

**Second**, we assessed the impact of the non-sedate program on how **efficiently** the hospital was able to make use of MRI suite time (a scarce and valuable resource) when completing sedated and non-sedated MR exams. We hypothesized that the non-sedate program might reduce the duration of MR scans and improve workflow efficiency.

We plan to submit the results of our analyses of workflow efficiency and scan duration to a peer-reviewed journal for potential publication. A draft version of the working manuscript is available on request. The abstract is shown here:

### **The effect of a non-sedate program on MRI workflow efficiency and scan duration**

#### **Background**

A hospital-based program, “MR-I Can Do It”, using play-based interventions, psychosocial support, and technology was implemented by certified child life specialists to provide patients over 6 years of age with the option to complete their MRI exam without sedation.

#### **Objective**

To examine the impact of the non-sedate program on workflow efficiency in the radiology department, primarily through the analysis of MR scan duration.

#### **Materials and Methods**

Patients between the ages of 6 and 17 years who participated during the first 18 months of the program (January 2012 to June 2013) were individually matched with control patients who received sedation during their MR exam based on age, exam-protocol combination, radiologist, and calendar time frame of the exam (July 2011 to June 2013). The starting and ending times of MR image acquisition were recorded and three time-based variables were calculated: scan duration, “effective MRI time”, and total visit time. These time-based outcomes were compared between the non-sedated and sedated groups.

#### **Results**

Of the 82 patients identified as program participants, 72 were successfully matched to a sedated control patient. The mean age of the patients was 8.3 years. Compared to sedated patients, scan durations among the non-sedated patients were, on average, 12 minutes longer. The average difference in scan duration were statistically significant for 4 of the 5 exam-protocol combinations ( $P<0.05$ ). For the most common combination, “effective MRI time” was also estimated to be 15 to 17 minutes longer among the non-sedated patients. On the other hand, total visit time was estimated to be 90 to 110 minutes shorter for patients who participated in the non-sedate program.

#### **Conclusion**

Although scan durations and “effective MRI time” were longer for patients in the non-sedate program, overall visit durations were much shorter compared to sedated patients. In addition, the other benefits of the non-sedate program, such as improved patient safety and cost and time savings for individual families may outweigh the downside associated with the slightly longer scan times.

And **third**, we examined the impact of the non-sedate program on referral **volume**. There is significant competition in our area for pediatric diagnostic imaging and we hypothesized that offering a unique service might help draw in new business through increased referrals from the families who participated in the non-sedate program and their referring physicians.

Once all of the results from the referring physician and family surveys have been finalized, we plan to submit them to a peer-reviewed journal for potential publication. A draft version of the working manuscript is available on request. The abstract is shown below.

Please note: The draft includes complete results from the internet-based referring physician survey and results from the phone interviews with all of the families of 6-8 year old children who agreed to participate. Children in that age range are the non-sedate program's key target age group and represented half of all the program participants between January 2012 and June 2013. We received IRB approval to do these surveys very late in the project (February 10, 2014) so chose to focus on interviewing that group of families first.

## **The impact of a pediatric non-sedate MR program on patient and provider loyalty**

### **Background**

A non-sedate MRI program using play-based interventions and psychological preparation was implemented by certified child life specialists to help reduce the need for deep sedation in patients 6 years and older.

### **Objective**

To examine the relationship between parent and provider satisfaction with the non-sedate MRI program and loyalty, specifically their likelihood to return to our facility and willingness to refer others.

### **Materials and Methods**

Parents and caregivers of patients between the ages of 6 and 17 years who participated in the program between January 2012 and June 2013 were identified as potential participants. All potential participants of patients in our target age group, 6 to 8 years, were contacted by telephone to participate in the survey. An email survey was distributed to all physicians and health care providers who referred these patients to the program during the same 18 month time period.

### **Results**

Of the 92 parents and caregivers contacted, 32 participated in the telephone survey and 30 answered all of the questions. 27 (87%) of 31 families reported feeling "extremely satisfied", while 4 (13%) were "satisfied" with their experience with the program. 24 (77%) of the 30 families who answered both questions indicated that their experience did influence their willingness to return to our hospital, although the relationship was not statistically significant ( $P=0.225$ ). Of 31 families, 21 (68%) said they had told others about the program and 95% of those families told at least one person with a child in our 6-8 year target age group. However, the relationship between satisfaction level and willingness to refer the program to other people

was not statistically significant ( $P=0.069$ ). A total of 28 physicians responded to the email survey. Of those who previously knew about the program ( $n=20$ ), 12 (60%) said the program did influence their decision to refer patients to our hospital.

## **Conclusion**

Parents and caregivers reported feeling overall satisfied with their child's experience in the non-sedate program, and the physicians reported that the program positively influenced their decision to refer patients in the future. It is evident that the participating families valued the option to have their child attempt a non-sedated MRI exam, as well as the time and preparation provided by the child life specialists. However, lack of knowledge about the program may have impacted the physician's likelihood to refer patients. We believe that increasing physician awareness about the non-sedate program will influence the number of patients referred to our hospital in the future.

## Section 2C      *Societal perspective: Potential impact on safety of care and national-level cost savings*

We explored three issues to help assess how the non-sedate program at Children’s National (or similar programs in other locations) could potentially influence patient safety and national-level cost savings over time. Although sedation is generally considered to be quite safe and is widely practiced during pediatric imaging, it is not completely risk-free. A major benefit of non-sedate programs is that they completely eliminate **all** of the short and longer-term health risks associated with sedation for every single child who succeeds in completing an MR exam without sedation.

**First**, we attempted to establish the overall rate of sedation-related adverse events at our institution in order to get a sense of the hospital’s current performance and how many children might be affected by the rare, but very real, medical risks associated with sedation.

### **Adverse event rates at Children’s National Health System in Washington, DC**

#### **Objective**

To estimate the rate of sedation-related adverse events at Children’s National Health System in order to establish how the hospital’s recent performance compares to other locations.

#### **Methods**

We calculated a crude sedation-related “adverse event rate” at Children’s National for January 2009-June 2013 by dividing the total estimated number of “adverse events” by 1) the total number of sedated MR exams and 2) the total number of patients sedated for MR exams during the same time period. Both of these rates were calculated because some patients had multiple MR exams conducted during the same visit. And, because the incident reports did not always state the age of the patient, we calculated the rates based on the total number of exams for patients 0-17 years of age as well as patients of all ages.

#### Hospital data sources:

- *Number of “adverse events”*: A list of incident reports related to the Radiology Department and sedation was obtained from the hospital’s legal department for the time period between January 2009 and June 2013. The incident reporting system is designed to provide staff members with a way to anonymously report specific incidents or systemic problems they believe might affect good patient care or have legal implications for the hospital. It is not meant to be a standardized tracking system for measuring medical complication rates in any specific department or for a certain type of procedure. However, the incident reports were used as a primary data source for this project because the hospital does not maintain a research database of individual patient records that can be used to measure sedation-related complications.
- *Type of “adverse events”*: A pediatric anesthesiologist and Certified Child Life Specialist jointly reviewed all of the incident reports that included the key words “sedate” or “sedation” and were specifically associated with MR exams conducted in the Radiology Department. The pair developed guidelines for classifying sedation-related complications

as major or minor clinical events based on the same data reporting procedures used by the Pediatric Sedation Research Consortium as part of a large, multi-site, prospective research project specifically designed to calculate the incidence of sedation-related adverse events across a wide range of institutions.

- *MR exam volume*: The total number of sedated MR exams was calculated during the same period using a database of MR exams constructed by merging data on individual MR exams from the Radiology Information System with anesthesia billing data obtained from the Anesthesiology Department.

## Results

Overall, there were relatively few sedation-related adverse events identified based on the hospital incident reports, but the majority of those were classified as major clinical events. A total of 40 incident reports from January 2009 to June 2013 were reviewed. After eliminating two that involved patients who did not receive any form of sedation, the remaining 38 were divided into system-related complications (n=27) and medical complications related to sedation (n=11). The 11 sedation-related complications were then classified as either major (n=9) or minor (n=2) clinical events based on the predetermined criteria.

A total of 16,239 sedated MR exams were conducted on 13,808 patients (of all ages) at the hospital over the same time period. This resulted in overall adverse event rates of 0.68 per 1,000 MR exams (see **Table 12**) or 0.80 per 1,000 sedated patients (see **Table 13**). This means that, between January 2009 and June 2013, an incident report that involved a sedation-related adverse event for a patient getting a sedated MR exam was reported for less than 1 in every 1,000 patients.

**Table 12. Sedation-related adverse events (per 1,000 sedated MR exams) from January 2009 - June 2013**

Age categories	Number of events in incident reports			Total sedated MR exam volume	Event rate (per 1,000 exams)		
	Major	Minor	Total		Major	Minor	Total
0-17 yr	9	2	11	15,925	0.57	0.13	0.69
All ages	9	2	11	16,239	0.55	0.12	0.68

**Table 13. Sedation-related adverse events (per 1,000 sedated patients) from January 2009 - June 2013**

Age categories	Number of events in incident reports			Total number of sedated patients	Event rate (per 1,000 patients)		
	Major	Minor	Total		Major	Minor	Total
0-17 yr	9	2	11	13,556	0.66	0.15	0.81
All ages	9	2	11	13,808	0.65	0.14	0.80



## Discussion

As expected, the overall rate of adverse events experienced by patients during their hospital visit was quite low (< 1 per 1,000 sedated patients which is equivalent to < 0.1% of sedated patients) between January 2009 and June 2013. However, these figures probably underestimate the true adverse event rate at Children's National because hospital incident reports were used to identify patients who experienced adverse events, rather than a tracking system specifically designed for this purpose. We suspect that many minor events were not reported because the sedation teams are specifically trained to monitor and manage patients who experience a wide range of minor physiological changes or complications that other research studies would consider to be adverse events.

The largest published research study that focused on propofol sedation during MR exams comes from a multi-center study that reported an overall adverse event rate of 4.99% (for all types of major and minor complications combined) among a series of 5,072 MR procedures (Mallory, 2009). Thus, even if the true sedation-related adverse event rate at Children's National were actually 10 times higher (meaning 1.0%) it would still compare favorably with the results observed in a variety of other institutions.

**Second**, we conducted a comprehensive review of the medical literature in order to identify research studies that aimed to measure the range, type and frequency of adverse events that young children might experience during sedated MR exams. The main goal was to identify quantitative risk estimates we could use as part of our projections about the broader societal level impact of expanding the non-sedate program at Children's National and other similar institutions, nationwide.

We plan to submit the results of our literature review to a peer-reviewed journal for potential publication. A draft version of the working manuscript is available on request. The abstract is shown here:

### **Understanding the potential for sedation-related complications associated with diagnostic imaging exam**

#### **Background**

The increase demand for diagnostic imaging requiring sedation in an outpatient setting challenges any institution's resources to accommodate safety and efficiency.

#### **Objective**

We aimed to identify published studies which report incidence and potential risks of well-known (or suspected) complications associated with the use of propofol for pediatric sedations during magnetic resonance imaging exams.

#### **Materials and Methods**

We conducted an extensive Pub Med search to locate articles which provide evidence of short and long term adverse events associated with propofol during MRI exams. The abstracts of each study were reviewed and full copies of the most relevant articles were obtained. Studies that mentioned radiological procedure and sedation were reviewed. We were particularly interested in studies with propofol sedation MRI exams. The relevant studies were classified into group based on age, type of sedative(s), type of medical procedures, sample size, and key outcomes of the study.

#### **Results**

We reviewed over 100 articles and identified a core set of 30 studies. Most of the studies identified sedation complications either during the procedure itself or soon (within 24-48 hours) afterwards. A limited number of studies tracked adverse events after discharge. The most commonly reported risk of sedation with any sedative was respiratory distress. Few studies identified long term risks of sedation specifically neurotoxicity in children under the age of three. Anecdotal reports suggest there may be other risks of sedation which include dreaming and prolonged recovery resulting in children missing school; none of these have been clinically investigated.

#### **Conclusion**

Although extremely safe when administered by a pediatric anesthesiologist, pediatric sedation is not entirely risk-free. There are many published studies that associate short term risks with sedatives such as propofol for diagnostic procedures. However, limited studies exist on the potential long term neurological damage from sedation in humans. Sharing these risks with parents will help them make informed decisions about choosing a non-sedate option (if appropriate) or knowing what type of complications might occur when sedatives are used.

And **third**, we developed some initial projections regarding the potential scope of societal level benefits measured in terms of 1) potential improvements in patient safety and 2) the total cost savings that might be generated by more widely implementing non-sedate programs across the United States.

## Potential improvements in patient safety

### Background

The extent to which Child Life supported non-sedate programs can improve patient safety may vary widely across individual hospitals (or imaging centers) and will depend on two key factors.

- First, the number of children who successfully avoid sedation by participating in a non-sedate program during a specific time period. This depends on the total number of potentially eligible patients (which, in turn, depends on the type of MR exams being offered and the patient mix), the number of patients who are successfully recruited, and finally, the success rate among the patients who do participate in the program.
- Second, the institution's sedation-related complication rate during MR exams.

This type of information would be very difficult, if not impossible, to compile for every single hospital or imaging center across the US that might run a non-sedate program for MR imaging, either now or in the future. Therefore, the potential contribution that non-sedate programs could make to improved patient safety must be based on projections.

### Objective

To estimate the total number of children across the US who could potentially avoid sedation and all sedation-related complications as a result of participating in highly successful Child Life supported non-sedate programs for MR imaging.

### Methods

We drew on a wide range of data sources to develop our assumptions about the number of children's hospitals (or radiology imaging centers) in the United States, MR exam volumes, % sedation rates, % success rates for non-sedate program participants, and short-term complication rates among children who are sedated during MR exams. The best available data were then used to develop a set of low, medium, and high-end projections about the potential number of children who would benefit from non-sedate programs for MR imaging.

Data sources: The total number of children's hospitals with high-volume radiology practices (n=51) was based on SCORCH (Society for the Chairmen of Radiology in Children's Hospitals) membership in 2011. The MR exam volume among those same 51 hospitals came from an unpublished 2011 SCORCH dataset. The total number of children's hospitals in the US (n=236) was estimated from data posted on the Children's Hospital Association website (<http://www.childrenshospitals.org/>). The total annual number of pediatric MR exams in the US in 2011 (~ 3.2 million) was estimated based on a national survey of hospitals and facilities that perform MR exams in the US (IMV Medical Information Division, Inc., 2012). The % sedation rates and % success rates were developed based on a combination of published estimates and expert opinion. The short-term complication rates among sedated children were based on a variety of published estimates.

Additional assumptions: We assumed that relatively few hospitals (or imaging centers) are currently running non-sedate programs, and even fewer serve 100% of all potentially eligible children. Thus, our estimates represent the overall improvement in patient safety that could potentially result after moving to widespread and full-scale implementation of highly successful non-sedate programs.

#### Low, medium and high-end projections

For the sake of simplicity, the low, medium, and high-end projections were developed by varying the starting point (the total annual number of children who have a MR exam (sedated or not) and keeping the other three key assumptions (% sedation rate, % success rate and % complication rate) the same. We realize these three key assumptions may not be appropriate for the high-end MR volume estimate in particular, because many of the free-standing imaging centers where pediatric exams are performed do not offer sedation services.

- The low-end projection was based on actual MR volume data (~500,000 MR exams per year) from the 51 high-volume radiology practice hospitals in the SCORCH database. This represents a conservative, but reliable, estimate of annual MR exam volume among the pediatric patients in those locations.
- The medium-level projection was based on doubling the annual MR volume data to ~1 million MR exams per year. This assumption suggests that the 51 children's hospitals with high-volume radiology practices account for half of all pediatric MR exams and that an equal number of MR exams are being conducted on an annual basis in all other types of hospital or imaging centers, combined.
- The high-end projection was based on an annual MR exam volume of ~3.2 million MR exams per year. This estimate was derived from a national survey of hospitals and facilities that perform MR exams among all ages of patients (IMV Medical Information Division, Inc. 2012). The survey data suggest that 32 million MR exams were performed in 2011 and that 10% of them were among pediatric patients.

## **Results**

**Tables 15** show the results of the low, medium, and high-end projections. The most conservative estimates suggest that, on an annual basis, 50,000-75,000 children could completely avoid sedation by participating in a Child Life supported non-sedate program and that 500-3,750 children might avoid experiencing some type of short-term adverse event. The least conservative estimates suggest far higher numbers: 320,000-480,000 children avoiding sedation and 3,200-24,000 who avoid experiencing a short-term adverse event.

## **Discussion**

The projected number of children across the US who could potentially benefit by participating in a Child Life supported non-sedate program for MR imaging ranges quite widely based on current assumptions. We believe the medium-level projections to be most plausible. These suggest that, on an annual basis, somewhere in the range of 100,000-150,000 children could completely avoid sedation during MR exams. Furthermore, by avoiding sedation, 1,000-7,500 children would also avoid experiencing any short-term sedation-related adverse events.

**Table 15. Low, medium and high-end estimates regarding the annual number of children who could benefit by participating in a non-sedate program for MR imaging**

Description of estimate	Low	Medium	High
Annual number of children who have MR exams (sedated or not)	~500,000 <sup>a</sup>	~1 million <sup>b</sup>	~3.2 million <sup>c</sup>
Annual number of children who have a sedated MR exam <sup>d</sup>	250,000-375,000	500,000-750,000	1.6-2.4 million
Annual number of children who could completely avoid sedation as a result of participating in a non-sedate program <sup>e</sup>	50,000-75,000	100,000-150,000	320,000-480,000
Annual number of children who might avoid experiencing a minor short-term adverse event associated with sedation <sup>f</sup>	500-3,750	1,000-7,500	3,200-24,000

<sup>a</sup> MR volume data reported by the SCORCH (Society of Chairmen of Radiology Departments in Children's Hospitals) member institutions in 2011. Although some children may have more than one MR exam in a year, we used the exam volume data as a proxy for the number of children.

<sup>b</sup> 500,000 MR exams per year x 2 = 1 million.

<sup>c</sup> Survey data suggest that 32 million MR exams were conducted in the US during 2011 and that 10% of them were pediatric exams (IMV Medical Information Division, Inc., 2012).

<sup>d</sup> Assumes that 50-75% of all patients were sedated during their MR exam, extrapolated from overall sedation rates reported by several of the largest children's hospitals in the US, personal communication 2013-2014.

<sup>e</sup> Assumes that 20% of all sedated children could avoid sedation (be eligible, recruited and then succeed) if a non-sedate program was made available to them. This estimate is based on a combination of the % reductions in sedation achieved among different age groups at Children's National and published estimates from Harned & Strain 2001, Etzel-Hardman et al. 2009, Khan et al. 2007, and Lemaire et al. 2009.

<sup>f</sup> Assumes that 1-5% of sedated children may experience a minor short-term adverse event. Several research studies involving tens of thousands of children who were sedated using different medications for various medical procedures (including MR exams) found that less than 1 in every 1000 children (0.1%) had complications serious enough to require a hospital stay after being sedated (Couloures et al. 2011, Cravero et al. 2009, Mallory et al. 2009). Minor adverse events, although still rare, do occur more frequently during sedation. In a study of over 7000 sedated MR exams, up to 5.5% of children experienced something classified as an adverse event. However, many were minor and quickly resolved (Mallory et al. 2009).

## Total potential cost savings

### Background

The total cost savings that all Child Life supported non-sedate programs could potentially generate on an annual basis, nationwide, will depend on the total number of locations with non-sedate programs and the annual cost savings generated by each one.

### Objective

To estimate the total potential cost savings that could be generated each year by Child Life supported non-sedate programs across the US operating under different cost structures for sedation services and different volumes of program participants.

### Methods

We estimated the total number of institutions across the US that could potentially run a Child Life supported non-sedate program and serve 50 or more patients per year. The lowest estimate (n=50) is based on the total number of children's hospitals with high-volume radiology practices in the 2011 SCORCH (Society for the Chairmen of Radiology in Children's Hospitals) database. According to the Child Life Council membership database, all 51 of the SCORCH hospitals offered Child Life Services in 2014. There are probably many more locations capable of running relatively small volume programs across the US, but for the sake of simplicity we developed estimates based on a total of 50, 60 and 70 locations.

We then used the table of program cost savings developed earlier in the project (see **Table 5**) to select a low (\$200,000), medium (\$900,000), and high-end (\$2 million) estimate for the annual cost savings generated by one Child Life supported non-sedate program. **Table 16** explains the basis for those estimates.

Finally, we multiplied the number of program locations by the estimated annual cost savings for each of the 9 combinations of assumptions.

Additional assumptions: Relatively few hospitals (or imaging centers) are currently running high volume non-sedate programs in the US. Thus, the higher end estimates represent the total annual costs savings that might be realized only after much more widespread implementation of highly successful non-sedate programs, nationwide.

### Results

**Table 16** shows that Child Life supported non-sedate programs could generate a wide range of total cost savings -- anywhere from \$10-140 million each year.

### Discussion

The potential economic value of scaling up non-sedate programs across the US could be quite substantial. Millions of dollars in unnecessary sedation-related medical bills could be avoided if Child Life supported non-sedate programs were more widely implemented.

**Table 16. Total annual estimated cost savings that could be generated by Child Life supported non-sedate programs, nationwide**

	Annual estimated cost savings on medical bills for families (per location) <sup>a</sup>	Total number of program locations (hospitals and/or imaging centers)		
		50	60	70
Low <sup>b</sup>	\$200,000	\$10 million	\$12 million	\$14 million
Medium <sup>c</sup>	\$900,000	\$45 million	\$54 million	\$63 million
High <sup>d</sup>	\$2 million	\$100 million	\$120 million	\$140 million

<sup>a</sup> See **Table 5** for the entire range of annual cost savings estimates under different cost structures and total volume of program participants.

<sup>b</sup> The estimate of \$200,000 per year applies either to a low volume program (50 exams per year) at a cost of \$4000 per sedated exam OR a slightly higher volume program (100 exams per year) with a lower cost per sedated exam (\$2000).

<sup>c</sup> The estimate of \$900,000 per year comes from a slightly higher volume program (300 exams per year) and a cost of \$3000 per exam.

<sup>d</sup> The estimate of \$2 million per year comes from an even higher volume program (500 exams per year) and a cost of \$4000 per exam.

## Section 3 Conclusions and recommendations

The MR-I Can Do It (non-sedate) Program at Children's National (and similar programs in other locations) creates competing costs and benefits for individual families, their insurance companies, the hospitals (or imaging centers) that run non-sedate programs, and society in general.

### Conclusions

For individual families, participating in a non-sedate program will:

- Substantially reduce the total medical bills they receive to get an MR exam for their child
- Save them time every step of the way (before, during and after the actual exam)
- Eliminate the other financial and/or opportunity costs associated with the longer process of getting a sedated MR exam for their child

For insurance companies (local, state, federal and commercial plans), having patients who participate in a non-sedate program and avoid sedation will:

- Substantially reduce the total medical bills they are asked to pay for children who get MR exams

For hospitals (or imaging centers), offering a non-sedate program will:

- Improve patient safety
- Fulfill the goal of providing high quality, family-centered care
- Make more rational use of a scarce resource (pediatric sedation services)
- Help build patient and provider loyalty over time
- Be revenue negative, but may evolve into a more revenue neutral state

For society in general, expanding non-sedate programs will:

- Improve patient safety
- Make more rational use of a scarce medical resource (pediatric sedation services)
- Substantially reduce the total medical bills that insurance companies as a whole (and Medicaid in particular) need to pay on behalf of children who need MR exams

### Recommendations

- The Child Life Council (and health care partners) should consider advocating for changes in medical billing practices so hospitals can bill for and insurance companies can cover the provision of child life services associated with non-sedate programs.



# Appendices

## Appendix A *Bibliography*

1. Anonymous (no date). "Summary of the 2012 Child Life Profession Compensation Survey Results". PDF file "2012SalarySurveySUMMARY.pdf" downloaded from [www.childlife.org](http://www.childlife.org) on December 9, 2013.
2. Anonymous (2011). "Cinemavision MRI video: Proven to reduce MRI sedation in children". Powerpoint file "Cinemavision\_\_MRI\_patient\_video\_Sept\_2011.ppt" downloaded from [www.cinemavision.biz](http://www.cinemavision.biz) on May 15, 2014.
3. Boston Children's Hospital website (no date). "Sedation-free MRI resonates with younger patients", accessed at <http://www.childrenshospital.org/health-topics/procedures/magnetic-resonance-imaging-mr-or-mri> on May 15, 2014.
4. Couloures, K. G., Beach, M., Cravero, J. P., Monroe, K. K., & Hertzog, J. H. (2011). Impact of provider specialty on pediatric procedural sedation complication rates. *Pediatrics*, 127(5), e1154-1160.
5. Cravero, J. P. (2009). Risk and safety of pediatric sedation/anesthesia for procedures outside the operating room. *Curr Opin Anaesthesiol*, 22(4), 509-513.
6. Etzel-Hardman, D., Kapsin, K., Jones, S., & Churilla, H. (2009). Sedation reduction in a pediatric radiology department. *Journal for Healthcare Quality*, 31(4), 34-39.
7. Harned, R.K. & Strain, J.D. (2001). MRI-compatible audio/visual system: impact on pediatric sedation. *Pediatric Radiology*, 31(4), 247-250.
8. IMV Medical Information Division, Inc. (2012). 2012 MR Benchmark Report. Des Plaines, Illinois ([www.imvinfo.com](http://www.imvinfo.com)).
9. Khan, J. J., Donnelly, L. F., Koch, B. L., Curlwright, L. A., Dickerson, J. M., Hardin, J. L., ... & Gessner, K. E. (2007). A program to decrease the need for pediatric sedation for CT and MRI. *Applied Radiology*, 36(4), 30.
10. Lemaire, C., Moran, G.R. & Swan, H. (2009). Impact of audio/visual systems on pediatric sedation in magnetic resonance imaging. *Journal of Magnetic Resonance Imaging*, 30(3), 649-655.
11. Mallory, M. D., Baxter, A. L., & Kost, S. I. (2009). Propofol vs pentobarbital for sedation of children undergoing magnetic resonance imaging: results from the Pediatric Sedation Research Consortium. *Paediatr Anaesth*, 19(6), 601-611.

## **Appendix B      *History of Child Life Services in the Radiology Department at Children’s National Health System***

In 2000, a dedicated child life specialist position was assigned to support the Department of Diagnostic Imaging and Radiology at Children’s National Health System in Washington, DC. The position was under-utilized and the value of child life support was not fully realized. In order to maximize coverage to all areas of the hospital the radiology position was reassigned and support was provided to the department on an on-call basis. At that time, there were only five full-time Child Life Specialist positions funded through the Department of Family Services.

In 2007, eight full time Child Life Specialists provided support to all inpatient and outpatient areas of the hospital. The Department of Diagnostic Imaging and Radiology, under new leadership and recognizing the worth and benefit of consistent child life support, hired a full-time Radiology-specific Certified Child Life Specialist with the goal to improve the quality of patient care for children requiring fluoroscopy, nuclear medicine, PET/CT, ultrasound, diagnostic imaging, interventional radiology procedures or MR exams. Many of these radiology procedures are invasive and/or time-consuming and require the child life specialists to have specific technical knowledge of the equipment and procedures.

Diagnostic Imaging and Radiology was the first department within the hospital to budget for a Child Life Specialist position using departmental funds. Since 2007, the number of full-time positions for hospital-wide Child Life Specialists has increased to eighteen. These staff members continue to provide support for peri-operative services, emergency and trauma medicine, outpatient hematology/oncology services and all inpatient units. Over the same time period, the number of full-time Radiology Child Life Specialists positions has increased to three. These staff members support patients at Children’s National’s Sheikh Zayed campus in Washington, DC, and at the Outpatient Diagnostic Imaging Center in Rockville, MD.

The current long term goals of the Child Life Specialists in the Radiology Department are to: 1) reduce parental and patient anxiety, promote comfort and increase the patient’s ability to cope with the experience of getting a variety of diagnostic procedures, 2) model best practices and educate department staff members about child friendly language, developmental considerations and inclusion of caregivers in patient care and 3) reduce the amount of sedation associated with pediatric MR exams in particular. On a day-to-day basis the Child Life Specialists are responsible for providing direct patient care and working on other activities that support the other longer-term goals.

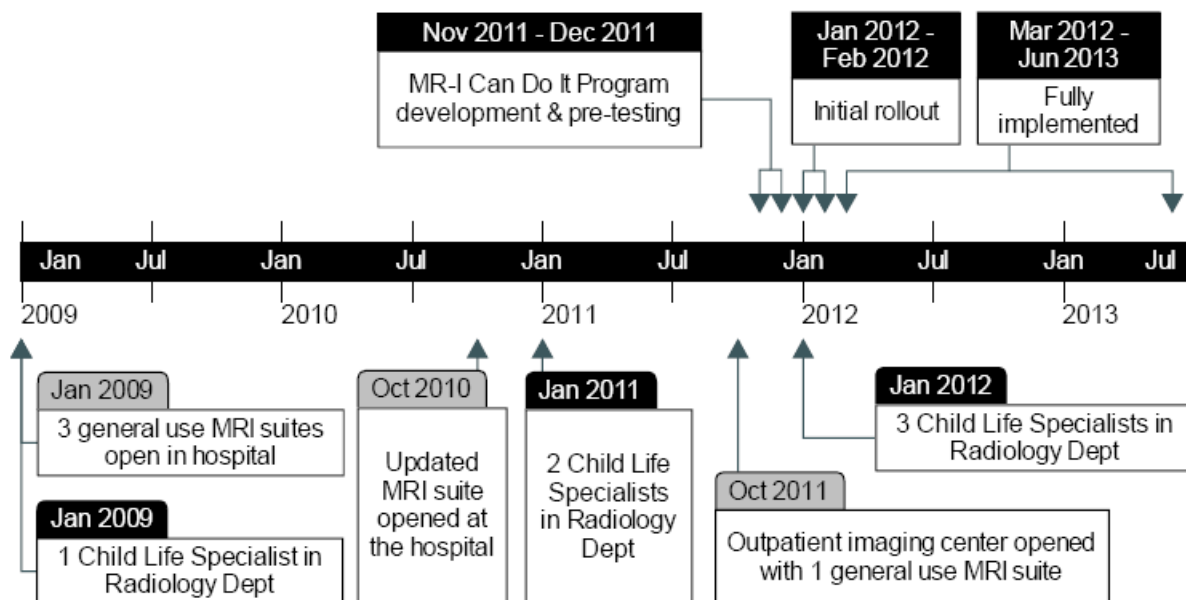
The Radiology Department provides patient care 24 hours a day, 365 days a year and currently performs ~150,000 procedures a year (~400 per day). Many of the patients receiving these procedures would benefit from the support of Child Life Services. However, at the current staffing level, only ~5% of the children can receive support from the Child Life Specialists on any given day. Children are prioritized to receive support based on the procedure’s level of invasiveness, the child’s age and diagnosis, whether the child has had a previous traumatic experience (especially in the hospital setting), the referral source, and by specific request of the parent or patient.

The department plans to add an additional child life position in the future, expanding our team of specialists to four, in order to maximize the support this valuable service provides to our patients, families and staff.

## Appendix C Development of the MR-I Can Do It (non-sedate) Program

Once the decision was made to launch a non-sedate program for MR imaging in 2011, the program was established in three phases: 1) a development and testing phase, 2) a brief rollout period and then 3) a full implementation phase. **Figure C1** shows a timeline of events associated with the program's development.

**Figure C1. Key events related to the expansion of MR exam capacity and Child Life Services in the Radiology Department at CNMC**



No major changes in the type of pediatric anesthesia/sedation services offered

**Development phase (Nov-Dec 2011):** In November 2011, the chief of Radiology asked the Radiology Child Life team to establish a program to reduce the amount of sedation in MRI. The Radiology Child Life team immediately began researching other non-sedate programs worldwide. They gathered information from the published literature, informal phone interviews with other child life specialists nationally and finally through the Child Life forum. The resulting information was analyzed and the initial plan of action was developed. This plan was thoroughly discussed with various management staff members, nursing staff, schedulers and technologists. Revisions were made based on suggestions. Furthermore, to become an official program it was decided that it was vital to establish a formal name. An informal departmental contest was launched to elicit suggestions and after much deliberation “MR-I Can Do It” was selected as the official name of the program. The program was unofficially tested from November 2011-January 8, 2012.

**Initial rollout (Jan-Feb 2012):** On January 9, 2012 the first official participant was enrolled, beginning phase two of the program's development. During the official roll out and subsequent weeks after, Children's National did not have the Cinemavision movie goggles installed and all program participants utilized either music or no-distraction during the scan. In February 2012, the Cinemavision goggles were installed. During the initial three months of the program key challenges included a reduced amount of child life staffing availability for other departmental modalities, training of new staff and scheduling difficulties. Furthermore, the program was initially designed to have a Sunday component where families who wanted additional support could come in for a pre-arrival visit to meet the staff and practice lying on the MRI camera bed. However, due to staffing complications and scheduling complications with emergent MRIs this component was changed to pre-arrival phone calls and preparation on the day of the exam.

**Full implementation:** The initial challenges were overcome by approximately March 2012 and phase three (full implementation) of the program began. At this stage the program is designed to have child life receive referrals from the radiology scheduling department, a referring nurse practitioner or physician, a parent's request or by patient finding. After child life receives the referral a Radiology Child Life Specialist will call the parent or guardian to assess the child's ability to complete the scan. The Child Life Specialist will ask the parent or guardian questions such as "How does your child cope with typical doctor's appointments?" "Has your child ever had an IV?", "Tell us about the temperament of your child." In addition to learning about the child the Child Life team also provides the parent or guardian with more information on what the MRI Radiology Child Life specialist can do to provide individualized support. As we know in child life, every child is different. Some children are frightened by loud noises, some have difficulty holding still for lengthy periods of time, and some are scared of small spaces, although as we have learned through this program, that is rare since many children choose to hide in small spaces.

After the phone call is completed, the Child Life Specialist will email the families information to better prepare for the day of the scan. The email includes three key pieces of information. First, pre-arrival information sheets created by the Child Life Specialists describe the process of having a non-sedated MR exam and provide suggestions for language to use when talking with the child. Second, a PDF file of a preparation book specifically written by the Child Life Specialist team for the child to read with the parent, and third, three sound files of what the MRI sounds like in order to help desensitize the child. The parents are encouraged to play a game with the children to help them relate the sounds to sounds they hear in everyday life (i.e. a train, plane, alarm, etc.)

On the day of the scan, a Child Life Specialist meets the family and helps provide individualized support during their entire process, for example IV teaching, incentive/compliance issues, etc. The Child Life Specialist will use specific interventions such as medical and therapeutic play through a doll sized wooden mock scanner and play space to allow the child a chance to have control of their experience.

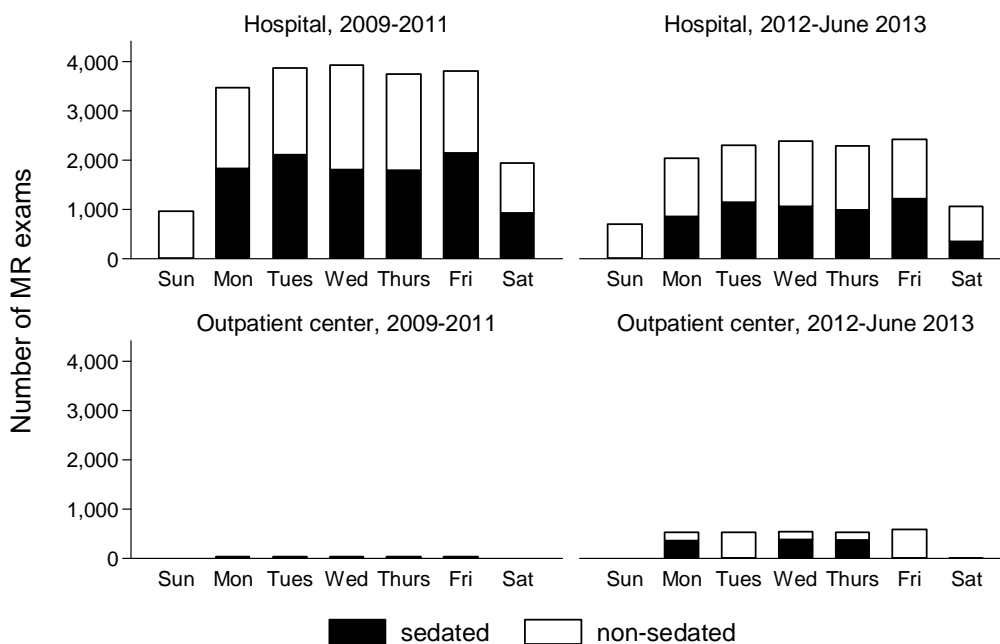
**Eligibility criteria:** In order to be eligible for the MR-I Can Do It program a child must be 6 years or older—however, the child life team will make exceptions based on parent or physician request. Though different criteria for eligible exams were examined throughout the process, all exams scheduled to last longer than 1 hour are highly discouraged due to length of scan and children's attention spans. Moreover, participants are ineligible if they have significant developmental delays or autism and claustrophobia. Future modifications to the program hope to find ways to better serve these more challenging populations.

## Appendix D Trends in sedated and non-sedated MR exam volume

Anesthesia and/or sedation services are offered to serve all patients 24 hours a day, 365 days a year at Children's National in Washington, DC. However, since MR exams are most often used as a diagnostic tool among stable patients, the vast majority of sedated and non-sedated MR exams take place at the hospital on weekdays during the day or early evening hours. There are some emergent or urgent MR exams that are completed at night, on holidays or weekends with the help of anesthesia services. Since late 2011, the associated outpatient imaging center in Rockville, MD, has also offered non-sedated MR exams from Monday-Friday and sedated MR exams three days a week on Mondays, Wednesdays and Thursdays. **Figure D1** and **Figure D2** show how the overall volume of sedated and non-sedated MR exams compared across the two sites over time during the three year period (2009-2011) before the MR-I Can Do It program began and the 18 month period (January 2012-June 2013) after the program began.

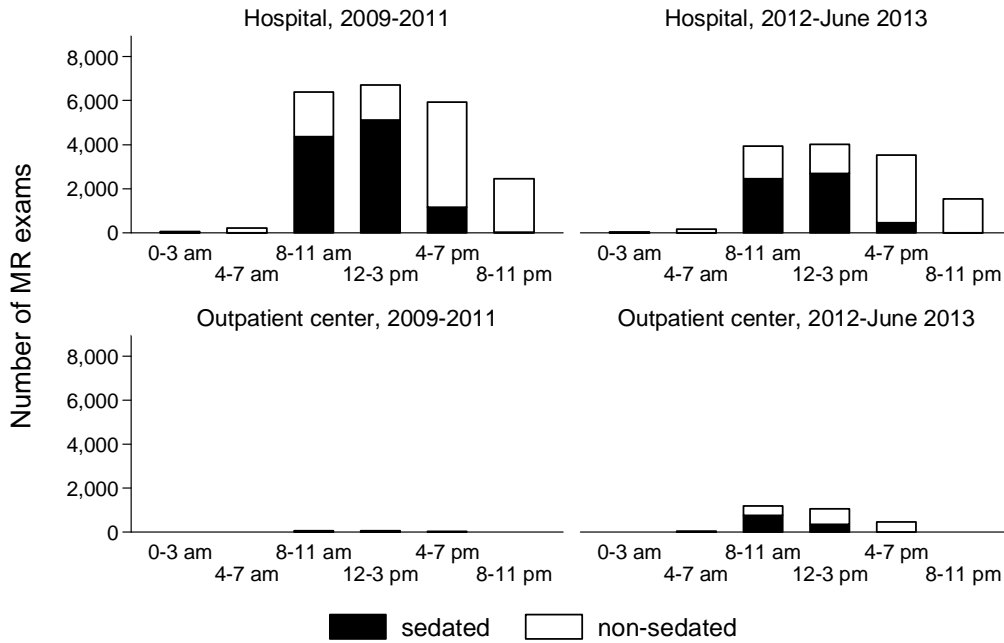
Both the hospital and outpatient center are staffed by the same team of pediatric anesthesiologists capable of providing a wide range of sedation and anesthesia services to all age groups. **Figure D3** shows how the volume of sedated and non-sedated MR exams among different age groups compared across the two sites over time. Overall, younger children were sedated for their MR exams more often than older children. The highest rates of sedation were observed among children who were either 3-5 or 6-8 years old, followed by those under 2. Older children (>8 years of age) are more mature and naturally more capable of completing an MR exam without sedation while very young babies will often sleep through the procedure if they are fed and swaddled right before it begins.

**Figure D1. MR exam volume by day of the week**



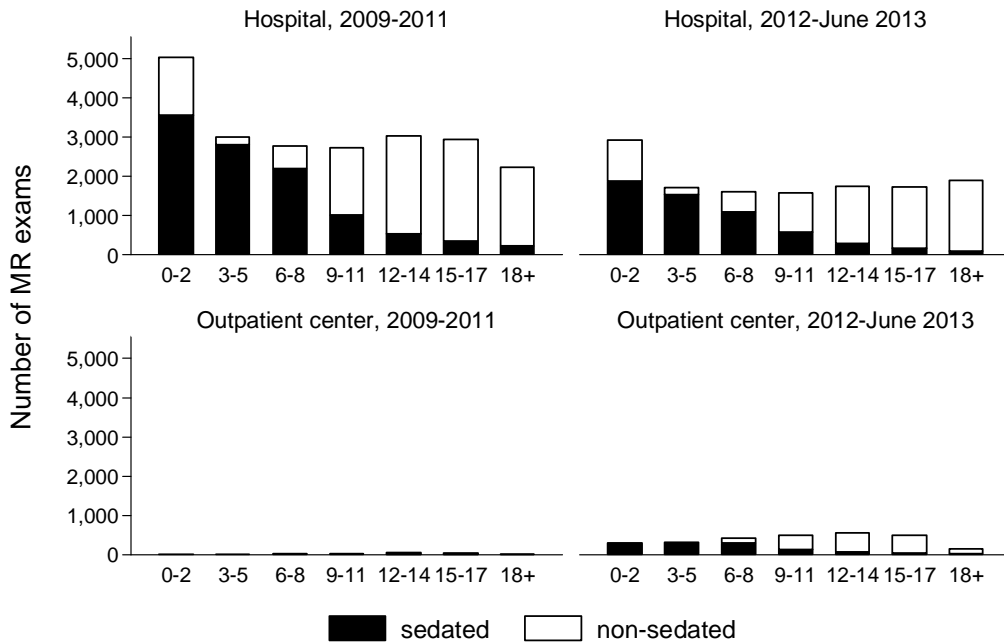
\* The Outpatient center opened in late 2011

**Figure D2. MR exam volume by time of day the exam ended**



\* The Outpatient center opened in late 2011

**Figure D3. MR exam volume by patient age group**



\* The Outpatient center opened in late 2011